Technical Feasibility Report

Enhancing adaptive capacities of coastal communities, especially women, to cope with climate change induced salinity

A report prepared by the Government of Bangladesh, with technical support from the United Nations Development Programme and International Centre for Climate Change and Development (ICCCAD) - Informed by site studies by Practical Action and Water Aid

August 2017
Foreword

Climate change poses significant challenges to Bangladesh. It is not merely an environmental issue that is defined by rise in sea level and precipitation changes; it represents a serious sustainable development problem that affects everyone in our country, particularly women and marginalised groups in coastal communities who are the most vulnerable. Bangladesh, therefore, considers effective and ongoing efforts to adapt to climate change a national priority.

As an active party of United Nations Framework Convention on Climate Change, Bangladesh has worked closely with the international community to address climate change and the consequences thereof for coastal communities. This Green Climate Fund Feasibility Study supports the design of the project proposal of **Enhancing adaptive capacities of coastal communities, especially women, to cope with climate change induced salinity** in further addressing these consequences and impacts.

The geographic and climatic characteristics of Bangladesh combined with the marginalisation of large parts of the population makes the nation particularly susceptible to the impacts of climate change. The country has repeatedly been listed as being globally among the most vulnerable countries to climate change\(^1\)\(^2\)\(^3\). According to the World Risk Index, Bangladesh ranks fifth of countries most at risk of a natural disaster, scoring 32 per cent for exposure, 40 per cent for susceptibility, 57 per cent for lack of adaptive capacity, 61 per cent for vulnerability, and 86 per cent in lacking coping capacities\(^4\). These sentiments were shared by the Intergovernmental Panel on Climate Change (IPCC) who noted that Bangladesh will be amongst the worst victims of climate change.

The key ocean and climate drivers projected to affect the nation are: (i) Variations in air and ocean temperatures; (ii) Changes in precipitation patterns; (iii) Sea level rise; and (iv) Intensification of extreme weather phenomena, such as cyclones. An increase in overall mean sea level exacerbates the impact of extreme tides and tidal surges, leading to inundations of coastal areas with saltwater. Sea level rise in the coastal zone of Bangladesh has been 6-21 mm per year, rising faster than the global average.

Two thirds of Bangladesh is less than five metres above sea level, making the coastal regions particularly susceptible to tidal surges and incremental impacts, such as erosion and salinity. Sea level rise will be a significant driver of coastal inundations with saltwater amplifying current trends of salinity intrusion in ground and surface water aquifers, and soils. This leads to significant impacts on the agricultural productivity and fresh water availability of communities living in the coastal belt. These impacts associated with salinity intrusion will further be exacerbated through an intensification of extreme weather phenomena like cyclones and consequential tidal surges caused by climate change. The Districts of Khulna and Satkhira, identified as among the most vulnerable districts in Bangladesh due to geographical positioning and climate, remain a key focus of the government and many other development partner organizations’ interventions for addressing climate change impacts.

The Government of Bangladesh has recognized the risks associated with climate change for several decades and has been accessing the Least Developed Country Fund, the Special Climate Change Fund and Adaptation Fund to address them. With the recommendations in 2005 by the National Adaptation Programme of Action, the Government of Bangladesh initiated a USD 100 million equivalent budget allocation to advance climate

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4. The 2014 World Risk Report (WRR 2014) published by UNU-EHS and the Alliance Development Works/Bündnis Entwicklung Hilft (BEH) systematically considers a country’s vulnerability, and its exposure to natural hazards to determine a ranking of countries around the world based on their disaster risk.
change activities, revised the Bangladesh Climate Change Strategy and Action Plan, and initiated legal processing of two funds to administer multi-institutional implementation of climate change related activities: the Bangladesh Climate Change Trust Fund and the Bangladesh Climate Change Resilience Fund. Several initiatives by non-governmental organisations have built confidence in community-based adaptation to expected long-term climatic changes with donor support and additional funding through the Pilot Programme for Climate Resilience. While several projects and programmes aimed at improving the resilience of the vulnerable communities to climate change were implemented in recent times, many of them did not directly address climate change impacts on women and children, some of the most vulnerable members of society.

Against this background, the Ministry of Women and Children Affairs (MoWCA) is pleased to present the findings of the feasibility study for proposed project ‘Enhancing adaptive capacities of coastal communities, especially women, to cope with climate change induced salinity’. MoWCA prepared this assessment in coordination with the Department of Public Health and Engineering (DPHE). The United Nations Development Programme provided overall technical support to the Ministry to complete this assessment with inputs from International Centre for Climate Change and Development (ICCCAD). The study consolidates findings from site-specific assessments prepared by Practical Action and Water Aid. (attached as additional annexes)

The study examines observed climate changes and projections for Bangladesh and its impacts on salinity, freshwater based agricultural livelihoods and drinking water supplies. It further recommends solutions and measures to sustainably address these impacts, focussing on Khulna and Satkhira Districts which are most vulnerable. The recommendations formulated by this study have been used to identify and inform concrete activities to strengthen the resilience and adaptive capacity of the most vulnerable communities in Bangladesh, recognising the unique role and circumstances of women. The proposed project contributes towards GoB’s achievement of priorities outlined in the Intended Nationally Determined Contributions (INDC) and its climate change strategies, as well as being prioritized for inclusion in the country’s GCF Country Work Programme, currently under development.

We look forward to working together with concerned national and international institutions, UNDP and the Green Climate Fund to increase the resilience of vulnerable communities in the Coastal Zone of Bangladesh. It is expected that the experiences gained through implementation of these recommendations will result in activities and strategic frameworks that can be replicated in other agro/ecological districts in Bangladesh.

Minister of Women and Children Affairs,
Dhaka, Bangladesh
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List of acronyms and abbreviations

ACS  Apprreciative Consulting Services
AF  Adaptation Fund
AOSED  An Organization for Socio Economic Development
ASL  Above Sea Level
ASP  Adaptive Social Protection
ATP  Asset Transfer Programme
BARI  Bangladesh Agriculture Research Institute
BCCRF  Bangladesh Climate Change Resilience Fund
BCCSAP  Bangladesh Climate Change Strategy and Action Plan
BCCTF  Bangladesh Climate Change Trust Fund
BDT  Bangladeshi Taka
BFRI  Bangladesh Fisheries Research Institute
BINA  Bangladesh Institute of Nuclear Agriculture
BOT  Build – Operate – Transfer
BPC  Bangladesh Planning Commission
BRAC  Bangladesh Rural Advancement Committee
BRDB  Bangladesh Rural Development
BRRI  Bangladesh Rice Research Institute
BUET  Bangladesh University Engineering and Technology
BWDB  Bangladesh Water Development Board
CBA  Community-Based Adaptation
CBO  Community Based Organisation
CCA  Climate Change Adaptation
CCCDF  Canadian Climate Change Development Fund
CCF  Climate Change Fund
ccGAP  Climate Change and Gender Action Plan
CCRIP  Coastal Climate-resilient Infrastructure Project
CCTF  Climate Change Trust Fund
CDMP  Comprehensive Disaster Management Programme
CDS  Coastal Development Strategy
CEIP-I  Coastal Embankment Improvement Project - Phase I
CIF  Climate Investment Funds
CLP  Chars Livelihood project
CoP  UN Conference of the Parties
CPTU  Central Procurement Technical Unit
CRA  Community Risk Assessments
DAE  Department of Agricultural Extension
DDM  Department of Disaster Management
DEM  Digital Elevation Model
DHTW  Deep Hand Tube well
DIPECHO  Disaster Preparedness of the European Commission’s Humanitarian Aid and Civil Protection Department
DLS  District Livestock Services
DoE  Department of Environment
DPHE  Department of Public Health Engineering
DRR  Disaster Risk Reduction
DRR  Directorate of Relief and Rehabilitation
ds/m  deciSeimens per metre
DWA  Department of Women Affairs
EED  Evangelischer Entwicklungsdiensst
EMAPS  Electronic Maps to Assist Public Scienc
Annex II (a) – Feasibility Study
GREEN CLIMATE FUND FUNDING PROPOSAL

FGD  Focus Group Discussions
GCM  General Circulation Model
GDP  Gross Domestic Product
GED  General Economics Division
GIS  Geographic Information System
GoB  Government of Bangladesh
HEKS Das Hilfswerk der Evangelischen Kirchen Schweiz
HFA  Hyogo Framework for Action 2005/2015
HH  Household
HTW  Hand Tube Wells
HVCs high-value crops
ICCAD International Conference on Computer Aided Design
ICZM Integrated Coastal Zone Management
IFCAS Integrated Floating Cage Aquaponics System
INC Initial National Communication
ITN-BUET International Training Network – Bangladesh University of Engineering and Technology
JCS  Joint Country Strategy
JJS  Jagrata Juba Shangha
JMP  Joint Monitoring Programme
KF  Kreditanstalt für Wiederaufbau
KWASA Khulna Water Supply and Sewerage Authority
LACC The Livelihood Adaptation to Climate Change
LC  Least Developed Countries Fund
LDRRF Local Disaster Risk Reduction Fund
LGI Local Government Institutes
LGSP Local Government Support Project
LoCAL Local Climate Adaptive Living Facility
LoGIC Local Government Initiative on Climate change
LP  Litre Per Capita Per Day
LPD Litre Per Day
MAR Managed Aquifer Recharge
MCA multi-criteria assessment
MCPI Multi Criteria Poverty Index
MIS Management Information System
MoEF Ministry of Environment and Forest
MoFDNM Ministry of Food and Disaster Management
MoWCA Ministry of Women and Children Affairs
NAPA National Adaptation Programme of Action
NARRI National Alliance for Risk Reduction and Response Initi
NEC National Economic Council
NEMAP National Environment Management Action Plan
NPDM National Plan for Disaster Management
NWMP National Water Management Plan
O&M Operation and Maintenance
PEACE People’s Empowerment for Addressing Environmental Justice and Climate Justice
PECM Poverty Environment and Climate Mainstreaming
PKSF Palli Karma Shohayak Foundation
PPCR Pilot Programme for Climate Resilience
PP Public private initiatives
PPP Public Private Partnership
ppt parts per thousand
PRA Participatory Rural/Rapid Appraisal
PSF Pond Sand Filters
<table>
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<tr>
<td>PWS</td>
<td>Pipe Water Supply/System</td>
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<tr>
<td>REEP</td>
<td>Reducing Vulnerability to Climate Change</td>
</tr>
<tr>
<td>REOPA</td>
<td>Rural Employment Opportunities for Public Assets</td>
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<td>RO</td>
<td>Reverse Osmosis</td>
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<td>RRAP</td>
<td>Risk Reduction Action Plan</td>
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<td>RRF</td>
<td>Rural reconstruction foundation</td>
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<td>RVCC</td>
<td>Reducing Vulnerability to Climate Change</td>
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<td>RWH/S</td>
<td>Rainwater Harvesting/System</td>
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<td>SMC</td>
<td>School Management Committee</td>
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<td>SME</td>
<td>Small Medium Enterprise</td>
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<td>SP</td>
<td>Social Protection</td>
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<tr>
<td>Sq.km/km2</td>
<td>Square Kilometre</td>
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<tr>
<td>STW</td>
<td>Shallow Tube Well</td>
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<tr>
<td>ToT</td>
<td>Trainings of Trainers</td>
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<tr>
<td>UDMC/UzDMC</td>
<td>Upazila Disaster Management Council</td>
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<td>UNFCCC</td>
<td>United Nations Framework Convention on Climate Change</td>
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<td>UP</td>
<td>Union Parishad</td>
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<td>VGD</td>
<td>Vulnerable Group Development</td>
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<td>WAB</td>
<td>WaterAid Bangladesh</td>
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<td>WARPO</td>
<td>Water Resources Planning Organization</td>
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<td>WASH</td>
<td>Water, Hygiene and Sanitation</td>
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Executive Summary

Bangladesh is a low-income country with a high population density, particularly in the southern coastal regions. Approximately eighty per cent of the landmass of Bangladesh is made up of fertile alluvial lowland, in which most elevations are less than ten metres above sea level (ASL), particularly in the coastal south where the terrain is close to sea level. Such low elevations leave already marginalised populations vulnerable to climate related hazards including river flooding, cyclones, storm surges, sea level rise (SLR) and associated saltwater flooding. Observations and predictions indicate rising temperatures, SLR and increases in intense/heavy rainfall, concomitant with expected increases in cyclone intensity, which are predicted to lead to increased storm surge and saltwater flooding. The combined impacts of sea level rise and storm surge are projected to increase saltwater intrusion impacts on fresh-water dependent agriculture and reduce the availability of already scarce drinking water. Further changes in the seasonal timing and periods of rainfall, as well as increasing temperatures and associated rates of evaporation, particularly during the dry season, will increase the stress on freshwater supplies (including potable water). A large portion of the coastal population is therefore highly exposed to the impacts of climate change, particularly climate-induced increases in the salinity of soil and fresh water supplies (through sea level rise and cyclone driven salt-water inundations). These high levels of salinity are a significant threat towards agricultural-based livelihoods and drinking water supplies in southwestern coastal districts (within Khulna and Satkhira Districts, upazilas already experience groundwater salinities beyond the limit for potable and irrigation use i.e. >2500 uS/cm). Furthermore, salinities are predicted to increase significantly in districts further east due to climate change in the coming decades, suggesting the problem will worsen and affect other coastal districts. This situation is exacerbated due to extreme poverty in these regions, which limits the capabilities of populations to both recover from climate shocks (as seen by long recovery periods after events such as cyclone Sidr), as well as adapt to long-term changes in climate (which require resources and technical knowledge). This is particularly a problem in Khulna and Satkhira where approximately sixteen to forty per cent of people are classed as extremely poor.

Increasing salinity levels in both freshwater sources and soils affects the functioning of agricultural freshwater-based livelihoods, making them increasingly untenable and economically unviable, a situation that will worsen under climate change. This is already evidenced in clear shifts to more saline tolerant practices e.g. shrimp farming, in the last 1-2 decades. Whilst these practices enable economic activities to continue, they contribute to further salinization of soils and water, as well as primarily benefitting those who already have economic resources; the poor generally work as labour when needed and are unable to undertake alternative climate-resilient livelihoods. Similarly, the availability of good quality drinking water is heavily impacted by climate change. Many people in the coastal zone must travel to obtain their potable water that has not been contaminated by salinity, and the distance increases during drought periods. The alternative is the use of already contaminated/salinised water sources, which pose health risks (affecting hypertension and cardiovascular function) to all members of the population. Water treatment and water supply infrastructure will be a challenge in the future, as fresh water options face further salinization under climate change. Several options are available to address these expected impacts, including pond based systems and Rainwater Harvesting (RWH), through collecting rainwater from both household and community/institutional structures.

Gender inequality in Bangladesh is compounded by climate change as women have to spend more time and resources dealing with the impacts and consequences. Women face the disproportionate impacts from the loss of productive agricultural land, due to increased salinity, reducing their options to generate income. Climate change induced loss of livelihoods forces men to seek employment elsewhere, which further increases the vulnerability of women who are left behind. Furthermore,
women are expected to manage the domestic space and oversee the provision of safe drinking-water, often traveling long distances to access a clean water source which will become rarer due to climate change. Unsafe drinking water poses significant health risks, especially for pregnant women and children while traveling long distances to collect water exposes women and girls to safety hazards. The burden of the collection of water increases time spent by women and girls on domestic chores reducing their opportunities to invest in economically productive activities (e.g. climate-resilient agriculture) and/or educational activities.

**The policy environment** is generally conducive to addressing many of the climate resilience issues faced by coastal zone farmers and fishers. The water sector is particularly in an important position to promote adaptation to climate change as a cross-cutting sector. **There are, however, several key barriers which hinder efforts to address climate-resilient livelihoods and drinking water solutions.** These include a lack of information, skills, and access to technologies and inputs to adopt diverse, resilient livelihoods, limited business skills and market access, as well as the technical and financial capacity to promote alternative value chains for resilient livelihoods. Institutional barriers include inadequate training and capacity to use improved technologies for climate-resilient agriculture, as well as providing marketing and coordination between institutions responsible for managing different aspects of drinking water systems and agriculture. Currently there are limited knowledge, skills and capacities to plan for and implement drinking water technologies in response to increasing surface water salinity. This situation is exacerbated by a lack of financial capacity to invest in these solutions, as well as the capacity to plan and manage the continued upkeep and associated operations and maintenance, through responsible community structures.

**Recent experiences and consultations provide several important lessons to be considered when designing solutions.** Multi-stakeholder consultations throughout project development included the National Designated Authority (NDA), MoWCA, DWA, DPHE, relevant national government agencies, international partners including donors and multi-lateral agencies, Civil Society Organizations, NGOs, Indigenous people’s organizations, the private sector, and communities in Khulna and Satkhira Districts. Past experiences show that to ensure the sustainability of the interventions it is necessary to include the beneficiaries of climate-resilient livelihood options and drinking water technologies in the design, planning and implementation, as well as sustained management of the solutions as climate change risks evolve. Prior efforts and field level consultations also indicate the link between drinking water technologies and the success of the community-based model for operation and management, capacity building, institutional coordination and the need for an integrated approach. Several development efforts in the coastal region have either narrowly focussed on a particular technology, did not fully account for the expected impacts of climate change, or did not prioritise transformational change for the lives and livelihoods of the most affected people. Past efforts further demonstrate that forming sustainable public-private platforms helps to ensure that agricultural livelihoods are more likely to be sustainable in the long-term and have a greater influence on behavioural change after the project ends. Therefore, creating an enabling environment for the local private sector to become an active partner is proposed, which will promote the sustainability of project interventions.

Communities, especially women, within Khulna and Satkhira have experienced deteriorating freshwater resources which has affected both freshwater-based agricultural livelihoods and access to safe drinking water. Therefore, addressing this freshwater deterioration involves addressing both livelihoods and water; building livelihood resilience helps sustain the assets and management of water infrastructure, while provision of year-round safe drinking water helps communities to invest in income generation/livelihoods and education opportunities, whilst improving safety. To inform the design of these synergistic interventions, **site-specific assessments for agricultural livelihoods and drinking water provision were commissioned for the districts of Khulna and Satkhira.**

The Livelihoods Assessment Report (Annex IIb) details the findings of the study aimed at identifying the most feasible climate-resilient livelihoods for women and was conducted by Practical Action with
a multidisciplinary team of experts (on agriculture, aquaculture, climate change, gender and market development), using a mixed-methods approach. This included a literature review, participatory field assessments, remote sensing analyses, stakeholder consultations, and data interpretation and analysis, all of which was used to produce evidence- and scientifically-based suggestions for climate-resilient livelihoods in each location.

Profiles for 39 unions were prepared, with data being collected from 353 respondents to understand perceptions of potential livelihoods, identify their constraints and concerns, and gain an understanding of recent livelihood changes and potential drivers of those changes (see Livelihoods Assessment Report, Annex IIb for five of the union reports and for the remaining reports, refer to Annex IIId). Random sampling was used to select females between 18 to 49 years old, and focus group discussions (FGD) were conducted with different union officials and community representatives, including the chairman, members, and secretaries of the Union Parishad. Key informant interviews were used to verify the information, and provide insights into existing technologies, capacities, and perceptions on the feasibility to implement climate-resilient livelihoods. Transect walks identified market places, housing structures, living conditions of local communities. These data have been consolidated with information from the participatory rural appraisal (PRA), satellite imagery, market analysis, key informant interviews and targeted literature reviews.

Analysis of satellite imagery was used to: (i) analyse land-use/cover change; and (ii) determine the quality of building structures of local households. A Multi-Criteria Poverty Index (MCPI) was used to identify potential beneficiaries, which were verified through transect walks. GIS maps showed historical trends of land-use changes, key geographic and socio-economic characteristics, infrastructure and market places. A multi-criteria screening and filtering of livelihood options was conducted to identify alternative, climate-resilient livelihoods for women and coastal communities. These livelihood options were screened against salinity tolerance, cyclone resistance and adaptive capacity. Expert judgement was used to decide whether the livelihood was adaptive, non-adaptive, or maladaptive, whether it was gender equitable, its likely profitability and market/value-chain access, identify any further socio-economic considerations and likely community acceptance and environmental impacts. Eight livelihood options were identified as having the highest potential to be alternative, climate-resilient livelihoods for women in coastal communities in southwest Bangladesh. The value chain analysis was based on the ‘Participatory Market System Development’ tool, developed through PRAs, key informant interviews, FGDs, and transect walks. Five relevant value chains were mapped and assessed to understand their climate change resilience, value chain actors, existing and potential new market linkages, gender-responsiveness and potential for market system development. To promote feasible and adaptive value chains, the potential to include private actors in developing new market structures was assessed. Only households requiring diversification away from current livelihoods, which are not resilient to climate change induced rises in salinity, or who have already lost livelihoods to salinity induced impacts, were targeted.

**Recommended alternative, climate-resilient livelihoods** include: (i) crab farming and trading; (ii) crab nurseries; (iii) aqua-geoponics; (iv) hydroponics; (v) plant nursery; (vi) sesame oil seed production; (vii) fish feed processing and trading; and (viii) homestead vegetable gardening. These livelihood options have been screened and shown to be resilient in the face of a changing climate. Additionally, they are suitable for women’s participation and empowerment, and are appropriate for the local market system.

Additionally, the **Drinking Water Assessment Report (Annex IIc)** was developed to identify the most appropriate climate-resilient drinking water technologies, based on site-specific assessments in the same communities targeted for the livelihoods interventions. Household surveys were supplemented with a desk review of available secondary references. The assessment used primary research methods e.g. Participatory Rapid Appraisal (PRA), and reviews of recognised best practices, to identify the most feasible interventions. For the PRA, two stages of participatory community consultation were undertaken: (i) Ward-level (i.e. ward PRA on water source mapping) with
knowledgeable community members (men and women) represented by different social groups, to create socio-economic distribution maps; (ii) The union-level with Union Parishad representatives. The need for water-supply points/infrastructure was assessed and Union Parishad representatives attended the PRA process/sessions that were undertaken at both ward and union levels.

Nine ward maps were compiled and both existing water supply infrastructure, as well as current expansion plans (both ongoing projects and DHPE) were mapped and used to identify current gaps and potential water technology options for populations already identified through the livelihood targeting exercise (see section 6.1). The resulting recommendations for climate-resilient water supply infrastructure were based on: ability to cope with expected climate risks (salinity, extreme weather events and long-term changes rainfall patterns), gender responsiveness and sustainability of technological options per site; accessibility to ensure distances to water supply points are less than one kilometre; community preferences; and nationally acceptable, appropriate technological options for saline coastal zones of the country. Primarily these solutions are based on RWH units (at three scales: community, institution and household-level) and pond-based filtration systems for the safe storage of rain water. Existing surface water ponds (which are not exposed to man-made salinity, e.g. through shrimp farming) are an alternative and popular option of potable water supply in the coastal belt and ponds typically do not dry up during the dry season, providing viable additional safe water source after treatment. In these areas, pond based systems are recommended, filtering raw water (from an existing pond) using a commercially available filtration treatment system that reliably meets the GoB drinking water standards and World Health Organisation (WHO) guidelines for drinking water. The systems are designed to meet the supply gap, given other existing efforts, and for long-term viability given projected climate change risks. This study further recommends an implementation model and institutional arrangements, as well as a clear exit strategy for developing capacities of the communities and institutions for sustainable operation and maintenance of the drinking water supply systems.

Crucial to the success of both the proposed climate-resilient livelihood options and drinking water solutions will be: (i) Capacity building of women producer groups, water user groups, local communities, local government institutions, MoWCA, DPHE and NGOs/CBOs; (ii) Adequate and suitable access to resources for the beneficiaries and value chain actors; (iii) Collaborative approaches between government and development partners; (iv) Private sector engagement; (v) Improved climate adaptation knowledge, attitude and practices among communities; and (vi) Community ownership. These issues cut across communities and both livelihood and water supply related activities, particularly as the same communities are being targeted for both. It is therefore recommended that wherever possible community structures and groups should fulfil multiple roles, both in managing water infrastructure and promoting climate-resilient livelihoods. The sustainability of the interventions is based on the need to ensure livelihood options are climate-resilient, the strengthening of institutional and social structures, improved financial management and incomes of beneficiaries, as well as the sustainability of water supply infrastructure through caretakers and community led operations and maintenance activities. By providing safe drinking water supplies and promoting climate-resilient livelihoods, the coastal communities’ capacity to adapt to climate change induced salinity will be strengthened. The proposed project contributes towards GoB’s achievement of priorities outlined in the Intended Nationally Determined Contributions (INDC) and its climate change strategies, as well as being prioritized for inclusion in the country’s GCF Country Work Programme, currently under development.
1 Climate Risk Profile of Bangladesh

1.1 Country Background

1.1.1 Geographical context and vulnerabilities

1. Bangladesh has made considerable progress over the past decades in growing the country’s economy, which is shifting from an agro-economy into a mixed economy with a diverse range of employment opportunities. Economic and social indicators including Basic Human Needs and Health and Wellness have all improved, although Bangladesh remains a country of low Social Progress. Regardless, the Country’s progress on several indicators has surpassed neighbouring developing nations in South Asia. Furthermore, the Government of Bangladesh (GoB) is striving to achieve middle-income status by 2021 – the 50th anniversary of its independence.

2. Bangladesh is also one of the most disaster-prone countries in the world affected by floods, tropical cyclones, storm surges, and droughts. The exposure of its economy to disaster losses continues to increase, especially in real terms given the multiple and frequent large-scale disastrous hazards, higher economic growth, increases in assets, and population and urbanization. Conservatively estimated, the five largest major disasters since 1998 have together caused damage of 15 per cent of Gross Domestic Product (GDP), with an average of 2.7 per cent GDP per event.

3. The hydro-geophysical features of the country significantly contribute to its high vulnerabilities to natural disasters and climate change. About 88 per cent of the landmass of Bangladesh consists of a flood plain that sits in the world’s largest delta, Bengal Delta, which forms part of the greater Ganges-Brahmaputra-Meghna river basin system which spans across five countries in Asia including India (62.9 per cent), China (19.1 per cent), Nepal (8 per cent), Bangladesh (7.4 per cent) and Bhutan (2.6 per cent). The geographic location is such that it is heavily influenced by monsoon rains and, whilst the landmass consists of only 7 per cent of the combined catchment areas of three great rivers, the Ganges, the Brahmaputra and the Meghna, this region must drain over 92 per cent of rainfall runoff generated in the combined Ganges-Brahmaputra-Meghna catchment, within a period of four and a half months (June to mid-October). The monsoon season is followed by a prolonged dry season, where lack of appreciable rainfall and almost continuous evaporation from the top soil give rise to aridity and subsequent (phonological) moisture stress. Neap tides during the peak of the monsoon are high enough to penetrate coastal plains which may be protected by embankments, leaving entire areas under such embankments inundated with saline water. Owing to an inverted funnel-shaped shoreline and being located on the path of cyclonic storms and associated surges occurring in the northern Indian Ocean, the country remains highly vulnerable to cyclonic disasters.

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6 Social Progress Imperative. 2015, Social Progress Index. Retrieved from http://www.socialprogressimperative.org/system/resources/W1siZiIsIjIwMTUvMDUvMDcvMTcvMjkwMzEvMzI4LzIwMTYfU09DSUFWX1BST0dSRVNTXIOREVyQZITkFMNLn8ZidXQ/2015%20SOCIAL%20PROGRESS%20INDEX_FINAL.pdf
10 Ibid.
1.1.2 Low-lying coastal areas

4. Encompassing a total of 19 districts along a 710-km coastline, the coastal zone of Bangladesh (Figure 1(a) covers an area of over 47,150 km² and is home to 38.52 million people. Based on three hydro-morphological characteristics, the coastal zone can be delineated into three regions: (i) The Ganges Tidal Plain or the Western Coastal Region, (ii) The Meghna Deltaic Plain or the Central Coastal Region and (iii) The Chittagong Coastal Plain or the Eastern Coastal Region. The coastal zone is quite distinct and is characterized by a wide network of rivers and channels, high discharge of water with large amounts of sediments, many islands, the Swatch of No Ground (underwater canyon located 45 km south of the Sundarbans in Bangladesh), as well as the shallow northern Bay of Bengal which exerts a strong tidal influence. Based on the distance from the coast or the estuaries, the Integrated Coastal Zone Management Project of Water Resources Planning Organization further classified these 19 coastal districts into interior (7 districts, 48 upazilas) and exposed (12 districts, 99 upazilas) zones.

5. Bangladesh is predominantly flat and low-lying. Apart from hilly regions in the northeast and southeast corners of Bangladesh, most of the country is less than 10m above sea level (ASL). Additionally, most of the southwest coastal belt is less than 2m ASL with a significant area less than 1m ASL. The average elevation of the southwest coastal zone ranges from 1-2 m and in the southeast coastal zone 4-5 m ASL (Figure 1b). The low-lying flat topography and dynamic morphology of the zone significantly contribute to its vulnerability to sea level rise (SLR).

6. Potential target project areas (see Figure 1b) are mostly located in the Western Coastal Region or the Ganges Tidal Plain and are all < 7m ASL with those in the western regions < 4m ASL. The Ganges Tidal Plain is largely covered by the Sundarbans mangrove forests, which acts as a natural barrier against cyclones, storm surges, and soil erosion and provides some stability to the zone. Swamps, tidal floodplain and natural levees with numerous tidal creeks are also present in the area. Being a semi-active delta, the soils are composed mostly of silty loams, or alluvium washed down from the Himalayas. The Ganges tidal zone is also considered the most salinity-prone region of the coast, with the western part remaining more saline than the eastern part.

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12 Three characteristics: level of tidal fluctuations, salinity condition (both surface and ground water), and risks of cyclone, storm surge and tidal influence
15 Islam, M. S., 2001, Sea-level changes in Bangladesh: The last ten thousand years, Asiatic Society of Bangladesh.
1.1.3 Socio-Economic Context and Vulnerabilities

7. Based on World Bank data, the average population density for Bangladesh is 1,237 people per sq. kilometre\(^\text{18}\) with a growth trend. The average population density in the coastal belt region ranges from 369 people per sq. kilometre in Bagerhat to 823 people per sq. kilometre in Barisal, where the uninhabited Sundarbans (mangrove forest) is located. Within the seventh cycle of Five Year Plan period (2016-2020), population is projected to increase to 172 million\(^\text{19}\) and Bangladesh is expected to become a middle-income country by 2021. The Household Income and Expenditure Survey (HIES) of 2010\(^\text{20}\) estimated that poverty incidence is 31.5 per cent at the national level, 35.2 per cent in rural area and 21.3 per cent in urban area. The average monthly income per household in 2010, was BDT 11,479 (USD 148.13), in comparison with 2005, where the average monthly income was estimated at only BDT 7,203 (USD 92.95). Income per capita in the same year was BDT 2,553 (USD 32.94)\(^\text{21}\).

8. According to the World Bank, the GDP of Bangladesh in 2015 was USD 195.079 billion, and the GDP per capita USD 1,211.7. In 2010, 31.5 per cent of the population lived under the national poverty line, 18.52 per cent of the population lived with less than USD 1.9 per day and 56.8 per cent with less than USD 3.10 per day. Official poverty indicators show a slightly higher percentage of the population living below the absolute poverty line in the coastal zone compared to the rest of the country as a whole (52 per cent versus 49 per cent), while GDP per capita and the annual GDP growth rates in the coastal zone are similar to national averages.\(^\text{22}\)

9. Official poverty indicators show a slightly higher percentage of the population living below the absolute poverty line in the coastal zone compared to the rest of the country (52 per cent versus 49 per cent), while GDP per capita and the annual GDP growth rates in the coastal zone are similar to the national averages. The southwest of Bangladesh is amongst the poorer regions of the country.

\(^{16}\) Adapted from Ministry of Environment and Forest 2016, Assessment of Sea Level Rise on Bangladesh Coast through Trend Analysis. Climate Change Cell. Department of Environment.

\(^{17}\) Prepared using NASA’s SRTM data


\(^{20}\) Household Income and Expenditure Survey (HIES) of 2010


About 16-35 per cent of people living in Khulna are extremely poor. In Barisal, the percentage of extreme poor ranges from 6 per cent in the southern most districts, and more than 35 per cent in the city. Through good macroeconomic policies and a vigorous private sector, the country is maintaining a GDP growth rate of 6 per cent annually with a total GDP in 2013 of approximately BDT 10,380 billion. With increased life expectancy, a reduced mortality rate and improvements in nutrition, an increasing population will remain a challenge.

11. There is a substantial regional differentiation: in 15 out of the 19 coastal districts, the GDP per capita is below national or coastal zone averages. The southwest of Bangladesh is amongst the poorer regions of the country. About 16-35 per cent of people living in Khulna are extremely poor; Whereas in Barisal the percentage of extreme poor ranges from 6 per cent or less in the southern most districts. According to the Labour Force Survey\textsuperscript{23}, the economically active population stands at 56.7 million\textsuperscript{24}, with regional and gender-based differences a concern. Certain groups of people such as women, children, elderly, the disabled and remote rural dwellers are more prone to suffering from poverty, malnutrition and food insecurity, with almost 40 per cent of the rural population in Bangladesh live on less than USD 1.25 per day, and 60 per cent of that income is spent on food\textsuperscript{25}.

12. At present, nearly 40 million live in the coastal areas of Bangladesh which depending on population growth, by 2080 may vary between 51 to 97 million. The IPCC reports that by the year 2050 approximately 27 million people in the coastal areas of Bangladesh will be at risk due to sea level rise\textsuperscript{26}. Pender et al.\textsuperscript{27} further projected that by the year 2080, assuming a sea level rise of 62 cm, up to 17 million, 12 million and 14 million people are expected to be at low, medium and high risk, respectively. Therefore, the southern coastal districts not only house a higher percentage of poorer people than the rest of the country, but they are also those most likely to suffer a wider range of and intensification of impacts from climate change. Impacts in the coastal region include SLR and increased storm surges from cyclones and tropical storms, in addition to the increases in temperature which will be experienced over the whole country. All three of these impacts work to increase the salinity of land and freshwater sources, through increased inundation of sea water and evaporation of fresh water. In turn, this places further stress on populations who rely on both surface and groundwater for drinking and agricultural/farming activities, causing people (often women) to have to travel further to source safe and potable drinking water, and for agriculture to shift to more saline resilient activities (see Figure 2).


\textsuperscript{24} The total employed labour force stands at approximately 54.1 million and the unemployed (those not economically engaged at the time of the survey) stands at 2.6 million.

\textsuperscript{25} Bangladesh Integrated Household Survey, 2011-12.


\textsuperscript{27} Pender, J.S. 2008. What Is Climate Change? And How It Will Affect Bangladesh. Briefing Paper. (Final Draft). Dhaka, Bangladesh : Church of Bangladesh Social Development Programme
1.2 Climate Change: Observed and projected climate variability and change
1.2.1 Precipitation patterns

13. Located within the south Asian monsoon region, Bangladesh enjoys a warm, humid and tropical climate, influenced primarily by monsoon and partly by pre-monsoon and post-monsoon circulations. With the Bay of Bengal and the Indian Ocean to the south and large mountain ranges—Himalayan Mountains and Arakan Ranges to the north and east respectively—the country receives very high annual precipitation, most of which is concentrated during the monsoon season. There are four prominent climatic seasons in Bangladesh—winter (December-February), pre-monsoon (March-May), monsoon (June-September) and post-monsoon (October-November). Although the onset of the monsoon tends to vary from year to year, it starts during the first week of June on average and withdraws by the first week of October. Intense heat and consequent low-pressure systems over Punjab (in Pakistan and India) and the Upper Ganges draw in moisture-laden southwest trades to the Indian sub-continent, starting the main rainy period in Bangladesh. Besides monsoon, easterly trade winds are also active in the country, providing warm and relatively drier circulation.

14. Analysis of precipitation data from 1961-2010 for 234 stations managed by the Bangladesh Water Development Board (BWDB) indicates that annual precipitation data in Bangladesh is essentially free of any significant change and trend\(^2\). Country-wide annual normal rainfall over a

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period of 30 years (1980-2009) is found to be 2,306 mm. Precipitation during 1960-1989 and 1970-1999 were 2,298 and 2,314 mm, respectively. However, the study noted that while all-country precipitation data remains trend-free, significant changes in some regional annual rainfalls were observed. The far northwest (Rangpur-Dinajpur) and southwest (Jessore-Khulna-Satkhira) regions exhibited increases in annual rainfall at 90 per cent level of confidence while the south-central and southeast regions (Faridpur-Comilla-Barisal) exhibited decreasing trends. Shahid (2010)\textsuperscript{30} uses a different precipitation dataset from 1958-2007 for 17 stations managed by the Bangladesh Meteorological Department. They observed an increase of precipitation by 5.5 mm per year. The study, similar to Mondal et al. (2013)\textsuperscript{31}, reported a statistically significant increase in precipitation in the northwest and southwest regions (Figure 3a).

15. Seasonal rainfall trends when compared for three periods—1960-1980, 1970-1999 and 1980-2009 revealed that pre-monsoon and post-monsoon precipitations have increased whereas the monsoon rainfall has decreased\textsuperscript{32}. Winter rainfall has also increased in the last two periods relative to the first one. However, except for the pre-monsoon season, these precipitation trends are not statistically significant. Shahid (2010)\textsuperscript{33} found an increasing trend in pre-monsoon rainfall. Stronger and more continuous winds from the Bay of Bengal during pre-monsoon months in recent years, because of increased sea surface temperatures\textsuperscript{34}, are postulated to be the cause of increased pre-monsoon rainfall in Bangladesh.

16. Mondal et al.\textsuperscript{35} observed non-significant increases in precipitation in March and October, and decreases in June and August. The study further found that the number of rainy days and consecutive rainy days has been increasing in Khulna and Satkhira, two of this project’s six proposed target districts, with areas further along the coast indicating statistically non-significant changes. Both stations also exhibited significant decreasing trends in non-rainy days.

\textsuperscript{30}Shahid S. 2010, Recent trends in the climate of Bangladesh. CLIMATE RESEARCH. Vol. 42: 185–193. doi:
\textsuperscript{10.3354/cr00889}
\textsuperscript{31}Mondal M. S., Islam A.K.M. S., Madhu M. K. 2013, Development of Four Decade Long Climate Scenario & Trend: TEMPERATURE, RAINFALL, SUNSHINE & HUMIDITY. Institute of Water and Flood Management Bangladesh University of Engineering & Technology. Comprehensive Disaster Management Programme (CDMP II). Ministry of Disaster Management and Relief
\textsuperscript{32}Mondal M. S., 2013, Development of Four Decade Long Climate Scenario & Trend: TEMPERATURE, RAINFALL, SUNSHINE & HUMIDITY. Institute of Water and Flood Management Bangladesh University of Engineering & Technology. Comprehensive Disaster Management Programme (CDMP II). Ministry of Disaster Management and Relief
\textsuperscript{33}Shahid S. 2010, Recent trends in the climate of Bangladesh. CLIMATE RESEARCH. Vol. 42: 185–193. doi:
\textsuperscript{10.3354/cr00889}
\textsuperscript{34}Khan, T.A., 2000, “Water Based Disasters in Bangladesh”, in Q.K. Ahmad (ed.) Bangladesh Water Vision 2025: Towards a Sustainable Water World, Bangladesh Water Partnership (BWP), Dhaka, pp. 54-62
\textsuperscript{35}Mondal M. S., 2013, Development of Four Decade Long Climate Scenario & Trend: TEMPERATURE, RAINFALL, SUNSHINE & HUMIDITY. Institute of Water and Flood Management Bangladesh University of Engineering & Technology. Comprehensive Disaster Management Programme (CDMP II). Ministry of Disaster Management and Relief
1.2.1.1 Modelled future change

17. Models of climate change suggest higher than average monsoon rainfall in the future, with the findings of Agrawala et al.\textsuperscript{37} reported in the key government publications. Table 1 summarizes the modelling data that represents climate change scenarios for the country under three different timelines. Winter months (December, January, February) will become warmer and drier while monsoon months (June, July and August) will become warmer and wetter.

\footnote{36 Adapted from Shahid S. 2010, Recent trends in the climate of Bangladesh. CLIMATE RESEARCH. Vol. 42: 185–193. doi: 10.3354/cr00889}
Table 1: Temperature and precipitation scenarios used in GoB documents

<table>
<thead>
<tr>
<th>Timeline</th>
<th>Mean Temperature Change (°C)</th>
<th>Mean Precipitation Change (%)</th>
<th>Sea Level Rise (cm)</th>
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<td>Annual DJF JJA</td>
<td>Annual DJF JJA</td>
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<td>5 -2 6</td>
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<tr>
<td>2110</td>
<td>2.4 2.7 1.9</td>
<td>10 -10 12</td>
<td>88</td>
</tr>
</tbody>
</table>

Note: December, January, February indicates dry season, comprising of December, January and February, while June, July and August indicates peak monsoon, comprising of June, July and August months.

18. The monthly distribution of rainfall and the number of rainy days for the Khulna and Barisal Divisions (which contains the target project areas) projected by the four GCMs are presented in Figure 4 and Figure 5. These predicted changes in seasonal temperature and rainfall pattern will have will have implications on lives and livelihoods of people. Increased monsoon rainfall may lead to frequent occurrence of high-intensity floods over the floodplains. Monsoon flood duration will be prolonged by a significant number of days and inundation area, and inundation depth will be increased. The reduction of rainfall during the drier months (November to March) coupled with increased surface desiccation, will heighten moisture stress and phonological drought in Bangladesh, particularly the western parts of the country.

Figure 4: Monthly precipitation in 2050 in Khulna and Barisal Divisions as predicted by four GCMs

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40 Climate Change Cell (CCC) 2017 website, About Us Retrieved http://www.climatechangecell.org.bd
41 Ahmed 2016; BCAS-RA-Approtech, 1994; Huq et al., 1996
1.2.2 Temperature Trends

19. According to a study conducted by CDMP in 2013\textsuperscript{44}, Bangladesh has been exhibiting increasing trends in mean annual temperatures. Data from all 34 stations in Bangladesh suggests that the trend is 1.2°C (Figure 6)\textsuperscript{45}. This is in-line with the results obtained by Shahid\textsuperscript{46} who analysed temperature from 17 stations over the period of 1958-2007 and observed an increase of mean temperature by 0.097°C per decade.

20. Data from all 34 stations demonstrates a trend for increasing temperature rates for the period 1980-2010 compared to 1948-2010, for example, it is getting warmer quicker. It was evident that the annual trend in mean temperatures during the 1980-2010 period at 2.4°C, was nearly twice the value computed using the data for the entire period (1948-2010). The CDMP study\textsuperscript{47} further noted that corresponding winter (December-February), pre-monsoon (March-May), monsoon (June-September) and post-monsoon (October-November) trends have been 1.2, 0.7, 1.2 and 2.0°C respectively.

21. Shahid\textsuperscript{48} observed that, except the northern areas, there has been a significant increase in mean temperature in most parts of the country (Figure 3b). The highest increase was observed in November at a rate of 0.3°C per decade\textsuperscript{49}. Seasonal analysis of temperature shows that the temperature is increasing significantly, but only in winter. Mean temperature has been increasing in the potential project areas. The mean temperature increase observed, although not statistically significant, is 0.09°C and 0.04°C per decade for Satkhira and Khulna stations, respectively\textsuperscript{50}.

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\textsuperscript{43} Ibid.
\textsuperscript{44} CDMP 2013. Local-level Hazard Maps for FLOOD, STORM SURGE & SALINITY. STUDY REPORT. Comprehensive Disaster Management Programme (CDMP II). Ministry of Disaster Management and Relief
\textsuperscript{45} Ibid.
\textsuperscript{47} CDMP 2013. Local-level Hazard Maps for FLOOD, STORM SURGE & SALINITY. STUDY REPORT. Comprehensive Disaster Management Programme (CDMP II). Ministry of Disaster Management and Relief
\textsuperscript{49} Ibid.
\textsuperscript{50} Ibid.
1.2.2.1 Modelled future change

22. Several modelling exercises have noted a general increase in surface temperature, with higher rates of change during the drier periods\(^{51}\). Since the 1950s, a surface warming increase of approximately 0.74 °C has been observed in Bangladesh, a trend which is increasing\(^{52}\). This is likely to reduce moisture from top soils, and exacerbate evaporation from plants and water bodies. These trends are expected to continue in the future as demonstrated by four general circulation models (GCMs) used to model temperature changes under the A1B scenario.

23. Figure 7 presents the maximum and minimum temperatures in Barisal and Khulna divisions as predicted by the four GCMs, with increases between 1 and 2°C by 2050. The PRECIS model (Providing Regional Climates for Impacts Studies) also predicted that annual maximum and minimum temperature will follow an increasing trend\(^{53}\).

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1.2.3 Storm surge and cyclones

24. Bangladesh is considered as a global hotspot for natural disasters and was ranked fifth globally in terms of disaster risk. Major natural disasters include floods, tropical cyclones, storm surges, and droughts. Tropical cyclones are the worst form of meteorological disasters whereas floods remain the key natural disaster affecting Bangladesh. Each year approximately 25 per cent of the country is flooded, and the country is hit by a severe flood every 4-5 years which may inundate 60 per cent of the country. While most of the country is typically susceptible to river and rainwater flooding, low-lying coastal areas remain vulnerable to tidal flooding.

25. The coastal areas of Bangladesh are frequently hit by cyclones that are formed in the Bay of Bengal. Every three years a severe cyclone strikes the area and causes havoc in the lives and livelihoods of people living by the coast. In 2007, the tropical Cyclone Sidr caused a financial loss of USD 1.7 billion according to an estimate of GoB. During the period of 1978-2013, a total of 129 tropical cyclones were formed in the Bay of Bengal, of which 32 (25 per cent) hit Bangladesh. A seasonal distribution of the formed tropical cyclones indicates that the months April-June and September-December are the tropical cyclone seasons for the Bay of Bengal (Figure 8). The highest frequency of intense tropical cyclone has been reported to occur between the months of October and November.

Figure 7: Maximum and minimum temperature in Khulna and Barisal Divisions as predicted by four GCMs

Figure 8: Monthly distribution of the tropical cyclones formed in the Bay of Bengal during 1978-2013

26. Using a data set used by Quadir and Iqbal\(^{59}\) and Joint Typhoon Warning Centre Best Track tropical cyclone data it can be observed that between 1961 and 2013, a total of 61 cyclones hit Bangladesh (analysis taken from Delta Plan 2100). The spatial distribution of these cyclones is shown in Table 2. The south-western and south-central coastal zones were hit by 28 per cent and 16 per cent respectively by the reported cyclones between 1961 and 2013.

Table 2: Distribution of land-falling cyclones to different coastal regions during 1961-2013\(^{60}\)

<table>
<thead>
<tr>
<th>Coastal region</th>
<th>No. of tropical cyclones hit the coast</th>
<th>% of the total number of tropical cyclones</th>
</tr>
</thead>
<tbody>
<tr>
<td>South-eastern coast (Southern Chittagong, Cox’s Bazar and Teknaf)</td>
<td>18</td>
<td>29.5</td>
</tr>
<tr>
<td>Sundarban coast (Satkhira, Khulna and Bagerhat)</td>
<td>17</td>
<td>27.9</td>
</tr>
<tr>
<td>Meghna estuary, east central coast (Eastern Bhol, Noakhali and Chittagong)</td>
<td>16</td>
<td>26.2</td>
</tr>
<tr>
<td>Central coast (Borguna, Potuakhali, Pirozpur, Barisal, Bhola)</td>
<td>10</td>
<td>16.4</td>
</tr>
<tr>
<td>Total</td>
<td>61</td>
<td>100</td>
</tr>
</tbody>
</table>

27. The primary damage from cyclones is caused by storm surge flooding. If cyclones make landfall during high tide, surges are higher, penetrate deeper inland and are deadlier. Available literature for cyclones between 1960-2013 shows associated storm surge ranging from 1.5 to 10.0m\(^{61}\). The frequency of occurrence of a wave about 7 m high along the Bangladesh coast is nearly 5 years while a wave with a height of 10 m is approximately 20 years\(^{62}\). Figure 9 shows the inundation risk map for different storm surge height.

\(^{59}\) Quadir and Iqbal Tropical Cyclones: Impacts on Coastal Livelihoods. Investigation of the Coastal Inhabitants of Bangladesh. IUCN. December 2008


\(^{61}\) Brammer, H., 2014, Climate Change, Sea-level Rise and Development in Bangladesh, (Dhaka: University Press Ltd)

\(^{62}\) MCSP 1993, Multipurpose cyclone shelter programme. Final Report, contributed by Bangladesh. University of Engineering and Technology; Bangladesh. Institute of Development Studies; UNDP; World Bank
1.3 Contribution of SLR, Cyclones and Associated Storm Surges

1.3.1 Future changes in cyclones, storm surge, and inundation

28. Increasing sea surface temperature (SST) is projected to increase the frequency depressions in the Bay of Bengal. While this does not necessarily mean there will be an increase of cyclones in the future, storms of lesser intensity are expected to become more frequent in coming years\(^64\). According to the IPCC, tropical cyclone frequency in Bangladesh is likely to decrease or remain same, but the number of intense cyclones will likely increase. Tropical cyclones will likely become stronger with greater wind speeds, higher storm surges and more heavy rainfall as SSTs in the northern Indian Ocean increase. Pender et al.\(^65\) report that increased wind speeds resulting from higher sea surface temperatures due to climate change means that storm surge heights will increase from 15 per cent to 25 per cent in the 2020s and 32 per cent in the 2050s. An analysis of cyclones occurring in the Bay of Bengal from 1960 to 2007 show there have been more cyclones of higher intensity between 1991-2007 than in the previous few decades (see Figure 10).

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63 Adapted from Bala S. K., 2016. Coastal Vulnerability Index (CVI) for Bangladesh considering climate change. Institute of Water and Flood Management (IWFM). Bangladesh University of Engineer and Technology (BUET).
29. Unnikrishnan et al. (2006)\textsuperscript{67}, argues that there will be a significant increase in the frequency of highest storm surges for the Bay of Bengal even if there is no substantial change in the frequency. Their study used dynamic, Regional Climate Model (RCM)-driven simulations of current and future climates. Emanuel (2005)\textsuperscript{68} also projects increased intensity of tropical storms by 2100 for the North Indian Ocean\textsuperscript{69}. Combined with expected rises in sea-level, these higher intensity cyclones are predicted to cause increased tidal surge heights. Bangladesh already receives about 40 per cent of the impact of total storm surges in the world\textsuperscript{70}. Dasgupta et al. (2014) modelled cyclone storm surge impacts under a changing climate scenario in 2050. Their model in a bid to determine potential future inundation zones by 2050 under the climate change scenario, was run for five cyclone tracks (covering the entire coastal area), incorporating a 27-cm rise in sea level\textsuperscript{71}, a 10 per cent increase in wind speed, and landfall of cyclones during high tide. It predicted that by 2050 an additional 15 per cent of the coastal area of Bangladesh will be inundated with storm surges during cyclones. Table 3 and Figure 11 show the additional area that will be impacted by inundation in 2050. Not only will areas in Khulna, Bagerhat and Satkhira Districts be newly exposed, but tidal surges at 3 metres height will inundate 69 per cent more land area than they do at present.\textsuperscript{72}

Table 3: Vulnerable Area Estimates (km\textsuperscript{2})

<table>
<thead>
<tr>
<th>Inundation Depth</th>
<th>2050 Without Climate Change (km\textsuperscript{2})</th>
<th>2050 with Climate Change (km\textsuperscript{2})</th>
<th>% Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>More than 1m</td>
<td>20,876</td>
<td>23,764</td>
<td>+ 14%</td>
</tr>
<tr>
<td>More than 3m</td>
<td>10,163</td>
<td>17,193</td>
<td>+ 69%</td>
</tr>
</tbody>
</table>

\textsuperscript{69}Measured by the per cent change in landfall power using the Model for Interdisciplinary Research on Climate (MIROC) General Circulation Model
\textsuperscript{70}Murty, T.S., and El-Sabh, M.I. 1992. Mitigating the Effects of Storm Surges Generated by Tropical Cyclones: A proposal, Natural Hazards 6(3), 251-273
\textsuperscript{71}Ministry of Environment and Forests (2003) has reported an average sea level rise of 32 cm as opposed 27 cm used for this model
30. Polders are particularly at risk of higher tidal surges. This is because once a polder embankment is breached, the enclosed land often stays waterlogged for long periods of time, making agriculture and other livelihood activities nearly impossible. Figure 12 shows the number of polders in the region that risk being overtopped by 2050 under changing climate conditions.

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73 Dasgupta et al. 2015. Climate change and soil salinity: The case of coastal Bangladesh.
31. Furthermore, a 27-cm sea level rise in combination with storm surges from an average 10-year return period cyclone (such as Sidr), projected for 2050, could inundate an area more than 80 per cent larger than the area inundated at present by a similar event. An estimated 3.45 million people were exposed to flooding because of Cyclone Sidr. Compared to the no-climate change baseline scenario, an additional 7.8 million people would be affected by flooding higher than one metre in Bangladesh because of a potential 10-year return cyclone in 2050 (an increase of 107 percent). A total of 9.7 million people (versus the 3.5 million in the baseline scenario) are projected to be exposed to severe inundation of more than 3 metres under this same scenario.

1.3.2 Sea Level Rise (SLR)

32. The three main coastal regions can be further subdivided into six sub-regions: the Ganges Tidal Floodplain (saline), the Ganges Tidal Floodplain (non-saline), Meghna River Floodplain, Meghna Estuarine Floodplain (Charland), Chittagong Coastal Plains and St. Martin’s Island. CCC (2016) in a bid to assess the historical change of sea level rise along the coast of Bangladesh selected 15 monitoring stations along the coast to cover three major geo-morphological regions and six physiographic subregions. The study analysed 30 years (between 1980 and 2012) of tidal data and reported that the overall trend for SLR in the coastal zone of Bangladesh for the past 30 years was 6-21 mm per year. The water level in the Ganges tidal floodplain was found to have risen by 7-8 mm/year, in the Meghna Estuarine by 6-10 mm/ year and in the Chittagong coastal plain areas by 11-21 mm per year (Figure 13). The observed trend derived from the tidal gauge data along the coast of the Bay of Bengal also indicate that the SLR in Bangladesh “is much higher than the global mean sea level trend derived from long-term global tide gauge data and short-term satellite data”.

33. Previously Pethic and Orford (2013) studying data from three estuarine tide gauges located in the Sundarban area of southwest Bangladesh reported that rates of increase in relative mean sea level (RMSL) in the southwest region ranges from 2.8mm per year to 8.8 mm per year. They also argued that “the trends in RMSL disguise the fact that high water levels in the polder zone have been increasing at an average rate of 15.9 mm per year and a maximum of 17.2 mm per year.

34. According to the Ministry of Environment and Forests, the country can expect to experience a sea level rise of 14 cm, 32 cm and 88 cm by the year 2030, 2050 and 2100, respectively. Millman and colleagues noted that the local rise in sea level at Bangladesh by the year 2050 would be between 13 and 209 cm, and by 2100 would be between 28 cm and 447 cm. Both the historical increases noted above and the further expected increases due to climate change are expected to have significant impacts, including raising the salinity of freshwater sources.

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76 Ibid.
78 MoEF 2005
1.4 Key Climate Change Risks: Cyclone and SLR-induced Salinity and impacts on drinking water and fresh-water-based livelihoods

35. As stated above the key climate change risks are from SLR, increased storm surges due to increased intensities of tropical storms and cyclones, and increasing temperatures. All three of these changes in climate act to increase both surface and groundwater salinities; Increases in storm surge and SLR increase saltwater intrusion into the coastal region; Increasing temperatures leads to greater evaporation, which in the absence of increases in rainfall, leads to greater concentrations of salinity in landlocked water sources. The timing of the dry and wet monsoon season can also increase extreme salinity levels at the end of the dry season when temperatures/evaporative demand is highest and less freshwater is available. Other non-climate stresses, such as reduced freshwater river inflows due to increased abstraction, further act to exacerbate/increase salinity levels. These processes which cause increases in the salinity of coastal freshwater sources and land, and which affect drinking water availability and agricultural livelihoods are detailed below.

1.4.1 Saltwater intrusion

36. Salinity intrusion in the south-western coastal Bangladesh results from a combination of events, including decreases in upstream freshwater flow, sea-level rise, cyclones, storm surges, and variability of rainfall. While future model projections clearly show the impact of sea-level rise on salinity intrusion, as yet very few initiatives clearly distinguish the relative contribution of factors that led to the current level of salinity observed in south-west coastal Bangladesh. The construction of the Farrakh Barrage in India in 1965 led to significant reduction in freshwater flow in the Gorai River, which substantially increased salinities during the dry season, whilst during the monsoon heavy rainfall flushes and dilutes these salinities. Since the Ganges Treaty in 1996 Bangladesh has received an average of 750 m$^3$/sec of water (between 1996 and 2009), which higher than the 425 m$^3$/sec received between 1990 and 1996. Therefore, the contribution of upstream freshwater flows to

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salinity increases has itself decreased since 1996, compared to the time period 1990-1995. However, salinity intrusion has continued to increase during this period. As noted by MoEF, Bangladesh has been experiencing a sea-level rise of 6-21 mm/yr and thus it is likely that SLR has also been contributing to recent increases in salinity. Bhuiyan and Dutta (2012) using a salinity flux model coupled with a hydrodynamic model simulated the risk and change in salinity with four different sea level rise scenarios. Their work indicates that due to sea level rise, salinity in the Gorai River Basin has increased. The study estimated that “sea level rise of 59 cm produced a change of 0.9 ppt at a distance of 80 km upstream of the river mouth, corresponding to a climatic effect of 1.5 ppt per meter sea level rise.” This also provides evidence that SLR has contributed to the currently observed salinity in the coastal areas of Bangladesh.

37. To demonstrate the impact of cyclonic landfall on salinity intrusion, Akter et al. (2016) compared simulated salinities in normal dry conditions without any cyclonic event to salinities in normal dry conditions under the influence of a Sidr-like cyclone. The results as presented in Figure 14 indicate that deflection of isohalines depends on the location of landfall, track and strength of cyclone, with further inland intrusion of salinity due to additional storm surges.

Figure 14: Isohaline lines of normal dry condition (year 2011) with and without the impact of a Sidr-like cyclone (the thin line shows the normal condition and the thick line shows the impact of the cyclone)

38. Three main pathways have been suggested for aquifer salinity in the coastal areas: i) salt water intrusion from the Bay of Bengal to the coastal groundwater that may accelerate due to sea level rise and/or decreasing ground water level, ii) Percolation of saline surface water to the aquifer

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83 CCC 2016
resulting from storm surges, embankment failure and/or transgression of the coast, and iii) Due to movement of existing saline water pockets in the subsurface. Shallow coastal aquifers have high salinity and as such water supply wells must penetrate 250 metres or more to find water of acceptable quality\(^7\). Limited use of shallow aquifers for domestic purposes is however sometimes possible due to flushing of saline water in isolated pockets during the monsoon.

39. Miah et al. (2010)^88 reported that saline area in 10 selected coastal districts had increased on average by 27 per cent between 1973 and 2009 (Table 4). Such findings are similar to Dasgupta et al. (2015)^89 who found soil salinity to be gradually increasing. Studies have shown that salinity is moving further inland (Figure 15). Increases in surface and river water salinity have been noted for coastal rivers. For example: during 2004-2009 the greater Khulna District rivers experienced an increase of 20.5 per cent to 433.3 per cent in salinity\(^90\).

Table 4: Increase of soil salinity affected area over the years (1973-2009)^91.

<table>
<thead>
<tr>
<th>Year</th>
<th>Non-saline with some very slight saline (S1) 1.28-2.56 ppt</th>
<th>Very slightly saline with some Slight saline (S2) 2.62-5.12 ppt</th>
<th>Moderate to some strongly saline (S3) 5.18-10.24 ppt</th>
<th>Very Strongly saline with some strongly saline (S4) &gt;10.24 ppt</th>
<th>Total Salt affected area</th>
</tr>
</thead>
<tbody>
<tr>
<td>1973</td>
<td>246.67</td>
<td>397.83</td>
<td>71.75</td>
<td>34.7</td>
<td>750.95</td>
</tr>
<tr>
<td>2000</td>
<td>244.65</td>
<td>264.74</td>
<td>320.78</td>
<td>85.17</td>
<td>915.34</td>
</tr>
<tr>
<td>2009</td>
<td>269.32</td>
<td>241.4</td>
<td>339.9</td>
<td>100.16</td>
<td>950.78</td>
</tr>
</tbody>
</table>

\(^7\)Ibid.

\(^88\)Ibid.


\(^90\)Miah, M. M. U. 2010, Assessing long-term impacts and vulnerabilities on crop production due to climate change in the coastal areas of Bangladesh (Final Report PR #10/08).

\(^91\)Ibid. Salinity values were originally reported as dS/m which converted to ppt by multiplying the dS/m values with 0.64.
40. Saline river water accumulates more than 150 km inland in the west during dry season and 50 km in the east. This discrepancy is partly due to the Gorai River, which is the main upstream distributary from the Ganges and the main freshwater source in the western part of the region and has suffered a serious decline in dry season freshwater inflows after the building of the Farakka Barrage. Salinity in this region is thus closely related to Gorai River flow (Figure 16A). Therefore, the western part of the southwest regions remains more saline than the eastern part of the region, as the latter receives freshwater flow from the Padma and lower Meghna Rivers, through the Arial Khan, Bishkhali, and Buriswar rivers. The salinity distribution in the south-western region closely follows the seasonality of the region’s hydrology and decreases as monsoon sets in and upstream flows and rainfall increase. Figure 16B shows the clear relationship between monthly precipitation and soil salinity in the districts, with peak salinities at the end of the dry season.

92 Adapted from Soil Resource Development Institute (2010). Saline Soils of Bangladesh. Government of the People’s Republic of Bangladesh
94 IWM, 2014. Ibid.
1.4.1.1 Projected changes in salt water intrusion

41. Dasgupta\textsuperscript{97} predicted river salinity across the coastal areas of Bangladesh for the year 2050 for two different IPCC scenarios (A2 and B1) using the 2012 salinity data as the baseline. The results as shown in Figure 1 indicate that due to sea level rise and other climatic conditions salinity will move further inland. It can be seen that some area of central coastal region (Patuakhali, Pirojpur, Barisal Region) which are currently not saline (below 2 ppt) would become saline. It is also evident that salinity in some of the project areas that are already saline will increase further under both climate scenarios in 2050 (Figure 18). For example: some of the project areas in Khulna and Satkhira Districts where salinity levels were below 15 ppt and 20 ppt respectively will likely go beyond the salinity levels in 2050. Similarly, this is likely for project areas in Barguna.

42. Such movement of the salinity has clear implication for both project beneficiary selection as well as for designing project interventions as some those interventions would have to be designed considering the projected salinity levels. This also demonstrates that under a climate change scenario salinity levels in some of the proposed project areas will rise even more and eventually exerting further stress on the already stressed local ecosystem.

\begin{itemize}
  \item 95 Palash W. 2015, Salinity in the South West Region of Bangladesh and the Impact of Climate Change
  \item 96 Lazar A. N., et al. 2015, Agricultural livelihoods in coastal Bangladesh under climate and environmental change – a model framework. Environ. Sci.: Processes Impacts, 17, 101
\end{itemize}
43. Under a scenario of 30 cm sea level rise (SLR), the surface water salinity pattern will experience significant changes. The present dry season saline front (2 ppt) is projected to move 30 km to 70 km north affecting most of Khulna, Jessore, Barisal, Patuakhali, and Noakhali (greater) Districts99. With a 1m SLR, the saline front is projected to move further north on the north-eastern side of Bangladesh. Figure 18 shows projected soil salinity levels in 2050.

44. Nearly 6 million people are already exposed to high salinity (>5 ppt), but because of climate change the number is expected to increase to 13.6 million in 2050 and 14.8 million in 2080, with the population in Khulna, Satkhira, and Bagerhat most affected. This will not only make household water supply scarcer, it will also affect agricultural production in these areas. A study conducted in Khulna, Bagerhat, and Satkhira projects that with a 32 cm SLR the suitable area for transplanted Aman rice cultivation will reduce from 88 per cent to 60 per cent and further to 12 per cent with an 88 cm rise in sea level100 (see Figure 18 and Figure 19).

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98 Adapted from Dasgupta et al. 2014
Annex II (a) – Feasibility Study
GREEN CLIMATE FUND FUNDING PROPOSAL

Figure 18. Predicted Soil Salinity in 2050

Figure 19: Land use map of the Southwest Coastal Bangladesh 2012


1.4.2 Impacts of increasing salinity on agriculture-based livelihoods

45. Climate change, particularly through increasing salinities, reduces the availability of freshwater (and drinking water) in the coastal zones of Bangladesh, in turn reducing the potential to undertake freshwater-based livelihood activities, particularly those that are agriculturally based. In this way climate change affects both the availability of drinking/freshwater and agricultural livelihoods, through its impact on salinity levels in these regions.

46. The coastal zone in Bangladesh constitutes 32 per cent of the total area and 28 per cent of the total population. The region faces drinking water scarcity, land erosion, high arsenic content in groundwater, waterlogging, soil salinity and various forms of pollution, all of which has slowed down social and economic developments. As such GoB has labelled the coastal zone an “agro-ecologically disadvantaged region”. Salinity intrusion and tidal flooding has prevented expansion of agriculture in the coastal region, which is why in the 1960s-1980s, the World Bank and other development organisations helped boost rice production through large-scale polderization. This however made the southwestern area highly unsuitable for agriculture in the long run, though the high salinity opened the option of shrimp farming. Land used for agriculture has thus gradually decreased between 1980 and 2010. Aquaculture has, in recent years, been framed as both an adaptation and maladaptation to climate change, depending on its impact on salinity levels. Shrimp farming, in particular, has had some significant negative impacts on the livelihoods of coastal residents, particularly on women, affecting their work options and agency (in terms of conditions and ownership of agricultural enterprises). Whilst shrimp farming was one way to deal with the increasing levels of salinity, the activity itself has further increased soil salinity levels.

47. After the initiation of Coastal Embankment Project by World Bank in the 1980’s the dominant use of the land was for agriculture with 68.42 per cent used for paddy cultivation. At this point, traditional shrimp farming was mainly conducted in the lowland areas. In 1995, a radical shift towards shrimp farming was initiated, partly attracted by high prices both nationally and internationally. The shrimp area in 1980 was 2.34 per cent, which changed to 31.51 per cent in 1995. Because of the large revenue, this brought to Bangladesh shrimp areas expanded from 51,812 ha in 1983 to 137,996 ha in 1994 and to 141,353 ha in 2008.

48. This rapid increase in shrimp farming attracted even small farmers and led to widespread deforestation. However, in 2010 a virus outbreak, illegal gel pushing, and other factors led to a tremendous loss in shrimp farming. European countries banned shrimp imports which made the situation in Bangladesh worse and led to the use of HYV rice and vegetables. In 1980 agriculture was the most dominant land use in all southwestern coastal areas, including Satkhira, Khulna and Bagerhat Districts. However, this changed in 1995 when agricultural land shifted to shrimp farming in the southwestern coastal belt and in a period of 15 years’ agricultural land use decreased from 68.42 per cent to 42.53 per cent. This shift in land-use, and thereby livelihoods, was most extreme in Satkhira District (Figure 20) where areas used for shrimp farming increased from almost zero in 1975 to more than 60 per cent in 2005 (whereas, on the contrary, agriculture area dropped from 80 per cent to a little under 20 per cent over that same time period).

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106 Chu, 2006
49. Although coastal livelihoods are dependent on agriculture, land is only suitable for wet season cropping. During the dry season, soil salinity is too high for agriculture. Average net cultivated land is 1.95 million hectares, with the main types of crops produced in the coastal zone including pulses, oilseeds, betel nuts, potatoes and other winter vegetables. Aquaculture is also a prime economic activity in coastal regions, with shrimp exports the second biggest foreign exchange earner and Bangladesh responsible for a significant amount of the global shrimp trade. However, it is becoming evident that land used for shrimp farming can no longer be used for growing crops and vegetables. The pond for cultivating shrimp must be kept saline at all times, which leads to salt being accumulated in the soil. This salt then leaches into groundwater supplies and adjacent land, preventing opportunities for agriculture on surrounding land. This can have devastating effects on farmers.

50. The impacts of climate-induced salinity on agriculture-based livelihoods are significant and pose a tremendous risk to Bangladesh’s agro-based economy. Local communities experience direct damage of crops, decreasing freshwater fish stocks, and income loss, which leads to an increased vulnerability. This, subsequently, triggers and demands adaptive responses in livelihood choices and production patterns. The coastal belt already experiences reduced agriculture production due to a changing climate. A study conducted by Soil Resource Development Institute in 2009 showed that over 1 million hectares of cultivable land in the country are affected by salinity intrusion caused by slow- and rapid-onset events. According to the Bangladesh Bureau of Statistics (BBS), the net cultivated area in Satkhira decreased by about 7 per cent from 1996 to 2008 and production of the

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110 Lovatt, 2016 The Guardian. The Bangladesh shrimp farmers facing life on the edge
111 Hug, Nazmul, Huge, Jean, Boon, Emmanuel, Gain, K, Animesh, ‘Climate Change Impacts in Agricultural Communities in Rural Areas of Coastal Bangladesh: A Tale of Many Stories,’ Sustainability 2015, 7, 8437-8460; doi:10.3390/su7078437
principal rice crop in Satkhira decreased from about 0.3 million tons in 2008 to 0.2 million tons in 2010\textsuperscript{113}.

1.4.2.1 Modelled future changes in crop production

Under a moderate climate change scenario, crop losses due to SLR-induced salinity intrusion have been estimated to be approximately 200,000 metric tonnes\textsuperscript{114}. Other studies support this projection, estimating climate-induced increases in the salinity (+5 ppt) of irrigation water will lead to reduced farm productivity by up to 50 per cent\textsuperscript{115}. Losses for irrigated boro and rain fed aman rice yields in different regions due to projected shifts in climatic parameters by 2050 were also estimated by Thomas et al.\textsuperscript{116} and are presented in Table 6 below. Irrigated boro rice yields are predicted to reduce with low fertilizer regardless of cultivar and planting month, though with potential increases under high fertilizer and optimal cultivar and planting month. Rained aman rice is predicted to increase only under low fertilizer with optimal cultivar and planting month in Barisal and other divisions.

Table 5: Changes in irrigated boro yields from 2000 to 2050, median change\textsuperscript{117}

<table>
<thead>
<tr>
<th>Division</th>
<th>Low fertilizer</th>
<th>High fertilizer</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Keeping cultivar and planting month the same as in 2000</td>
<td>Optimal cultivar and planting month for 2050</td>
</tr>
<tr>
<td>All</td>
<td>-9.2%</td>
<td>-8.9%</td>
</tr>
<tr>
<td>Barisal</td>
<td>-10.7%</td>
<td>-10.2%</td>
</tr>
<tr>
<td>Khulna</td>
<td>-10.5%</td>
<td>-10.1%</td>
</tr>
</tbody>
</table>

Table 6: Changes in rain fed aman yields from 2000 to 2050, median change\textsuperscript{118}

<table>
<thead>
<tr>
<th>Division</th>
<th>Low fertilizer</th>
<th>High fertilizer</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Keeping cultivar and planting month the same as in 2000</td>
<td>Optimal cultivar and planting month for 2050</td>
</tr>
<tr>
<td>All</td>
<td>3.1%</td>
<td>5.8%</td>
</tr>
<tr>
<td>Barisal</td>
<td>-0.4%</td>
<td>1.8%</td>
</tr>
<tr>
<td>Khulna</td>
<td>-3.4%</td>
<td>-1.2%</td>
</tr>
</tbody>
</table>

52. Different varieties of crops will also be affected differently, depending on their sensitivity to salinity levels. According to CDMP (2014)\textsuperscript{119} in Satkhira wheat is expected to decrease from 2500

\textsuperscript{114} Mainuddin et al. 2011, ‘Planning and costing agriculture’s adaptation to climate change in the salinity prone cropping system of Bangladesh,’ Bangladesh Center for Advanced Studies.
\textsuperscript{115} Clarke, D., ‘Projections of on-farm salinity in coastal Bangladesh,’ Royal Society of Chemistry, 2015.
\textsuperscript{116} Thomas, T.S.; 2013, Agriculture and Adaptation in Bangladesh: Current and Projected Impacts of Climate Change. IFPRI Discussion Paper 0128
\textsuperscript{117} Ibid.
\textsuperscript{118} Ibid.
kg/ha to 1300 kg/ha; Boro rice from 5500 kg/ha to 4100 kg/ha, whereas aman rice yield is expected to slightly increase, between 1975 and 2075 (Figure 21). Another study in Khulna, Bagerhat, and Satkhira Districts depicted that with a 32 cm rise in sea level the suitable area for transplanted Aman rice cultivation will reduce from 88 per cent to 60 per cent and with 88 cm rise in sea level will cause a reduction of 12 per cent.120

![Figure 21: Predicted crop yield in Satkhira](image)

53. Significant portions of arable land are also predicted to be impacted by climate change by 2050. Table 7 shows the additional hectares of land that are expected to be impacted tidal surge inundation by 2050, with and without climate change. Based on yields from 2005, this means climate change-induced inundation will cause an additional loss of 422,642 tons of Aman rice, 156,928 tons of Aus rice, and 116,060 tons of Boro rice, which will have impacts on both the country’s economy and food security.122

Table 7: Parameters used for computation of Agricultural Loss

<table>
<thead>
<tr>
<th></th>
<th>Area exposed to storm surge inundation in 2050 without Climate Change (hectares)</th>
<th>Area exposed to storm surge inundation in 2050 with climate change (hectares)</th>
<th>Yield (ton/hectare) in 2005</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aman</td>
<td>1,092,645</td>
<td>1,305,028</td>
<td>1.99</td>
</tr>
<tr>
<td>Aus</td>
<td>526,040</td>
<td>618,897</td>
<td>1.69</td>
</tr>
<tr>
<td>Boro</td>
<td>272,768</td>
<td>388,828</td>
<td>3.44</td>
</tr>
</tbody>
</table>

1.4.3 Impacts of increasing salinity on aquaculture-based livelihoods

54. The Sundarbans, the world’s largest mangrove forest which has a considerable high biodiversity, is particularly under threat because of its coastal location. A study by the World Bank\textsuperscript{123} using different aquatic salinity scenarios in 2050 predicted that salinity increases will negatively affect 14 mangrove species (especially the most valuable Sundari). In turn, this will impact the livelihoods of poor communities who depend on the mangrove forest. It was projected that “the greatest negative impacts will be on the poorest upazilas via loss of standing timber value and honey production, as well as increased risk of human-wildlife conflicts.”\textsuperscript{124}

55. Similarly, salinity intrusion is also expected to have severe impacts on freshwater fish species. A 2008 study in highly saline Paikgacha Sub-District in Khulna and moderately saline Rampal Sub-District in Bagerhat found that freshwater species during 1975-2005 had decreased by 59 per cent and 21 per cent respectively in those regions. The slight increase in salt-tolerant species did not compensate for the loss in diversity that is a serious threat to the local ecosystem and food supply.\textsuperscript{125} Figure 22 shows the rapid decrease in fish production from rivers and estuaries between 1986 and 2006, which has only slightly risen in recent years because government policies aimed to conserve freshwater fish during peak season.

Figure 22: Fish and Shrimp Production in different ecosystems\textsuperscript{126}

56. The discussion around climate change and shrimp farming is an on-going debate. For some, shrimp farming represents an adaptation to climate change (as response to salinity intrusion), even if the activity began prior to climate change becoming a major issue for the country’s development. Increasingly, however, scholars are arguing that shrimp farming was ultimately a “maladaptation” to the increased salinity in the region, particularly for women.\textsuperscript{127}

\textsuperscript{124}Ibid.
\textsuperscript{125}Gain et. Al, 2008 Impact of River Salinity on Fish Diversity in the South-West Coastal Region of Bangladesh. International Journal of Ecology and Environmental Sciences 34 (1): 49-54, 2008 NATIONAL INSTITUTE OF ECOLOGY, NEW DELHI
not necessarily to those living in the region. Similarly, the production of shrimp did not ensure food sovereignty to the region, a concept which refers to the notion that local farmers are best equipped to mitigate risks and ensure survival through reliance on local food production, often through traditional means — as oppose to relying on large-scale, industrial processes meant primarily for global export. In the context of shrimp aquaculture, this has meant that rice production in the region has decreased, a staple item for most Bengali families. Shrimp farming also requires brackish water, which contributed to the salinization of nearby soils, rendering paddy farming in and around shrimp farms no longer possible.

57. Shrimp farming further requires less labour than traditional rice paddy farming, greatly affecting the local labour market and women’s opportunities in the region. Although rice production allowed for year-long employment, local men and women can only find work sporadically on shrimp farms, averaging only 15 days a month at times. Additionally, while there is a relatively high percentage of women working in shrimp aquaculture, making up to 37 per cent of the labour force, overall the shift to shrimp farming has decreased the livelihood options available in the region. This is because the permanent task of guarding and maintaining the shrimp farms is often give to men who are hired from outside the community. Only local residents participate in the annual repair of the dikes, with local women exclusively having the task of removing weeds. This job shortage in the region has led men to migrate to look for work, as well as created a surplus of women in the area that are without livelihood options. This surplus of women has allowed shrimp farms to provide incredibly low wages to the women who do work to cut weeds, earning at times only USD 0.91 a day.128

58. Furthermore, land use change resulted in the decline in production of assets that women exercise significant control over in the region such as cattle, paddy, and poultry. These assets have been replaced by livelihoods and incomes that men tend to dominate like shrimp, prawn, fish and rents from leasing out land. Women only exercise more power in aquaculture on their own farms when the men of the households are away — but must relinquish control once the men return. Women can also no longer engage in homestead farming, particularly in the dry season due to the high soil salinity levels.

59. Increasing climate-induced salinity clearly impacts the availability of fresh and brackish water fish and marine species in the coastal areas of Bangladesh. In one study129, 27 alternate climate change scenarios were used to extrapolate salinity trends in coastal rivers between 2012 and 2050 to project the impact on stocks of 83 different fish species. These species are commonly consumed in Bangladesh’s coastal zones and are an integral part of nutrition of local communities. Increases in salinity are expected to adversely impact the reproductive cycle and capacity, spawning area and feeding, breeding and longitudinal migration of many of the fish species130. The results further indicate that brackish water expanded into fresh water habitat, and 76 upazilas have projected species losses, with most the poor households likely being in the areas that are projected to be worst-affected.

1.4.4 Impact of salinity on freshwater sources for drinking

60. Devastating cyclones hit the coastal areas of Bangladesh almost every year usually accompanied by high speed winds, sometimes reaching 250 km/hr or more and 3-10 m high waves, causing extensive damage to life, property and livestock. Cyclonic storm Aila in 2009 was one of the

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130 Ibid.
worst natural disaster to affect Bangladesh. Torrential rains from Aila resulted in 190 fatalities and at least 7,000 injuries across the Khulna and Satkhira Districts. Approximately 9.3 million people were affected by the cyclone, of which 1 million were rendered homeless. According to local people, the coastal embankment was badly damaged during the cyclone Aila causing intrusion of salt water into the fresh water pond in the Union. The effect of Aila and saltwater intrusion due to sea level rise on surface water sources, e.g., ponds, left a very limited number of fresh water ponds as drinking water source for people living in many villages in these districts.

61. Tube well or groundwater is the main source of drinking water for 73 per cent of the population living in rural areas. On the coast, most of the groundwater used for water supply is pumped from the top 150 m, but much of it is saline. Data from Bangladesh Water Development Board (BWDB), as shown in Figure 23a, indicates that groundwater salinity in the potential project areas is beyond the limit for potable and irrigation use (>2500 uS/cm) and Figure 23b that surface water is beyond this limit in Satkhira and parts of Khulna Districts.

![Figure 23. (a) Groundwater and (b) Surface water (b) salinity in the Southwest Coastal Zone](image)

62. Drinking water sources are severely affected, including adverse effects on agriculture, health, fisheries and the ecosystem. The result of community perception reveals that local people are aware of the safe water scarcity and nearly all of them perceive that salinity is the main reason behind it. Even though socioeconomic factors affect their ability to adapt, communities have their own adaptation technologies to cope with the problem.

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131 Integrated Regional Information Networks, 2009
1.4.4.1 Drinking Water resources and quality

63. The total available water resources in Bangladesh has been estimated to be 1,211 billion cubic metre (bcm) of which 1,189.5 bcm are surface water, and 21.1 bcm are groundwater resources. The per capita availability of water is 8051 m³/yr.\(^{137}\) The key water-use and demands in Bangladesh include the agriculture, industry, environmental, fisheries and in-stream demands. According to the National Water Policy (1999)\(^{138}\) the priorities for water resources allocation in the country are in order of importance are: domestic and municipal uses, non-consumptive uses (e.g. navigation, fisheries and wildlife), sustenance of the river regime, and other consumptive and non-consumptive uses such as irrigation, industry, environment, salinity management, and recreation.

64. The agriculture sector with 90 per cent of all water use remains the largest water user in the country. Of the total irrigated area, 80 per cent is covered using groundwater and the rest using surface water. Rice is the main crop, and other irrigated crops are wheat, vegetables, and potatoes. In total, 36 bcm water is withdrawn, of which, nearly 32 bcm (89 per cent) is used for irrigation and the rest for domestic and industrial purposes. Groundwater is the source of nearly 88 per cent (28 bcm) of the total volume withdrawn for irrigation\(^{139}\).

65. Despite having plenty of natural water resources, drinking water quantity and quality are greatly affected by the precipitation during monsoon. Nearly 80 per cent of the rainfall takes place during the months of June-September (monsoon). The seasonal nature of water supply affects people’s drinking water choices. During the dry season water scarcity and deteriorated water quality compels people to avail themselves of multiple drinking water sources to meet basic personal needs\(^{140}\). During the monsoon, season aquifers are expected to be flushed and recharged bringing fresh subsurface water. However, it has been suggested that recharge is highly variable, owing to the presence of intermittent and thick deposits of clays\(^{141}\). Additionally, secured water supply options are very limited in some coastal areas as there are no rivers in the surrounding areas or freshwater aquifers at reasonable depths are not available\(^{142}\). Thus, a substantial number of coastal people rely on pond water\(^{143}\). Rainwater is preserved in some communities in natural and man-made ponds, and collection of rainwater often is the primary source of drinking water in those communities\(^{144}\).

66. Contamination of freshwater in southwest coastal Bangladesh is common. Shallow aquifers are frequently contaminated with salinity and arsenic. Salinity contamination is partly due to both incremental SLR and the impacts of storm surge by cyclones and tropical storms (as discussed above). Storm surge due to cyclones contaminates already scarce, freshwater sources in coastal areas; GoB reported that Cyclone Sidr in 2006 damaged a total of 11,612 hand tube wells and 7,155 ponds in 12 highly affected districts\(^{145}\). Ponds were damaged by saline water, dead animals, and debris. Figure 24

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139 FAO 2013
140 Ansari, M., Islam, H., Roy, K. 2011. Functionality and social acceptance of safe water, technology pond sand filter (PSF) and rainwater harvesting system (RWHS) in the southwest coastal region of Bangladesh. Saarbrucken: VDM Verlag.
145 Ministry of Food and Disaster Management 2008
shows the district distribution of the number of saline damaged tube wells and ponds during Cyclone Sidr. The economic damage for these was estimated to be approximately BDT 157 million (USD 2.28 million) and loss-totals of BDT 46 million (USD 0.67 million).146

67. Cyclone Sidr in 2007 and Aila in 2009 brought saline water inland and inundated rice fields that people depend on for employment and food. Satkhira had a drinking water shortage after Aila,147 which devastated all the drinking water sources (ponds and tubewells) with saline water. DPHE reported that Khulna and Satkhira were the worst affected in terms of Water and Sanitation facilities where 278 PSFs were damaged. The situation was acute in Gabura and Burigoalini Union of Satkhira District where most of the drinking water sources were damaged. Many people were forced to drink polluted water, whilst others relied on external sources which were mostly provided through relief efforts148.

Figure 24: No of damaged Tube well and ponds in Cyclone Sidr affected 12 coastal districts149.

68. Cyclone Aila caused similar damages (including saltwater contamination) to freshwater resources in 2009. The Cyclone damaged almost 444 deep tube wells, 594 shallow tube wells, 163 PSFs and 3,032 freshwater ponds in Koyra in Khulna District and Shayamnagar in Satkhira District; Two of the worst hit areas. Jahan150 noted that in Cyclone Aila affected areas pond water became salty and polluted. Subsequently, to meet drinking water requirements, people relied on external sources which were mostly provided through relief efforts151.

1.4.4.2 Drinking water security

69. Bangladesh’s annual water demand is expected to increase from current levels, which will further pressurize drinking water sources in the coastal region of the country, which are already struggling to supply safe drinking water. Drinking water security in this region is under further threat

146 Ibid.
148 Ibid.
149 Ibid
151 Ibid.
due to salinity intrusion from both sea level rise and increased height of tidal surges. The link between SLR and freshwater salinity has been clearly demonstrated, with climate change induced SLR increasing salinities and expanding the areas at risk, even without additional storm surge-related increases in salinity\textsuperscript{152}. Further storm surge related increases in inundation (see section 1.3.1) will further increase surface water salinity which will, over the long-term, increase the salinity of soils and agricultural lands, as demonstrated by increases in projected river salinities by 2050 (Figure 25).

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{fig25.png}
\caption{Projected river salinities in 2050 under two different climate change scenarios (A2 and B1).}
\end{figure}

1.4.5 Climate-induced Displacement and Migration

Climate change impacts such as riverbank erosion and floods are the main causes of internal displacement within the main lands in Bangladesh. In coastal Bangladesh, however, one of the primary environmental causes for displacement is the increase in tidal water height, followed by tropical cyclones and storm surges\textsuperscript{153}. When a cyclone sweeps across the coastal area destroying homes and croplands, thousands are killed and displaced within days. At least 650,000 people were displaced because of Sidr in 2007, another 200,000 following Cyclone Bijli in April 2009. A month later in May 2009, Cyclone Aila hit the region and affected nearly 4.82 million people\textsuperscript{154} and displacing

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\textsuperscript{152} Bhuiyan, Dushmanta Dutta. 2012. Assessing impacts of sea level rise on river salinity in the Gorai river network, Bangladesh. Estuarine, Coastal and Shelf Science 96 (2012) 219-227 MIAN


hundreds and thousands of people from the four severely affected upazilas - Koyra, Paikgacha, Dacope, and Batiaghata. In many cases the displacements are temporary. Analysing the data of 14 districts across Bangladesh from a period of 1994-2010 suggests that crop failures have a significant impact on mobility. For example, a large stretch of coastal land that was previously able to sustain three crops has been infested with salinity and can no longer bear more than one crop. In some cases, the lands have become barren, leaving families who live there no choice but to migrate. The reasons behind the decision to migrate are multi-causal. In most cases, there is no one factor that is the leads to displacement, and usually, multiple events occur at one time. For example, heavy rainfall aggravates flooding and river bank erosion, which can take place simultaneously. These events can lead to water logging and destruction of property.

In a study by Centre for Environmental and Geographic Information Services, Bangladesh found that 42 per cent of households declared that they have been displaced because of single disasters while 48 per cent said they were forced to migrate due to multiple disasters. The study observed that of the displaced category nearly 87 per cent of the interviewed households have experienced displacement (temporary, permanent and in-between were collectively 87 per cent) and 13 per cent were never displaced. Permanent displacement from the affected areas was lower than those temporarily displaced. It was reported that displaced people were primarily engaged in agricultural activities or as day labourers. The study also observed that both temporary and permanent displacements were due to push factors. Permanent displacement occurred because of both salinity intrusion causing decreases in agriculture production, and riverbank erosion.

Shrimp cultivation in case of salinity ingress was recognized as one of the reasons for increased unemployment and subsequent displacement. It was noted that those who were temporarily displaced faced such consequences because of Cyclone SIDR and Cyclone Aila in 2009, and this group remained vulnerable due to future disasters. Respondents noted that in the salinity affected areas previously agriculture was the main livelihood. Most farmers who could afford to do so shifted to shrimp cultivation. Gradually shrimp farming took over, leading in some cases to wide-scale unemployment. Many of the agricultural labourers were forced to work in fish farms or moved to peri-urban areas for their livelihood.

Estimates regarding the impact of climate change on migration in Bangladesh vary widely. Whereas some authors argue climate change will induce anywhere from 5 to 40 million migrants, others argue that the impact will be minimal.
others argue that migration is more complicated and not only will there be fewer people moving, but those displaced by environmental hazards are more likely to move short distances, for a short amount of time and will mostly be men with the women required to stay behind and manage their household.

1.4.6 Disproportionate impacts of climate change on women through affected livelihoods, drinking water security and extreme events

75. Whilst climate change affects both agricultural livelihoods and drinking water availability through increases in surface salinity, women are most affected by these changes. In particular the impacts on health, due to the use of saline water for drinking, also affects their ability to undertake household activities and pursue agricultural livelihood options. Bangladesh ranks 111th on a Gender Inequality Index developed by the United Nations Development Programme (measured by the quality of reproductive health, the degree of empowerment, and women’s economic status in the country). Gender inequality in Bangladesh arises from various societal and cultural norms that impact women’s day to day activities as well as their adaptive capacity to climate change.

76. In the southwest coastal region, women’s activities are assigned based on gender roles. Whereas men often leave the house for income generating activities, women take care of the domestic space and tend to do what is known as “reproductive labour” as oppose to “productive labour”. Women oversee ensuring safe drinking water for their families, which can often mean having to travel long distances to access a relatively clean water source. Additionally, women have less decision-making power and are often rendered immobile at the onset of an environmental hazard (while the husband and sons often migrate elsewhere to look for work). For example, while the total number of lives lost in Bangladesh during cyclones has gone down significantly in the last few decades, women still fall victim more than men. During the Bhola Cyclone of 1971, there were an estimated 300,000 victims, with female victims outnumbering male victims 14 to 1. More than thirty years later, by which time the country had considerably reduced the number of deaths during cyclones due to the construction of cyclone shelters and expansion of early warning systems, during Cyclone Sidr in 2007, women were still five times more likely to die than men (Table 8).

77. When disaster strikes many lives are lost simply due to the fact that people do not know what to do. It is only when people perceive the risks and understand how to act in emergencies that lives can be saved and losses avoided. Early Warning baseline surveys suggest that access to early warning information is higher among men (57.3 per cent) than women (42.7 per cent). Most women reported to receiving early warning signals from the following source: CPP (54.8 per cent), Radio (35.7 per cent), TV (4.1 per cent), and from neighbours (4.1 per cent). A gender-sensitive early warning system therefore needs to take these factors into consideration in its design and approach. Currently, warning information is transmitted by men to men in public spaces, but rarely communicated to the rest of the family. As many women are not allowed to leave the house without a male relative, they have often perished waiting for their relatives to return home and take them to a safe place. Moreover, as in many other Asian countries, most Bengali women have never learned to swim, which significantly reduces their survival chances during a flood.

78. In Bangladesh, being a traditional Muslim society, women’s participation in economic activities in general and in agriculture, in particular, has remained low. But recent Labour Force Surveys conducted by the Bangladesh Bureau of Statistics show rapidly increasing participation of

women in economic activities. The progress is attributed to poverty, empowerment of women by NGOs, and migration of male members from agriculture to non-farm occupation. With the absence of male members, women’s role is expanding to include not only unpaid family worker, but also to becoming farm managers. This means the affects of climate change have a direct negative impact on their daily economic activities, as well as on their social empowerment.

79. UNDP has conducted six Focus Group Discussions (FGDs) during project development (see Annex XIIIc The Stakeholder Consultation Report). Information was sought on disasters, climate change induced vulnerabilities, current adaptation strategies, and to identify gaps and needs to further strengthen women’s disaster and climate change resilience capacities. The consultations were carried out with extremely poor women and adolescent girls, and also included non-poor women and girls, male community members and union parishad members. One of the key aspects during these discussions was to understand the current gender relationship at household and community level. Similarly, women and UP representatives were asked in FGD to tell us how climate-resilient livelihood support and drinking water supply will make impact on gender. A compilation of the results of the six FGD findings are summarized in Table 9 and Table 10 below, which clearly demonstrate that gender relationships both at household and community levels are not balanced. Women are heavily engaged in unpaid domestic work and very marginalized in community and productive role.

### Table 8: Women to Male fatalities in selected severe cyclone in Bangladesh

<table>
<thead>
<tr>
<th>Cyclone Year</th>
<th>Women to Men cyclone death ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>1970</td>
<td>14:1 (total death 300,000-500,000)</td>
</tr>
<tr>
<td>1991</td>
<td>9:1 (total death 150,000)</td>
</tr>
<tr>
<td>2007</td>
<td>5:1 (total death 3361)</td>
</tr>
</tbody>
</table>

### Table 9: Gender relations at household-level in coastal areas (Baseline and Expected changes)

<table>
<thead>
<tr>
<th>Dimensions</th>
<th>Male</th>
<th>Female</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Baseline</td>
<td>Expected Changes</td>
</tr>
<tr>
<td>Division of Labor</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Productive</strong></td>
<td>++++</td>
<td>NA</td>
</tr>
<tr>
<td><strong>Reproductive</strong></td>
<td>+</td>
<td>NA</td>
</tr>
<tr>
<td><strong>Community/Social</strong></td>
<td>++++</td>
<td>NA</td>
</tr>
<tr>
<td>Unpaid Domestic Work</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Drinking Water Collection</strong></td>
<td>+</td>
<td>++</td>
</tr>
<tr>
<td><strong>Care of Livestock and Poultry</strong></td>
<td>+</td>
<td>++</td>
</tr>
<tr>
<td><strong>Cooking and Washing</strong></td>
<td>-</td>
<td>NA</td>
</tr>
<tr>
<td><strong>Child Care</strong></td>
<td>+</td>
<td>NA</td>
</tr>
<tr>
<td><strong>Home Repair</strong></td>
<td>++++</td>
<td>NA</td>
</tr>
<tr>
<td><strong>House Keeping</strong></td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td><strong>Collection of Fuel Wood</strong></td>
<td>+</td>
<td>++</td>
</tr>
<tr>
<td><strong>Purchasing Food</strong></td>
<td>++++</td>
<td>NA</td>
</tr>
<tr>
<td>Economic Entitlement</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Land</strong></td>
<td>++++</td>
<td>NA</td>
</tr>
</tbody>
</table>
Annex II (a) – Feasibility Study
GREEN CLIMATE FUND FUNDING PROPOSAL

<table>
<thead>
<tr>
<th>Dimensions</th>
<th>Male</th>
<th>Female</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Livestock</td>
<td>++++</td>
<td>NA</td>
<td>++</td>
</tr>
<tr>
<td>Poultry and Fisheries</td>
<td>++</td>
<td>NA</td>
<td>+++</td>
</tr>
<tr>
<td>Means of Earnings</td>
<td>++++</td>
<td>NA</td>
<td>++</td>
</tr>
<tr>
<td>Time Spent for Unpaid Work</td>
<td>+</td>
<td>NA</td>
<td>+++</td>
</tr>
</tbody>
</table>

**Empowerment**

| Decision making about HH asset         | ++++            | NA     | ++|
| Decision making about education        | ++++            | NA     | +|
| Decision making about marriage         | ++++            | NA     | +|
| Decision making about health            | ++++            | NA     | +|
| Decision making about food             | +++             | NA     | +++|
| Decision making about shopping          | ++++            | NA     | +++|
| Decision making about divorce           | ++++            | NA     | -|
| Decision making about sanitation        | ++++            | NA     | ++|
| Freedom of mobility                     | +++             | NA     | -|
| Freedom to work outside home            | ++++            | NA     | +|
| Decision making about livelihoods      | ++++            | NA     | ++|
| Control over money earned               | ++++            | NA     | ++|

Source: FGDs during Feasibility Study (2015)
Note: ++++ means highest score, where – means no score and + means minimum score.
Blue colour refers direct impact intended by the project interventions. The yellow colour refers to indirect impact anticipated by the project interventions

Table 10: Gender relations at community level in coastal areas

<table>
<thead>
<tr>
<th>Dimensions</th>
<th>Male</th>
<th>Female</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Community Leadership</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elected</td>
<td>++++</td>
<td>NA</td>
<td>+++</td>
</tr>
<tr>
<td>Natural</td>
<td>++++</td>
<td>NA</td>
<td>+</td>
</tr>
<tr>
<td>Community/Social</td>
<td>++++</td>
<td>NA</td>
<td>++</td>
</tr>
</tbody>
</table>

Participation in Community Decision Making

| Drinking Water Collection                | ++++            | NA     | +|
| Selection of Beneficiaries              | ++++            | NA     | +|
| Selection of Community Works            | ++++            | NA     | -|
| Active Role in Social Audits            | ++              | NA     | -|
| Selection of Employment                 | ++++            | NA     | ++|
| Selection of Means of Livelihoods       | ++++            | NA     | ++|
| Community Forestry                      | ++++            | NA     | +|
| Financing Instruments                   | ++++            | NA     | +++|

Political and Social Entitlement

| Can contest in election                 | ++++            | NA     | +++|
| Can become member of a political party  | ++++            | NA     | +|
| Can become leader in standing committee of UP | ++++ | NA     | +|
| Influence the decision of local government | ++++ | NA     | +|

Political and Social Empowerment
1.4.6.1 Vulnerable agricultural livelihoods - impacts on women

80. Climate change disproportionately threatens the livelihoods of women in the southwestern coastal region of Bangladesh, compared to those of men. Outside of the household, women are primarily engaged in two income generating activities: agriculture and shrimp aquaculture, both of which are expected to be negatively impacted by climate change and sea level rise induced salinity intrusion and sudden-onset events such as cyclones. Additionally, both sudden-onset impacts and slow-onset processes of climate change, are expected to render many women immobile and “trapped” in their households taking on extra burdens as the men in the household migrate to look for short-term work. As women are already marginalized within society, often lacking the ability to access resources that would otherwise raise their adaptive capacity, it is of little surprise that climate change will further their burden and inequality.

81. Salinity intrusion will render agriculture more difficult as soil salinity and irrigation water salinity increase. Although salt-tolerant seed varieties will ease the impact of salinity intrusion, it is likely in the long-term that agriculture will be rendered close to impossible in the region unless drastic actions are taken. Furthermore, salt tolerant rice varieties in Shayamnagar, Satkhira worked well until 2009 when Cyclone Aila hit the area and caused a sudden increase in salinity levels, and eventually, the farmers lost their harvest for that year. This is an example of how successful adaptation measures to slow-onset event can be disrupted by sudden-onset events in the coastal areas of Bangladesh. Ultimately such loss and damage of agriculture will destabilize women’s involvement in agriculture. Census data from 1991, 2001 and 2011 indicate that while women’s participation in agriculture increased from 1991 to 2001, it then decreased from 2001 to 2011. It is likely that as saline levels rise and agriculture becomes difficult, women’s livelihoods will be first affected due to their ascribed secondary role in society.

82. Another major reason for this decline in women’s involvement in agriculture is shrimp aquaculture. Since the 1980s, there has been a significant shift in land-use in the southwest coastal belt of Bangladesh. Whereas previously most land was used for rice paddy farming, it has since been

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converted to shrimp aquaculture. This was due to two reasons: an increase in salinity in the region that climate change played a role in, and the economic potential of shrimp exports.

83. However, this shift in land-use had a significant impact; Shrimp farming is unsustainable from an ecosystem and livelihoods perspective and has augmented inequalities in land ownership and social exclusion, with smallholdings declining as large and very large shrimp farmers have acquired more land\textsuperscript{166}. Although shrimp farming offers some seasonal income to poor landless people in the area, via activities such as fry collection, weeding out and de-heading, the negative effects it has on coastal livelihoods are manifested in many ways. Shrimp farming requires less labour than traditional rice paddy farming, which has greatly impacted the economic opportunities available to women. On the one hand, there is a relatively high percentage of women working in shrimp farming, making up 37 per cent of the labour force. Unfortunately, this relative high employment is still less than the total number of women previously engaged in rice paddy farming. Furthermore, a surplus of unemployed women looking for work has meant that the women who do work on the shrimp farms earn significantly low wages, at times only USD 0.91 a day\textsuperscript{167}. Although shrimp farming has been proposed as one adaptation to climate-induced salinity intrusion, the costs to women's livelihoods may outweigh the benefits, particularly as shrimp farms also contribute to further salinization of the region.\textsuperscript{168}

84. Through saline water percolation, shrimp farming affects adjacent agricultural lands and natural vegetation\textsuperscript{169}; its expansion has increased deforestation (e.g. of mangroves) and reduced grazing grounds and the forest resources local communities depended upon; The use of wetlands in the industry has blocked fish migration areas, destroying natural fish feeding and breeding grounds and causing declining fisheries. With reduced grazing grounds, the ownership of cattle and goats has declined and people moved to rearing chickens and ducks\textsuperscript{170}.

85. The shrimp farming expansion has been detrimental also in terms of health and nutrition as fresh groundwater sources become salinized, triggering salinity-related disease and burdening poor communities and women, as they are responsible to get freshwater from the increasingly more distant sources; Additionally, increasing skin-disease conditions has been related to the collection of fries, which requires women to spend multiple hours per day in the water. With increasing salinity levels and livelihood losses, rural people are migrating to the cities in search of job opportunities\textsuperscript{171}. As stated above, the detrimental effects of shrimp farming on traditional livelihoods exacerbate the impacts of climate change on coastal populations. With little alternatives to diversify their income, most poor coastal communities are still dependent on small-scale crop cultivation and fishing and remain frequently unemployed due to tidal flooding and other natural disasters, which results in food insecurity\textsuperscript{172}. Whereas, especially women are being increasingly marginalised from this climate-induced land conversion trend and their participation in agriculture significantly decreased between 2001 and 2011 in the proposed project Upazilas of Khulna and Satkhira.

\textsuperscript{166} Ibid.
\textsuperscript{168} Paprocki, K., & Huq, S. 2017 Shrimp and coastal adaptation: on the politics of climate justice, Climate and Development, 2017
\textsuperscript{171} Ibid.
\textsuperscript{172} Miah, M. M. U. 2010, Assessing long-term impacts and vulnerabilities on crop production due to climate change in the coastal areas of Bangladesh (Final Report PR #10/08).
86. Women’s livelihoods are impacted by sudden-onset events such as cyclones. Empirical evidence suggests that while men migrate in the aftermath of a cyclone, to look for short-term work to support their families, women are often forced to stay behind and look after their households. This adds an extra burden on women who not only have to look after their own gender-ascribed duties, but that of their husband’s and son’s as well. While some women have expressed increased agency in these times, this agency is lost when the males of the households return.

87. Changes in livelihoods need to be contextualized regarding current and past trends of livelihoods in the region. There is already considerable unemployment in coastal Bangladesh, and agriculture is already facing pressure from increased food demands and deteriorating resources. The percentage of men involved in household work is significantly lower than women, as can be expected due to societal gender roles adhered to in the region, whereas the percentage of women working in either the agriculture or non-agriculture sector is generally lower than men.

88. The Munda community, which is one of the ethnic indigenous groups living in the southern part of Khulna and Satkhira Districts, were consulted on identifying vulnerabilities and strategies for livelihood enhancement and climate change resilience. Among listed vulnerabilities were a lack of employment, reduced access to safe drinking water, and denial of access to natural resources. See Annex XIIIc The Stakeholder Consultation Report for further information.

89. Figure 26 gives a more detailed look at the change in the participation of women in agriculture from 2001 to 2011, broken down by district. Although women’s participation in agriculture in 2000 ranged from only 3-6 per cent of all women in the region, by 2011 it had about halved in each of the districts. This may have to do with the fact when the census data was taken in 2011, Cyclone Aila had occurred only two years earlier, not only rendering agriculture difficult but pushing women to take on other domestic burdens.

Figure 26: Participation of women in Agriculture between 2001 and 2011

90. Land use changes due to salinity are of significance for women as their livelihood is impacted due to fewer on-farm and post-harvest employment opportunities. As men migrate to search for

work, income from women’s productive labour become critical for families’ survival. The left-behind women face exploitation and become exposed to unsafe social and workplace conditions.  

1.4.6.2 Water security and quality - impacts on women

91. Women will be affected by the worsening water situation since it is usually the women of the household who oversee ensuring safe drinking water. The Gender Water Alliance recently produced a study of how salinity levels have impacted drinking water security in two villages in Bagerhat District. Their findings reveal salinity-induced water stress in the region and the impact such stress is having on the lives of women. A lack of available drinking water requires residents to go further in search for relatively safe drinking water sources. In general, women tend to be charged with this task (the Gender Water Alliance in their study found 67 per cent of the women in their sample population of 353 were responsible for collecting water for their families, whereas only 33 per cent of the men were for their families). Women included both mothers and daughters. Figure 27 shows a more precise breakdown within different demographic groups in which gender determines responsibility for collecting water for the household.

Figure 27: Percentage of Men and Women responsible for collecting water

92. Figure 28 reveals that there is considerable water poverty in the district, a term which refers to the difference between safe water needed and safe water received. On average, each household in the study requires about 75 L of water a day per, but only receives 28 L with a shortage of 47 L. The study also found seasonal variability in access to safe drinking water; While the rainy season is often the best time for available fresh water. The study found that people without rainwater harvesting tools were unable to collect fresh rainwater.

175 Ibid.
Projected climate change will clearly worsen the situation; As SLR, and tidal surges from cyclones increase, more domestic water ponds will be contaminated by saline water. Women were involved in one additional hour of non-income generating activities after Cyclone Aila, which was taken away from income-generating activities in either agriculture or otherwise. It is likely this extra hour was dedicated to collecting safe drinking water for the household, which is both a strenuous task and dangerous in situations where women must walk long distances without safe roads at risk of unwanted attention. Mallick additionally estimates that an average of 2.5 hours of women’s time in the project areas is used to collect water, which could otherwise be used for livelihoods activities.

Women and adolescent girls are at higher risk due to SLR and associated impacts. During the dry season, as freshwater sources become scarce they must walk further sometime up to ten kilometres on foot every day to collect water for their families. These journeys are not always pleasant and safe as they must endure long distance walking and risk sexual harassment. Also, women and adolescent girls in the area suffer gynaecological problems due to using saline water during menstruation.

WHO (World Health Organisation) recommends that adults and children, including pregnant women, should have no more than 2g/day of sodium (5g/day salt). Yet studies in southwestern coastal Bangladesh have shown that the average intake of sodium by people in this region far exceed that limit, and pregnant women are particularly at risk. A study by Ireson et al. involving a 24-hour urine analysis of a random sample of 343 pregnant women in Dacope (an upzilla located on a polder island in southwestern Bangladesh) found the average level of sodium in their urine was 3.4 g/day, with the highest measurement at 7.7 g/day. Additionally, women who sourced their drinking water from shallow tube wells were found to have the highest levels of sodium in their urine. Using rough estimates of salinity intrusion in water sources, and assuming an average daily consumption of water at about 2 L, the authors also estimated a salt intake of 5-16g/day during the dry season (when

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freshwater glacier melt from upstream is less) and 1.2 g/day during the monsoon season. This is highly problematic given that it far exceeds the 2 g/day recommended by the WHO in its 2012 report. This is particularly dangerous for pregnant women who are at risk of hypertension. There is furthermore a growing amount of scientific literature that suggests a causal link between salt intake, hypertension and other cardiovascular diseases\textsuperscript{181,182}, as well as mortality\textsuperscript{183}, especially among vulnerable groups such as expecting mothers\textsuperscript{184}, young children\textsuperscript{183} and young adults\textsuperscript{185}. Furthermore, a survey in 2008 found that pregnant women living in south-western coastal Bangladesh had much higher rates of pre-eclampsia and gestational hypertension than pregnant women living in non-coastal areas, thought to be because of high levels of sodium intake (see Figure 29)\textsuperscript{186}. This is a grave concern for women in the southwest region, a secondary impact of climate change that will further reduce women’s adaptive capacity.

![Figure 29: Dry season water sodium levels measured in Dacope, Khulna, between 2009-2010 (mg/L) per water source type\textsuperscript{187}](image)

96. An in-depth discussion on the impacts of salinity intrusion for Khulna and Satkhira are in the Drinking Water Assessment Report Annex IIc, section 4.6 and in the Livelihoods Assessment Report Annex IIb, Chapter 2).

1.5 Project rationale: impacts of climate change and focus on adaptive solutions

97. It is clear from the evidence presented above that climatic changes have been and will continue to affect the southwest coast of Bangladesh. These climatic changes affect the physical

\begin{itemize}
  \item \textsuperscript{181} WHO, Guidelines: Sodium Intake for adults and children, 2012; reprint 2014
  \item \textsuperscript{186} Khan et al. 2014 Sep Salinity in drinking water and the risk of (pre)eclampsia and gestational hypertension in coastal Bangladesh: a case-control study.30;9(9):e108715. doi: 10.1371/journal.pone.0108715. eCollection 2014.
  \item \textsuperscript{187} Khan et al. 2014 Sep Salinity in drinking water and the risk of (pre)eclampsia and gestational hypertension in coastal Bangladesh: a case-control study.30;9(9):e108715. doi: 10.1371/journal.pone.0108715. eCollection 2014.
\end{itemize}
environment in this region (often through the salinity of surface and groundwater) and can be summarised as:

- Temperatures have been rising and are predicted to continue to rise. One important consequence of this is the increase in evaporative demand from the soil surface, especially during the dry season when temperatures are greater, which in the absence of water saving measures will increase the amount of freshwater needed for agriculture, as well as increase the extreme salinity levels experienced in water sources and soils;

- Changes in rainfall are more uncertain. The historical record suggests that annual rainfall has increased in the far southwest (Khulna and Satkhria Districts), but changes in the pre- and post-monsoon seasons are less clear. Future scenarios also suggest increases in annual rainfall, more consistently during the monsoon. Changes in rainfall have the potential to affect water salinity, both through local rainfall and through upstream river flows, which are also dependent on upstream abstraction.

- Both historical observations and projected changes in cyclones demonstrate that frequency will stay the same or possibly decrease, but the frequency of intense cyclones will increase. Associated with these intense cyclones are greater storm surge, inundation levels and intrusion of saline water into freshwater surface and groundwater, leading to the availability of less potable water;

- Both historical observations and projected future changes demonstrate that sea level has and will continue to rise. Whilst this will be at rates close to the global average, this rate is expected to exponentially increase. Even at the lower rates mentioned above (which ignore the potential for ice sheet collapse, and rapid rises in sea level), saline intrusion is predicted to increase far above current levels, again leading to more saline contamination of freshwater sources;

98. Changes in the climate system and associated surface salinities pose direct and indirect impacts on the availability of freshwater resources and agricultural livelihoods which depend on these resources. The lack of freshwater additionally impacts human health. Climate change impacts on clean freshwater resources and safe water supply systems are exacerbated by non-climatic factors, including pond water usage being one of the main drinking water sources. Without further treatment/use of alternative freshwater technologies, and due to poor sanitation conditions, climate change will worsen this already precarious position. For example, the seasonal peak of escherichia coli diarrhea in Bangladesh, coincides with the time when food is contaminated due to higher bacterial growth caused by higher temperatures. These health impacts affect the productivity and livelihood activities of all members of households in these areas.

99. Livelihoods have been impacted by cyclones (and associated storm surge and wind damages), as well as associated increases in soil salinity, which without alternative freshwater resources, has decreased the economic viability of freshwater-based agricultural livelihoods. This has prompted a move away from traditional agriculture into other more saline-adapted livelihoods e.g. shrimp farming. However, shrimp farming has often had a detrimental impact on the local environment, further increasing the salinity levels of land used for these activities, and providing limited benefits for poorer households. In areas with high surface water salinities alternative, saline-resistant/resilient livelihood activities are needed. Given projected increases in salinity due to climate change above, this need will intensify in already saline areas and expand out into areas not currently requiring these livelihoods i.e. which currently sustain year-round freshwater livelihoods.

188 Impact of CC on Water Resources and Human Health; Md. Golam Rabbani, Saleemul Huq and Syed Hafizur Rahman
100. The population ultimately drinks water that is below WHO water quality thresholds, thus affecting their health and leading to a loss of income, unless freshwater solutions are provided e.g. reverse osmosis, rainwater harvesting, or pond sand filters. Consumption of sodium through drinking saline water forms a significant part of the total sodium intake in these areas190. The association between excessive sodium intake and increased risk of hypertension is widely known191. The association between drinking water sodium levels and pre-eclampsia (a condition in pregnant women characterised by high blood pressure) has been demonstrated in salinity prone areas in southern Bangladesh192. Furthermore, people residing in coastal areas may have hypertension/high blood-pressure attributable to drinking water salinity193, as well as suffering more from cardiovascular problems and higher mortality, particularly in mothers and the young.

101. Gender inequality in Bangladesh arises from various societal and cultural norms that impact women’s day to day activities as well as their capacity to adapt to climate change. Women have less decision-making power within the household and at the workplace and are expected to manage the household and care for the family. This includes ensuring safe drinking water for their families, which can often mean having to travel long distances to access a relatively clean water source. Nearly seventy per cent of the women working in income generating activities, have poultry and livestock rearing and homestead gardening as main livelihood activities. Women and are therefore disadvantaged by climate change on multiple levels; The responsibility for finding drinking water leaves less time to engage in income generation, and agricultural income generation becomes more difficult due to the lack of freshwater for either home gardens or other labour-related activities.

Figure 30: (a) Poverty, inundation risk, and surface salinity; (b) Future (2050) modelled salinity intrusion and cyclone induced inundation risk

190 Hoque and Butler 2016 Hoque, M. A., et al.; Drinking water vulnerability to climate change and alternatives for adaptation in coastal South and South East Asia
193 Hoque, M. A., et al.; Drinking water vulnerability to climate change and alternatives for adaptation in coastal South and South East Asia
1.6 Targeting – Priority geographic regions to address Climate Change-induced salinity

102. To deal with the increases in salinity due to climate change in southwest Bangladesh, access to freshwater drinking sources and livelihoods that are adapted to saline environments are critical. Furthermore, women are the most vulnerable to these impacts, and it is recommended that any project targets them, especially those coming from poor households. Figure 30(a) shows inundation risk and surface water salinity overlain on poverty levels, whereas Figure 30(b) shows future projected inundation risk and surface salinity by 2050. A greater percentage of poor are to be found in Satkhira, Khulna and Bagerhat Districts, as are higher surface water salinities, highlighting that districts to the west are the most vulnerable and suffer the highest impacts due to salinity (Figure 30(a)). However, Figure 30(b) shows that future increases in salinity intrusion and cyclone induced inundation will occur in districts to the east; Patuakhali, Barguna, and Pirojpur, increasing the impacts on livelihoods and drinking water. Districts to the west, especially Satkhira and Khulna, should, therefore, be targeted first and offer the opportunity to test adaptation options which will eventually, in the future and because of climate change, be needed in districts further east.

103. Additional reasons for initially targeting districts further west, particularly Satkhira and Khulna, include: a greater proportion of women are involved in agricultural activities (and hence less time available to source clean drinking water); And that livelihoods have been shifting in these areas, often to potentially maladaptive shrimp farming which increases salinity levels and provides limited benefits for the extremely poor. Whilst the initial focus should be the districts further west, it is clear that in the absence of alternative adaptive solutions, under climate change a similar situation will develop in districts further to the east (Bagerhat, Patuakhali, Barguna, and Pirojpur).
Policy and Institutional Frameworks related to climate-resilient development

2.1 National Policies and Climate Change

104. To develop successful climate change projects in Bangladesh it is important that they are embedded within the broader development framework. Whilst climate change affects the work of a wide range of Ministries within government, it is important to recognise that the Ministry of Environment and Forests (MoEF) is the lead climate change agency. Furthermore, Bangladesh is extremely vulnerable to climate induced hazards, irrespective of the exacerbation caused by increased greenhouse gases in the atmosphere. Not surprisingly, the country has developed and is continually improving its capabilities to respond to extreme weather events and that development policy necessarily tackles the impacts of climate variability. In recent years therefore, whilst climate change policy is a new element at the national level, it is usually framed within this broader context. The country signed the United Nations Framework Convention on Climate Change (UNFCCC) in June 1992 and ratified it in April 1994. The country ratified the Kyoto Protocol in October 2001. GoB submitted its Initial National Communication (INC) to UNFCCC in October 2002, its second national communication in October 2012 and adopted the Hyogo Framework for Action and committed to its five areas of priority action, guiding principles and practical means for achieving disaster resilience for vulnerable communities in the context of sustainable development.

105. With the support of the scientific community, Bangladesh has long been active in UNFCCC processes. Often policy and institutional changes undertaken by the Government are influenced by transformations in ideas, knowledge, actors and incentives. This has generated an increase in political commitment for climate change, whilst being influenced by international climate change politics and funding, and often driven by the dangers that climate change poses for economic growth - reflected in the 6th Five Year Plan. The government has taken several policy and institutional initiatives to adapt to the impacts of climate change. In particular MoEF has taken the lead on discussing, planning and developing policy and programmes on climate change, including development of the National Adaptation Programme of Action (NAPA), BCCSAP, establishing the Climate Change Unit (CCU) to strengthen coordination and management of the government funded adaptation and mitigation projects under the MoEF, as well as the Climate Trust Fund described below.

106. Bangladesh prepared its National Development Strategy in the form of a Poverty Reduction Strategy (PRS), named the National Strategy for Accelerated Poverty Reduction (NSAPR). The NSAPR-II (Revised), launched in 2009, as well as the Sixth and Seventh Five Year Plans (2011-2015, 2016-2020 respectively), all incorporated climate change as a specific challenge. Over several decades the Government, with the support of development partners, invested in:

- Flood management schemes to raise agricultural productivity of many thousands of kilometres of low-lying rural areas and to protect them from extremely damaging floods;
- Coastal embankment projects, involving over 6,000 km of embankments and polder schemes, designed to raise agricultural productivity in coastal areas by preventing tidal flooding and incursion of saline water;
- Over 2,000 cyclone shelters to provide refuge for communities from storm surges caused by tropical cyclones and 200 shelters from river floods;

Comprehensive Disaster Management (CDM) projects, involving community-based programs and early warning systems for floods and cyclones;
- Irrigation schemes to enable farmers to grow a dry season rice crop in areas subject to heavy monsoon flooding;
- Agricultural research programs to develop saline adapted high yielding varieties of rice and other crops, based on the traditional varieties evolved over centuries by Bangladeshi farmers;
- Coastal ‘greenbelt’ projects, involving mangrove planting along nearly 9,000 km of the shoreline.

2.1.1 The Environment Policy (1992)

107. The Environment Policy 1992 built upon the spirit of the Rio Conference and acknowledged that sustained development of the country is based on the well-being of the environment and ecosystems since they provide services necessary to fulfil the socio-economic needs of communities, which in turn contribute to climate mitigation and adaptation. The impact of environmental degradation on soil fertility, the quantity and quality of available water, air quality, forests, wildlife and fisheries were widely recognized. Whilst women face the greatest adverse impacts due to the degradation of natural resources on which they depend, the policy does not deal with the environmental impact on vulnerable women.

2.1.2 Livestock Development Policy (1992)

108. The livestock development policy emphasises enhancing livestock and poultry (meat and eggs) production to ensure a sustained supply of animal protein for the people. However, some of the objectives are relevant to biodiversity conservation. For instance, its target to produce biogas may contribute to reducing pressure (e.g. fuel wood collection by the rural community) on forest resources. The Policy, in conjunction with the National Agricultural Policy (1999, revised 2010) and National Fisheries Policy, is significant for livelihoods as it uses risk-based land use planning, which is critical for climate-resilient livelihoods in Bangladesh.

2.1.3 National Seed Policies (1993)

109. The national Seed Policy 1993, The Seeds (Amendment) Act 1997, and The Seed Rules 1998 are mostly aimed at achieving self-sufficiency in food production. Thus, the instruments include provisions for liberalizing the import of seed and seed processing machineries, the strengthening of quality control and research systems and maintaining seed security. Unfortunately, these instruments do little to conserve indigenous or local crop diversity, and protect local ecosystems and habitats from invasion of foreign species. However, food security enhancement does reduce community vulnerability, and importantly the Policy promotes stress-tolerant seed varieties, such as saline and drought tolerant seeds such as BINA-10, BRRI-28, 29, 47 (Saline tolerant) and BRRI-56, 57 (drought tolerant) seeds.

2.1.4 National Fisheries Policy (1998)

110. The National Fisheries Policy aims to enhance production of fish from inland marine sources, and to increase foreign currency earnings (Bangladesh is one of the top six aquaculture producing countries in 2016\(^\text{195}\)), whilst maintaining environmental balance and biodiversity conservation (objective 5 of the policy). The policy identifies different threats to fisheries, such as (i) population

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pressure, (iii) construction of infrastructure in the floodplains, (iii) pollution by chemical fertilizers, insecticides and pesticides. It attempts to stem the illegal act of collecting shrimp fry from the river and by doing so, killing national species and affecting biodiversity and fisheries’ livelihoods. It indirectly promotes the production of specific fry for entrepreneurs.

### 2.1.5 National Policy for Safe Water Supply and Sanitation (1998)

111. The policy calls for a transition from traditional service delivery arrangements, recognizing that water has an organic, social and an economic value. The policy states “as water is increasingly considered to be an economic good as well as a social good, water supply services shall be provided based on user demand and cost sharing”. It emphasizes viable service provision where the price of services is reflected in its economic value, with the eventual objective of covering the cost of production and supply. It also suggests that the transition from the current level of subscription to new payment rates should be gradual and there should be a safety net for ultra-poor communities.

### 2.1.6 National Water Policy (1999) and National Cost Sharing Strategy

112. Governance in the water sector has made bold steps through the National Water Policy which provides a comprehensive outlook of how water resources are managed in Bangladesh. The Policy provides short-, medium- and long-term outlooks on these resources. Section 9.4 of the Policy refers to the importance of water in wildlife and fisheries whereas subsections 12 and 13 respectively focus on the importance of water for the environment and wetlands. The water policy aims to provide direction for achievement of objectives that include:

- To address issues related to the harnessing and development of all forms of surface water and ground water and management of these resources in an efficient and equitable manner;
- To ensure the availability of water to all elements of society including the poor and underprivileged, and to take into account the particular needs of women and children;

113. To accelerate the development of sustainable public and private water delivery systems with appropriate legal and financial measures and incentives, including delineation of water rights and water pricing.

114. The Policy acknowledges that changes are required in the pricing system and other economic incentives affecting water demand and supply. To convey the scarcity value of water, the policy recommends a system of cost recovery, pricing, and economic incentives/disincentives, which is necessary to balance the supply and demand of water. It highlights the importance of public service agencies to be converted into financially autonomous entities, with effective authority to charge and collect fees against services.

### 2.1.7 National Water Management Plan (NWMP)

115. The National Water Management Plan provides a framework to plan and implement activities and projects in a coordinated manner, consistent with overall national and sectoral objectives. The

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196 Policy Support Unit (PSU) 2005; Revised 2011 http://www.psu-wss.org
198 Ibid.
goal of the Plan is for safe and sustainable water supply, sanitation and hygiene services for all, leading to better health and well-being. Starting in 2014 it will be reviewed annually and updated/revised after five years. The Strategy is based on guiding principles that include ensuring drinking water security through integrated water resource management and recognizing the importance of gender in all WASH activities\(^\text{201}\).

### 2.1.8 National Land Use Policy (2001)

116. The National Land Use Policy has little direct focus on climate change. However, components to reduce illegal land use conversion ensure that land use activities are attuned with environmental conservation, which indirectly links to climate change adaptation and mitigation. The policy advocated tree plantation in riverine and coastal islands to increase forest cover in the country, which may contribute in protecting people and resources in those areas from climate change induced hazards, particularly cyclone-induced winds and rising storm surge.

### 2.1.9 Pro-Poor Strategy for Water Supply and Sanitation in Bangladesh (2005)

117. The strategy was developed in recognition of two major needs. The first need is for ‘direct attack on poverty’ as the benefits of growth are not distributed equitably, and the second need is for providing a ‘safety-net’ for the ultra-poor in conjunction with reducing subsidies over time, which is also recommended by the National Policy for Safe Water Supply and Sanitation 1998. The strategy emphasizes the existing policy of the government that the community, irrespective of whether the beneficiary household is poor, ultra-poor or non-poor, is required to contribute 10 per cent of the capital cost of water supply projects as the ‘beneficiary’s share’. It also provides guidance that the capital cost contribution of the ‘Target Group’ (of ultra-poor households, residing in clusters below the BMSLS\(^\text{202}\)) would be 50 per cent of that earmarked for the non-ultra-poor\(^\text{203}\).

### 2.1.10 Coastal Zone Policy 2005

118. The Coastal Zone Policy recognizes the importance of ecosystems and biodiversity conservation, and that the coast contains several ecosystems that have important conservation value. A large portion of these resources include fisheries in the estuaries and in the Bay of Bengal, which provide livelihoods for millions of vulnerable coastal inhabitants. The policy supports coastal people to pursue their livelihoods in a sustainable manner without impairing the integrity of the natural environment. Amongst several objectives it identifies the following: the creation of sustainable livelihoods; intensifying the coverage of safe drinking water facilities; reducing vulnerabilities (including to Climate Change) and closing the gender gap\(^\text{204}\). The Coastal Development Strategy is based on the Coastal Zone Policy 2005. Its prime goal to reduce poverty through development of sustainable livelihoods and the integration of the Coastal Zone into national processes\(^\text{205}\).

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\(^{202}\) PRO POOR STRATEGY for Water and Sanitation Sector in Bangladesh 2005. As per the Pro-poor strategy Basic Minimum Service Levels (BMSL) are defined for Drinking water – for the purpose of drinking, cooking and personal hygiene, the basic minimum service level is defined as 20 litres per capita per day, the safe drinking water source should be within 50 meters of household premise, and the drinking water must meet the national water quality standards.

\(^{203}\) Policy Support Unit (PSU) 2005; Revised 2011 http://www.psu-wss.org


2.1.11 Agriculture Policy 1999 (Revised Draft 2010)

119. The existing National Agricultural Policy was adopted in April 1999, and later re-drafted (Agriculture Policy 2010). It aims to enhance crop productivity, profitability and employment in rural areas and to improve the well-being of the poor. The new agriculture policy outlines strategies so that agricultural lands are protected, the decline of biodiversity is arrested, and natural disasters including droughts and floods affecting agriculture resources can be addressed. Thus, appropriate implementation of the agricultural policy is important for food and livelihoods security.

2.1.12 Gender and the Women’s Development Policy (2011)

120. The objective of this policy is to take special measures to enhance the overall safety and security of women and children, helping them deal with disasters; Rehabilitation of those affected; Special consideration for disabled women; Ensuring food distribution and extending support and assistance to eliminate bottlenecks created due to extreme climate events and disasters. Incorporating gender and gender-sensitive policy and planning is an important aspect to understanding climate change impacts and the way effective, sustainable responses are developed at local, national and international levels, as articulated in The UN Conference of the Parties (CoP)-18 in Doha (2012).

2.1.13 Private Sector

121. Bangladesh’s Policy and Strategy for Public Private Partnership (PPP) 2010 and the Guidelines for Formulation, Appraisal and Approval of Large Projects, Medium Projects and Small Projects, 2010; All gazetted in 2010, they established the PPP Policy Framework. The documents are updated and supplemented regularly by specific PPP guidelines. The PPP Policy 2010 introduced a comprehensive range of reforms, including tax incentives for PPP projects to develop a sustainable PPP program across multiple sectors. These reforms were reinforced by government commitment through the allocation of more than USD 300 million for PPPs in the 2009/10 Budget to support the development, financing and funding of PPPs. The Ministry of Finance instituted a Viability Gap Fund for financing up to thirty per cent of capital costs of PPP projects. The PPP Office under the Prime Minster’s Office, which became fully operational in 2012, supports line ministries to identify, develop, tender and finance PPP projects and provides a centralized portal for high quality PPP projects to investors and lenders. The PPP Office is now supporting the development and implementation of more than forty PPP projects with a capital value of around USD 13 billion. Another PPP unit based in the Ministry of Finance assesses the financial viability of projects and determines the level of government support. Through the PPP program the government intends to pursue opportunities that aid the private sector in generating a profitable revenue stream that delivers social and economic public infrastructure services to citizens and also enables the government to meet its development goals. 206

122. Established in 1981, IPDC Finance Limited (previously known as "Industrial Promotion and Development Company of Bangladesh Limited") is a private sector financial institution which provides finance for development activities. It is supported by the International Finance Corporation and the governments of the USA, Switzerland, UK and Bangladesh. IPDC has been a partner in a number of milestone projects that were the first of its kind in Bangladesh. 207 Furthermore, the Bangladesh country strategy for the Asian Development Bank 2017–2019 programme will increase

206 ppo.gov.bd and www.weforum.org
support for infrastructure development, skills development, environment and climate resilience, and private sector development\textsuperscript{208}.

2.1.14 Civil Society

123. CSOs and NGOs (both national and international) in Bangladesh have played an important role in reducing the impact of hazards affected by climate change. Their efforts are often not reflected in national programmes and a substantial portion of donors’ assistance is channelled through NGOs. However, they operate outside the Joint Country Strategy (JCS) framework and being small in scale there is potential overlap and duplication with government development programmes as coordination is weak. This remains a major challenge to improve and sustainably manage climate-change related projects.

124. The GoB generally plays a supplementary role with the limited resources it mobilizes. Most development partners of the government either build resilience through well-developed preparedness plans, or provide help during a continuing disaster, or take part in post-disaster relief and rehabilitation. Support has been provided for building: over a thousand coastal cyclone shelters; Over 7,000 kilometres of embankments; Protecting more than a dozen hazard-prone cities including Dhaka; Building water structures such as sluice gates and regulators; Culverts for water passage and rubber dams for helping micro-scale irrigation\textsuperscript{209}. Such joint efforts have gradually reduced the national vulnerability to natural hazards.

125. In flood management, one-fifth of all support provided to stakeholders is contributed by the development partners, with the direct involvement of humanitarian NGOs. The entire Cyclone Sidr recovery and rehabilitation activities have been borne by NGOs alongside GoB efforts that enabled the affected population to bounce back within a few years. The globally reputable Cyclone Preparedness Programme (CPP) would not have been implemented had it not been supported by the Bangladesh Red Crescent Society and thousands of volunteers in association with local-level administrations. Local disaster management committees do play a role; However, it is the innovative dissemination of the CPP and the concerned agencies of GoB (for example Bangladesh television and Bangladesh Radio), which alert local people and the shelters which allow people to stay in safety during cyclones. A combination of the GoB, donors and NGOs/CSOs has proven to be key to addressing both CCA and DRR challenges in Bangladesh.

126. Stakeholder consultations with Civil Society Organizations took place in January 2017 with Initiative for Right View (IRV), An Organization for Socio Economic Development, Jagrata Juba Shangha), Rupantar, the Asia Pacific Forum on Women, Law and Development, Bangladesh Centre for Advanced Studies, Center for Participatory Research and Development, Rain Forum, Action Aid, MoWCA and UNDP. The aim of the meeting was to evaluate the revised proposal and gather feedback, particularly on gender. (See Annex XIIIe for further details). Interventions that were suggested include: adaptation and institutional capacity building for LGIs and NGOs along with public institutions; Strengthening existing government and non-government facilities to optimize their use and prevent creation of new institutions that would lead to redundancy; Continuous research and learning opportunities/incentives on climate-resilient new livelihood opportunities and water technologies; And create forums for beneficiary women from local to district levels, to enable them to act as change agents.


2.2 National Plans and Climate Change

127. There are wide and complex constituencies of interest in climate change, including central Ministries, line Ministries, local government, NGOs, the private sector (including households) and development partners. The Planning Commission is entrusted with preparing national plans and programmes according to the directives of the National Economic Council (NEC), with the MoEF CCU established to facilitate the financial and institutional mechanisms for implementation of the Bangladesh Climate Change Trust Fund. The importance of this proposed project for Bangladesh is highlighted by its being prioritized for inclusion in the country’s GCF Country Work Programme, which is currently under development.

2.2.1 Intended Nationally Determined Contributions (INDC)

128. INDC (now National Determined Contributions - NDC), lays out adaptation and mitigation strategies to increase climate resilience. The government has identified interventions to address the most pressing vulnerabilities to the adverse impacts of climate change, including: water security; Salinity intrusion control; And institutional capacity building. Adaptation actions are prioritized according to these identified vulnerabilities and USD 11.5 billion is estimated as being required to do this for the 2015-2030 period. INDC states that monitoring and evaluation of adaptation policies and programmes is also crucial to ensure that resources are efficiently utilized in order to increase resilience overall.

2.2.2 The National Plan for Disaster Management

129. According to the 6th Five Year Plan, over the decades, the Government, with the support of development partners, has invested in Comprehensive disaster management projects, involving community-based programs and early warning systems for floods and cyclones. GoB drafted the National Plan for Disaster Management (NPDM) 2008-2015 to comprehensively address Disaster Risk Reduction (DRR) and climate change adaptation (CCA) in all development plans, programmes and policies. The policy highlights priorities for DRR and adaptation through assessment of climate change risk, community-based programmes for risk reduction, public awareness, improving early warning systems, and strengthening communication facilities and emergency response systems. GoB has made significant progress in shifting its focus from traditional ‘relief and rehabilitation’ to a DRR approach that emphasizes cost effectiveness in approaches to DRR.

130. Although the Government has made considerable progress in establishing an institutional framework for DRR, many of the plans and policies are yet to be implemented. The transfer of knowledge about DRR and CC from science to project implementation within communities tends to be very limited and in general, as does the coordination among donors and NGOs. Although a detailed system for disaster management is in place (through CDMP) with Disaster Management Committees at different levels, they are inadequately funded to conduct their mandate effectively. There appears to be no broad-based ownership of community plans, resulting in different stakeholders implementing them in different ways, without a common national approach.

2.2.3 Bangladesh Climate Change Strategy and Action Plan (BCCSAP)

131. BCCSAP is the key climate change national plan and basis for climate investment in Bangladesh. BCCSAP provides an overall framework (see Table 11) for action, recognizing the need for adaptation and highlighting the GoB willingness to follow a low carbon pathway towards
achieving development.\textsuperscript{210} BCCSAP is a useful strategy/plan and a basic reference for aligning investments with climate change objectives. The programs are categorized under four timelines, from immediate to long-term, focusing on medium and long-term actions through pillars which draw on the areas set out in UNFCCC negotiations under the Bali Roadmap i.e. adaptation, mitigation, technology transfer and financing. Six thematic areas with 44 programs (and 145 actions) have been identified within these thematic areas (see Table 11). Regarding the needs of poor and vulnerable populations, BCCSAP emphasizes the inclusion of women and children in all the activities under the Action Plan.

### Table 11: BCCSAP Themes

| Theme 1: Food Security, Social Protection and Health: | Relates to ensuring food and livelihood security, especially for the poorest and most vulnerable in society, including women and children. It focuses on the needs for food security, safe housing, employment and access to basic services, including health. |
| Theme 2 Comprehensive Disaster Management: | This is to further strengthen the country’s already proven disaster management systems to deal with increasingly frequent and severe natural calamities. |
| Theme 3 Infrastructure: | This theme is to ensure that existing assets (e.g. coastal and river embankments) are well-maintained and fit-for-purpose and that urgently needed infrastructure (e.g. cyclone shelters and urban drainage) is put in place to deal with the likely impacts of climate change. |
| Theme 4 Research and Knowledge Management: | This is to predict the likely scale and timing of climate change impacts on different sectors of the economy and socioeconomic groups; To underpin future investment strategies; And to ensure that Bangladesh is networked into the latest global thinking on science, and best practices of climate change management. |
| Theme 5: Mitigation and Low Carbon Development: | This theme is to evolve low carbon development options and implement these as the country’s economy grows over the coming decades and the demand for energy increases. |
| Theme 6: Capacity Building and Institutional Strengthening: | This theme is to enhance the capacity of government ministries and agencies, civil society and the private sector to meet the challenge of climate change and mainstream them as part of development actions. |

#### 2.2.4 National Adaptation Programme of Action (NAPA) 2005

\textsuperscript{132} The NAPA (2005) identified 15 priority activities, including general awareness raising, capacity building and project implementation in vulnerable regions, with a focus on agriculture and water resources. The NAPA considered only urgent and immediate priorities for adaptation, and was not a plan. The NAPA was further updated in 2009 and identified 45 adaptation measures with 18 immediate and medium-term adaptation measures. However, an evaluation of the NAPA process in Bangladesh found that its technical legacy is only recognized within the high-level planning arena, and has led to few practical interventions\textsuperscript{211}, though it incorporates gender in a reasonably comprehensive manner.


2.2.5  **Sector Development Plan (2011-25) for the water supply and sanitation sector**

133. The Sector Development Plan is considered as the main strategic and planning document for the water supply and sanitation sector to achieve its national goal and targets. The plan is built on a set of principles related to cost recovery, which include: (a) operation and maintenance of the water supply and sanitation systems based on sound technical and financial management practices, (b) adoption of cost recovery measures for WSS services in a manner that will ensure recovery of at least the operation and maintenance costs in the shortest possible time and then gradually recover capital costs and also generate funds for rehabilitation of degraded systems and expansion of facilities to meet future demands, (c) ensuring fairness and social justice among the customers and service providers while establishing service standards and tariff, and (d) providing safety nets for the poor and address the needs of women, children and people with disability.\(^{212}\)

2.2.6  **Climate Change and Gender Action Plan (ccGAP)**

134. The underlying principle of the ccGAPs is the transformative nature of gender interventions. ccGAP also has the potential to enhance the effectiveness and efficiency of climate change and socioeconomic development responses. The development of ccGAP followed a participatory process that included in-country meetings, stakeholder consultations involving representatives from several ministries/government departments, civil society, academia, research institutions, local NGOs and international organizations, a desk review of several key reports, publications, websites, surveys and in-person interviews.

135. The ccGAP integrates gender considerations into four of the six main pillars as identified in the BCCSAP: (i) Food security, social protection and health; (ii) Comprehensive disaster management; (iii) Infrastructure; And (iv) mitigation and low carbon development. The remaining two pillars of the BCCSAP, those of research and knowledge management and capacity building and institutional strengthening, were mainstreamed within the above four pillars as crosscutting topics.

136. Under the food security, social protection and health pillar, emphasis has been given to integrate gender and climate change concerns into policies and national documents concerning the agricultural sector, create an environment to lease land/water bodies to women, ensure crop insurance and/or other safety nets for poor female farmers, access to financial instruments and involvement of women applying alternative technologies e.g. bio-fertilizer and climate-resilient cropping practices.

137. Under the CDM pillar, some actions worth highlighting are the development of a gender responsive disaster management policy, increased participation of women in central and local disaster management councils (UDMC/UzDMC), allocating financial resources to address gender and DRR issues, participation of women in community risk assessments, vulnerability and capacity assessment activities, as well as activities to help women and men provide first aid and primary health care as first responders in an emergency.

138. In the context of Millennium Development Goals (MDGs), the Convention on the Elimination of All Forms of Discrimination Against Women (CEDAW) (1979), and the Beijing Platform of Action (1995), Bangladesh has developed several policies and sectoral strategies to ensure gender equality, which include:

- The Women’s Development Policy (WDP), 2011 within the framework of CEDAW;
- The National Action Plan (NAP) to implement the WDP;

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2.2.7 Climate Action Plan

139. The Bangladesh Climate Action Plan addresses both adaptation and mitigation for the current decade (until 2018). It was developed in 2009 and recognizes the need to address climate induced hazards and their associated impacts on different sectors. This Climate Action Plan is embodied in the BCCSAP and identified a set of activities/measures under six major themes:

i). Food security, social protection and health;
ii). Comprehensive Disaster Management;
iii). Infrastructure;
iv). Research and knowledge management;
v). Mitigation and low carbon development and;
vi). Capacity building and institutional strengthening.

2.3 Institutional arrangements

140. The National Environment Committee (NEC), headed by the prime minister, and a National Steering Committee on climate change, chaired by the Minister of MoEF, is tasked with harmonising the progress of all climate related activities in Bangladesh. The NEC has been set up to ensure effective top-level management of the environment and to integrate development and environment at the national level.

2.3.1 Institutions at National Level

141. GoB recognizes insufficient coordination as one of the major limitations of the current institutional set up to address climate change issues. To address the inter-agency coordination gap, focal points have been designated in each ministry and a few specialized and relevant agencies. The MOEF has trained focal points so that climate change is better addressed within national level activities. Several institutions have been established by the GoB to address climate change in view of BCCSAP. The Climate Change Trust is the latest institution to be set up within the ministry of Environment and Forest (MoEF) to assist the ministry regarding implementation of various activities under the BCCSAP and to provide secretariat support services for the Bangladesh Climate Change Trust Fund (BCCTF). Institutional arrangements are detailed below.

2.3.1.1 The Ministry of Environment and Forest (MoEF)

142. As the focal point of all climate change related activities on behalf of the GoB, MoEF is the key institution on climate change. MoEF was the custodian of two major funds for which a MoEF representative is chair of the awarding committees.

143. The Bangladesh Climate Change Trust Fund (BCCTF) was set up by the GoB and is managed and coordinated by MoEF. Government dedicated funding is provided to projects under the main pillars of the BCCSAP. A Trustee Board involving several ministers has been set up, supported by a technical evaluation committee, to examine the relevance of project requests and decide which eligible projects are to be implemented.

144. The Bangladesh Climate Change Resilience Fund (BCCRF) is a multi-donor grant fund, set up jointly by the GoB and its bilateral development partners. The objective of the Fund is to provide donor-funded support to the implementation of BCCSAP. The World Bank was invited by the GoB to administer the BCCRF, scrutinize projects, provide administrative support towards forwarding the fund and monitor and evaluate progress of awarded projects.

145. Since the development of the BCCSAP, the government strategy is to integrate climate change challenges and opportunities into the overall development plan and programs involving all sectors and processes for economic and social development. This process has been supported by the Poverty, Environment and Climate and Mainstreaming (PECM) Project of the General Economics Division of Planning Commission supported by UNDP. Climate change is furthermore incorporated into the critical planning documents: The Development Project Proforma, the Annual Development Plan (ADP), the sixth and seventh Five Year Plan, and the Perspective Plan 2010-2021.

2.3.1.2 The Ministry of Women and Children Affairs (MOWCA)

146. Many of the projects implemented by GoB agencies do not have specific activities to address gender sensitivity. The mission of the Ministry of Women and Children Affairs (MOWCA) is to establish the rights of women and children and to empower women by involving women in all mainstream development activities. One of its major functions is to promote the welfare of women and children through creating employment opportunities for women. MOWCA prioritises social protection and justice for vulnerable women and children, specifically the VGD Programme which is one of the largest programmes for women under the social safety net programme. The VGD has a long-term objective to improve socio-economic conditions of poverty prone and distressed rural women.

147. The Department of Women’s Affairs (DWA) implements the National Women Development Policy (2011), the objective of which is to eliminate impediments to development due to climate change and disasters. DWA implemented the Climate-resilient Drinking Water for Women and Girls in Coastal Areas Project to mitigate the impact of climate change in two coastal upazilas (Char Fashion and Borhanuddin), which was funded by the BCCTF to supply pure drinking water. DWA furthermore conducts disaster management training across its programs.

2.3.1.3 Department of Public Health Engineering (DPHE).

148. The Department of Public Health Engineering (DPHE) is the national lead agency for provision of drinking water supply and waste management, with specialized services to ensure water security. Its responsibilities include supporting local and national government institutions with the development of new supplies, as well as the Operations and Maintenance (O&M) of the water facilities. DPHE is committed to partnerships which ensure alternative livelihood opportunities for women affected by climate change in urban settings, and women’s involvement in efficient water management. Largely mobilized through DPHE in partnership with other institutions, recent governments have pushed for an expansion of tube wells to take advantage of good ground water aquifer systems to improve water accessibility in saline affected areas, including the southwestern coastal districts.

2.3.1.4 Bangladesh Planning Commission

149. The responsibility for central planning rests with the Bangladesh Planning Commission (BPC). The Prime Minister is the Chairman and the Minister for Planning is the Vice-Chairman of the Commission. Short, medium and long-term strategies and goals are determined by the commission, as are the formulation of policies to measure the achievement of planned goals and targets. The BPC is an advisor to the government on projects and programmes relating to climate, disaster and

214 The DWA implemented the project through DPHE through a GO to GO implementation arrangement.
216 Centre for Global Change (CGC) 2013 Water Aid, Bangladesh Assessment Of Increasing Water Scarcity In The Coast And Its Socio-Economic Impacts On Poor And Vulnerable People. Commissioned Report. November 2013
217 Ibid.
150. development. It is the key policy co-ordination mechanism in Government and plays a crucial role in enabling policy through the allocation of resources within different sectors.

2.3.1.5 Ministry of Food and Disaster Management

151. Due to Bangladesh’s vulnerability and regular experience of extreme weather event, notably cyclones and flood, disaster risk management is a major focus of Government effort and has been established longer than climate change. The Ministry of Food and Disaster Management (MoFDM) is the lead agency dealing with managing disasters. While over 75 per cent of ADP is spent through public procurement, MoFDM still accounts for more than TK 4,000 crore a year as it represents an important area of governance. Within MoFDM the Disaster Management Bureau (DMB) largely operates during and immediately after disasters, whereas the Directorate of Relief and Rehabilitation (DRR) is responsible for longer term post-disaster recovery work. DRR expenditure clearly shows that relief and rehabilitations programs have progressively increased in scope and frequency over the last 5-10 years.

152. Following the Hyogo Framework for Action 2005-2015, to which Bangladesh was a signatory, Bangladesh developed a regulative framework for disaster management. The framework includes the Disaster Management Act, the National Plan for Disaster Management (NPDM) and the Standing Orders on Disaster. The Disaster Management Act forms the legal basis (i) for the protection of life and property (ii) to manage long-term risks from the effects of natural and human induced hazards, and (iii) to respond to and recover from a disaster. NPDM provides the overall guidelines for the relevant sectors and the disaster management committees at all levels, as well as identifying the key sectoral policy agenda for disaster management. The Standing Orders on Disaster provide a detailed institutional framework for DRR and emergency management, outlining detailed roles and responsibilities of Ministries, divisions, departments, and other organizations involved in DRR and emergency management.

153. With support from UNDP and other donor agencies Bangladesh has developed the Comprehensive Disaster Management Programme (CDMP). The aim of the programme is to put greater emphasis on disaster preparedness and risk reduction. The three main areas of focus are: Capacity building for MoEF and DoE to coordinate and mainstream climate change into their existing activities; Strengthening existing knowledge and information accessibility on CC impact prediction and adaptation; And awareness raising, advocacy and coordination to promote CCA into development activities. The Local Disaster Risk Reduction Facility (LDDRF), a component of the CDMP, has the task of keeping the Climate Change Cell of the DoE informed and updated, and aims to improve coordination on disaster management aspects at the local-level.

154. Disasters risks and climate change risks are closely related and a Natural Disaster Risk Reduction Fund was established in 2004 from the government revenue budget, with an average annual allocation of TDK 89 crore for DRR and CCA. Additionally, the Cyclone Preparedness Programme (CPP) and Bangladesh Red Crescent Society have been engaged in large-scale public awareness and capacity development activities for pre-disaster preparedness at household and community levels. The programme is jointly managed by MoFDM and Red Crescent Society and many international and national NGOs now include community risk assessments and awareness activities as part of their projects. The success of the CPP is largely attributed to the robustness of the early warning system, the issuance of warnings through a unified signalling system, and the dissemination of information from door to door by approximately 62,000 volunteers of the Bangladesh Red Crescent Society.

218 Centre for Environmental and Geographic Information Services (CEGIS). (2010). Feasibility study of integrated development of Urir Char, Dhaka: Char Development and Settlement Project (CDSP) and Bangladesh Water Development Board (BWDB).
2.3.1.6 Ministry of Finance

155. In September 2014, GoB nominated Economic Relations Division (ERD) of Ministry of Finance as the National Designated Authority (NDA) of Bangladesh to GCF. ERD, one of the four divisions of the Ministry of Finance in Bangladesh, is responsible for mobilising external resources including climate finance for socio-economic development of the country.

2.3.2 Institutions at Provisional Level

156. The Union Parishad (UP) Act of 2009 is the main legal basis of the Local Government Institutes (LGI) to operate. According to the act, UP is a semi-autonomous self-governed institution, which is governed by 13 elected representatives. UP have the right to impose tax and also can generate revenue for greater public goods. The Local Government Division (LGD) has its offices (at the rank of deputy secretary, Deputy Director of Local Government) at the district level to monitor the functioning of LGIs (union, upazila and municipalities).

157. The Local Government Engineering Department (LGED) is the engineering arm of LGD to support all LGIs in Bangladesh in all engineering-related rural and urban infrastructures development e.g. roads, culverts, markets, and small irrigation infrastructure. However, the Department of Public Health Engineering (DPHE) is the main technical agency of LGD to support all LGIs in fulfilling their responsibilities in relation to drinking water supply and sanitation infrastructure. It also provides funds, if necessary, to LGIs for installing drinking water and sanitation infrastructures. DPHE is not, however, responsible for O&M of those infrastructures, rather this is the responsibility of LGIs and community members.

158. Water regulatory authorities overseeing the implementation of policies and acts include the Ministry of Water Resources, Bangladesh Water Development Board (BWDB), Water Resources Planning Organization (WARPO), River Research Institute, and Joint Rivers Commission. BWDB is responsible for implementing flood control, drainage and irrigation projects to increase productivity in agriculture and fisheries219.

2.3.2.1 Upazila and Union Parishad (UP)

159. Upazila and Union Parishad (UP) is the lowest tier of local government covering an average population of 25,000 people in rural areas220. It ensures improved service delivery on basic needs for the citizens at grassroots level; Representing rural community voices to the central government. The Local Government (UP) Ordinance (Ordinance No. Li Of 1983) provides UPs with the constitution for the Unions in rural areas. They have five functions among which are development and poverty alleviation, ensuring the supply and maintenance of drinking water services to all citizens, and disaster management during crises. In addition, UPs have been assigned the adoption and implementation of poverty alleviation programmes, either directly by themselves or through NGOs and co-operatives. UPs consist of a chairman, nine members, and three women members, elected through direct local votes (Figure 1). The following government officers are official members:

- Sub Assistant Agriculture Officer;
- Health Assistant, Family Planning Assistant, Family Welfare Worker;
- Ansar/VDP;
- Tube well Inspector;
- Sub-Assistant Fisheries Officer;

220 The Local Government (Union Parishad Act) 2009.
• Sub-Assistant Livestock Officer;
• Land Revenue Officer;
• Sub Assistant Engineer (works under LGED in upazila, but each one is responsible for a few unions).

160. Figure 31 below shows that each UP governs their functions through 14 standing committees to deal with, agriculture and other development works, cottage industries and co-operatives, women and children welfare, culture and sports, fisheries, livestock and rural water supply and sanitation.

![Figure 31: Formal arrangement of UP](image)

2.3.2.2 Academic/research institutions

161. Bangladesh has 35 public and 92 private universities providing higher education (bachelor and masters) to the majority of students. Most of the public universities have minimum research capacities, whereas a few private universities conduct research in the climate change disciplines. Overall, 121 government institutes and 1,473 private institutes provide Technical and Vocational Education and Training. In the six coastal districts, only a few public universities conduct research into climate change related sciences: Khulna University; Khulna University of Engineering and Technology; And Patuakhali Science and Technology University.

2.4 Institutional funding

162. Most ministries receive funds to implement programs (both for recurrent and capital investment) through the ADP and non-development budgets, whereas the MoEF has the mandate to implement projects from BCCTF and BCCRF. Therefore, a tension exists between ministries over climate change related issues because of differences in policy, mandates for the budget are accessible by each institution. This situation often calls for clarification of mandates and strengthening the interface between key institutions. Bureaucracy has often hindered progress in this regard, pointing towards the imperative of ensuring transparency and the fair distribution of funds.
2.4.1 Co-ordination of funds

163. There is a desire to improve the flow of funds and to ensure that climate change is reflected properly in implementation. There are mutual interfaces between all three mechanisms, between Finance Division and Planning Commission in the funding of ADP, between the Planning Commission and MoEF in the development of policy and between the Finance Division and MoEF through implementation of MTBF. Currently, the main responsibility to foster adaptation lies with the lead institution, MoEF, which is limited by the context of an overlapping mandate and weak legal framework, specifically referring to their Rules of Business.

2.4.1.1 UP project finances

164. Most project finances are decided by central government agencies but implemented locally, for instance by the UP. In effect, the cumulative resource allocation against projects usually exceeds the grant money received from central government, raising questions about rationalization and integration of such funds with the priorities and plans of the LGIs. It is therefore critical that during any projects design stage, the participation of LGIs in local components of national projects should be ensured. For example, UP manages project funds through two committees: The Financial and Establishment Committee and the Audit and the Accounts Committee. The two committees deal with all matters related to finances.
3  Past and ongoing efforts to improve the resilience of agricultural livelihoods and the supply of drinking water in coastal districts

165. This chapter summarises the most relevant rural development initiatives linked to agricultural livelihoods and drinking water supply in the southern coastal districts, which have been running (and continue to run) during the past two decades. These initiatives support the design of this project by providing important lessons for implementation, evidence of the effectiveness of different approaches to tackle specific problems and barriers (see chapter 4), as well as help in identifying current gaps in coverage and support. Set against the frameworks and structures for policy and governance (see Chapter 2), the government and development partners are seeking to build upon these initiatives where they have proved successful. Some of these initiatives have focused on water supply (ranging from large-scale infrastructure – e.g. polder management - to improving household drinking water), as well as the agriculture sector (including both production and market-related support). Both sectors are important for the rural economy at the national level and in the coastal districts.

3.1  Funding mechanisms and modalities for adaptation to climate change

166. Between 2001-2015, USD 3.4 billion was spent on development projects in the two targeted districts of Khulna and Satkhira and USD 513 million spent addressing salinity, waterlogging, and coastal inundation. The Bangladesh Water Development Board, the Local Government Engineering Departments, the Department of Disaster Management, DPHE, the Department of Agriculture Extension, and the Department of Fisheries spent the majority of these funds. GoB is developing a Delta Plan 2100 and many initiatives with support from donors and multi-lateral partners, related to infrastructure, disaster preparedness and response, water and sanitation, agriculture, and social protection. These include extension of the the Emergency 2007 Cyclone Recovery and Restoration Project which aims to support restoration and recovery from the damage to infrastructure and livelihoods caused by Cyclone Sidr; The Comprehensive Disaster Management Programme has introduced adaptation interventions and early warning community management; The Rural Water Supply and Sanitation Project aims to provide safe drinking water and sanitation for areas near contaminated shallow aquifers; And the Empowerment and Livelihood Improvement project, Ultra-Poor project, and the SHOUHARDO (CARE implemented) project support livelihoods for the poor.

3.1.1  Government of Bangladesh administered climate change funding mechanisms

167. Since the early 2000s, GoB recognized the risks associated with climate change and took a keen interest to address these with whatever means it can, including utilising financial and technical support from international sources, including multi-lateral sources such as the Least Developed Country Fund (LDCF), Special Climate Change Fund (SCCF) and Adaptation Fund (AF). The 2005 National Adaptation Programme of Action (NAPA) highlighted adaptation projects needed on an immediate and urgent basis.223 GoB took several initiatives in FY2009-10:

- GoB set aside a budgetary allocation of BDT 700 crore (USD 100 million Equivalent) to advance climate change activities with its own resources;

223 MOEF-UNDP 2005
GoB revised the 2008 early version of Bangladesh Climate Change Strategy and Action Plan (BCCSAP), published the revised version showing GoB’s full commitment to implement programmes on both adaptation and low carbon development; And

Initiated legal processing of two funds to administer multi-institutional implementation of climate change related activities in Bangladesh: (i) with own funds (thereby creating the Bangladesh Climate Change Trust Fund, BCCTF) and (ii) with bilateral funds (thereby creating the Bangladesh Climate Change Resilience Fund (BCCRF). See Table 12.

By 2010, GoB has taken initial steps towards institutionalizing the implementation of BCCSAP by engaging most national stakeholder institutions. Since then GoB has allocated a dedicated amount of BDT 2,700 crore for adaptation and mitigation, enabling its institutions to carry out projects under BCCSAP. As part of this the Climate Change Gender Action Plan (ccGAP), articulates the country’s commitment to ensuring gender equality in climate change related policies and interventions. An estimated ten per cent of BCCRF has been set aside to provide support to NGOs for implementing small-scale and/or pilot projects, mostly community based projects, the latter being administered by Pali Karma Shohayak Foundation (PKSF). NGOs and CSOs are engaged for a variety of activities, from reducing risks to natural hazards and building resilience, to adapting to climate change. This has helped to develop a comprehensive knowledge-base on climate change vulnerability and adaptation, primarily funded by donors mobilizing the research community and action research. Several initiatives by NGOs/CSOs extended DRR-focussed ideas to build confidence in community-based adaptation (CBA) to expected long-term climatic changes. GoB acknowledges the leadership of NGOs and CBOs in promoting CBA with donor support, including international funding through both LDCF and the Pilot Programme for Climate Resilience (PPCR) (see Table 12).

Table 12: Government mechanisms used to fund climate change related projects

<table>
<thead>
<tr>
<th>Title of Fund/Project</th>
<th>Total Amount of Funding</th>
<th>Duration</th>
<th>Key Focus</th>
</tr>
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<tbody>
<tr>
<td>Bangladesh Climate Change Trust Fund (BCCTF)</td>
<td>USD 400 million (approximately)</td>
<td>2009-present</td>
<td>Construction of embankments and river bank protective work, building cyclone resilient houses, excavation/re-excavation of canals, construction of water control infrastructures including regulators/sluice gates, waste management and drainage infrastructure, introduction and dissemination of stress tolerant crop varieties and seeds, afforestation, installation of solar panels. Targeted: BDT 40.0 in Khulna and BDT 170.7 in Satkhira for housing and rehabilitation of cyclone affected people, BDT 4.0 in Satkhira for rainwater harvesting infrastructure, another BDT 10,000,000 for housing and Pond Sand Filter construction support in Satkhira Upazila.</td>
</tr>
</tbody>
</table>


227 Asia Foundation (2012). Situation Analysis of Climate Change Adaptation Initiatives in Bangladesh. Asia Foundation, Dhaka

228 Ibid


230 Allocation for BCCTF, Ministry of environment and Forest
### Bangladesh Climate Change Trust Fund (BCCRF)

169. Bangladesh Climate Change Trust Fund (BCCRF) was created with an amount of USD 110 million, funded principally by DFID (USD 87 million), and also Denmark (USD 1.6 million), Sweden (USD 11.5 million), the EU (USD 10.4 million) and Switzerland. The purpose of the BCCRF is to support BCCSAP and provide funding for climate change management, primarily adaptation, but also mitigation. Its benefits are also intended to include high-level coordination, thus reducing the risk of overlaps, and to provide donor harmonization, flexible fund management and transparency. It aims to attract additional funding with the potential to be the “one-stop” mechanism.

170. A Governing Council provides overall strategic direction and guidance to BCCRF and ensures its alignment with the Bangladesh Climate Change Strategy and Action Plan (BCCSAP) and a Management Committee is responsible for the work program, ensuring that the BCCRF is implemented in line with the agreed implementation manual. Both the Governing Council and the Management Committee are chaired by the Government and include representatives from line ministries, development partners and civil society.

### Pilot Programme for Climate Resilience (PPCR)

171. An amount of USD 110 million in the form of grants (USD 50 million) and concessionary loans (USD 60 million) from multilateral development banks was approved for Bangladesh in October 2010 for “piloting” adaptation activities in climate vulnerable areas through the Pilot Programme for Climate Resilience (PPCR). A significant amount of these funds is being allocated to top-up major investment projects, which had already been planned, and are also being funded with a loan component. The lead agency is the Asian Development Bank (ADB) with the World Bank and IFC who are taking responsibility for different components. There is considerable ambition for the PPCR, with significant expected outcomes:

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• Increased resilience of coastal infrastructure (housing, connectivity, flood control and improved drainage systems within polders, improved water supply and sanitation) for withstanding effects of climate induced seasonal and natural disasters;
• Reduced water and soil salinity and improvements in agricultural and fisheries production;
• Improved capacity of MoEF to manage and coordinate investments in and knowledge on climate-resilient initiatives.

172. The premise of PPCR is that embankments and strong rural roads lead to a reduction in seawater intrusion inland. The monitored salinity level does not indicate any reduction due to the impact lag period required, as scenario predictions are that sea level will rise and salinity will increase.

173. There were several Climate Investment Funds (CIF) preparatory meetings and a stakeholder consultation workshop. From these discussions, four thematic areas were identified, which overall “support one of the country’s top priorities: protecting people and land in low-lying coastal regions”235. The four thematic areas are:
• Promoting climate-resilient agriculture and food security;
• Coastal embankments improvement and afforestation;
• Coastal climate-resilient water supply, sanitation, infrastructure improvement;
• Technical assistance, climate change capacity building and knowledge management.

3.1.1.3 Strategic Programme for Climate Resilience (SPCR)

174. SPCR is one of the largest climate funds in Bangladesh among three climate funds (BCCTF, BCCRF and PPCR) with USD 681.4 m. It directly lends to GoB and covers twelve of the most climate vulnerable coastal areas. It established mechanisms for private sector involvement in climate-resilient development. Its main structural components include climate smart agriculture technology, coastal protection through climate proofing of coastal embankments and polders, rural infrastructure and greenbelt, water supply & sanitation, and livelihood improvement. Projects under SPCR are shown in Table 13.

Table 13 Key Strategic Programme for Climate Resilience (SPCR) Projects

<table>
<thead>
<tr>
<th>Project</th>
<th>Total Amount of Funding (million)</th>
<th>Duration</th>
<th>Key Focus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coastal Embankment Improvement Project (Phase 1)</td>
<td>USD 400.</td>
<td>2013-2020</td>
<td>The project will increase the area protected by polders from tidal flooding and frequent storm surges, which are expected to worsen due to climate change; Improve agricultural production by reducing saline water intrusion within polders. Funding sources: USD 25 million PPCR grant and USD 375 million IDA and credit with USD 0.2 million grant from GFDRR. Expected Outcomes include reduced impacts of cyclonic storm surges and wind damage through rehabilitating &amp; upgrading the embankments and afforestation measures; Improved agricultural and fisheries production by reducing salinity intrusion.</td>
</tr>
</tbody>
</table>

## Annex II (a) – Feasibility Study
GREEN CLIMATE FUND FUNDING PROPOSAL

<table>
<thead>
<tr>
<th>Project</th>
<th>Total Amount of Funding (million)</th>
<th>Duration</th>
<th>Key Focus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coastal Climate-resilient Infrastructure Project (formerly Climate-resilient Infrastructure Improvement in Coastal Zone Project)</td>
<td>USD 15</td>
<td>2013-2018</td>
<td>The impact of the project will be improved livelihoods in rural coastal districts, including Khulna and Satkhira, which are vulnerable to climate change. Funding sources: USD 30 million PPCR (USD 10 million grant and USD 20 million concessional loan), ADB-USD 20 m, KfW- USD 8.8 m, IFAD USD 60 m and USD 31.2 m from GoB. Outcomes expected: Enhanced climate resilience coastal infrastructure in 12 rural coastal districts benefiting the poor and women, including enhanced climate change adaptation capacity.</td>
</tr>
<tr>
<td>Coastal Towns Environmental Infrastructure Project</td>
<td>USD 117.1</td>
<td>2014-2020</td>
<td>The project will provide climate-resilient water supplies, sanitation, drainage, and other municipal infrastructure to vulnerable coastal towns that have limited access to basic urban services and are also at high risk to CC&amp;V. Funding sources: PPCR is USD 40.4 (USD 30 m concessional loan and USD 10.4 million grant), ADB is USD 52 million, GoB is USD 23.1 million and BMGF is USD 1.6 million. Expected Outcomes include improved climate-resilient municipal infrastructure and disaster preparedness in eight vulnerable coastal Pourashovas; Strengthened institutional capacity, governance &amp; public awareness and key infrastructure investments include water supply. Investment will benefit women and the poor in coastal municipalities (e.g. Amtoli, Golachipa, Pirojpur, Motbaria, Patuakhali, etc.).</td>
</tr>
<tr>
<td>Climate-resilient Agriculture and Food Security</td>
<td>USD 13.1</td>
<td></td>
<td>Funding sources: USD 100,000 project preparation grant, USD 3 million advisory services, USD10 million concessional loan. Expected outcomes include (i) Increase farmer &amp; agribusiness firm revenues through adoption of sustainable climate-smart agriculture technologies &amp; practices; (ii) Demonstrate business model for climate-smart agriculture technologies, products and services that can improve productivity of farmers and offer incentives for private sector to invest in climate-smart agriculture related products and services to ensure sustainable sourcing.</td>
</tr>
<tr>
<td>Feasibility Study on Climate-resilient Housing for Low-Income Communities</td>
<td>USD 0.4</td>
<td></td>
<td>Expected outcomes: (i) Develop a pilot program for building climate-resilient and individually owned houses to supplement traditional cyclone shelters; (ii) Establish a viable business model to induce private sector involvement in the lower income housing market; And (iii) safe, yet affordable shelter that can reduce pressure on existing cyclone shelters. Outcomes include a study and training for selected financial institutions and real estate developers.</td>
</tr>
</tbody>
</table>
### 3.1.1.4 Least Developed Countries Fund (LDCF)

175. GoB has been implementing priority NAPA projects with support from LDCF, UNDP and FAO. The UNDP projects have been highly successful in promoting agricultural adaptation in the coastal zone through community level horticulture, livestock and forestry-related activities. These projects have a strong community focus, which enabled them to work directly with vulnerable men and women in the coastal areas and offshore islands. An Adaptive Social Protection (ASP) approach combines elements of Climate Change Adaptation (CCA), Disaster Risk Reduction (DRR) and Social Protection (SP). The success of this approach was recognised when the project received a UNFCCC Best Practices Award on Adaptation. See Table 14.

#### Table 14: LDCF projects in Bangladesh ongoing

<table>
<thead>
<tr>
<th>LDCF Project title</th>
<th>Total project cost (USD million)</th>
<th>Year</th>
<th>GEF agency</th>
<th>Executing agencies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Integrating community- based adaptation in afforestation and reforestation programme</td>
<td>47.834</td>
<td>2012</td>
<td>UNDP</td>
<td>Ministry of Environment and Forests/ Bangladesh Forest Department</td>
</tr>
<tr>
<td>Community-based climate- resilient fisheries and aquaculture development</td>
<td>21.240</td>
<td>NA</td>
<td>FAO</td>
<td>Department of Fisheries</td>
</tr>
<tr>
<td>Community based adaptation to climate change through coastal afforestation</td>
<td>10.890</td>
<td>2008</td>
<td>UNDP</td>
<td>Department of Forest, Ministry of Environment and Forest (MOEF)</td>
</tr>
</tbody>
</table>

### 3.1.2 Private sector involvement in project implementation

176. Involvement of the private sector in implementing climate change-related projects is at its initial stage in Bangladesh. Bangladesh has not yet formulated a policy in relation to private sector involvement in climate change and has not set any targets for mixing public and private funding or
delivery modalities. The private sector has yet to tap into climate change adaptation programmes in Bangladesh at a large scale, though the government via Infrastructure Development Company Limited supported some large-scale microcredit based solar energy programmes in southern coastal areas. However, energy programmes based on micro-credit schemes are usually not offered to many community members, due to the prevalence of extreme poverty.

177. Under the Climate-resilient Agriculture and Food Security component of the PPCR, a private company (Supreme Seeds) has agreed to provide agricultural inputs. A Trainings of Trainers (ToT) has been implemented and Supreme Seeds has signed agreements to invest in vulnerable polder areas in the south, with the objective to promote climate smart agriculture techniques. The project includes SMEs with supply-chains extending to the south, as well as those offering a product or services to vulnerable populations. Under the project, two insurance products have been developed by Green Delta Insurance.

178. Most people use their limited resources for household spending to sustain their livelihoods in the event of climate related disasters or challenges because they are either not receiving government, NGO or other types of support or, these types of support are insufficient. For example, when Cyclone Aila affected Padmapukur Union of Shamnagar Upazila, people lost most of their resources and relied heavily on loans to survive, exposing them to additional financial-related vulnerabilities. Household spending to address the damage from climate impacts has varying impacts across different economic classes. For the extreme poor and landless households, damages often exceed household income, sometimes by more than 100 per cent.

3.1.3 Gender as a key component of project activities

179. Many development partners integrate gender sensitivity and gender related services in relation to disaster and climate change adaptation responses. UNDP developed a unique set of resources to assist high-risk countries in gender-sensitive disaster risk reduction and recovery planning and programming, including: awareness and advocacy; Capacity development; Gender-aware DRR knowledge products; Gender-sensitive risk assessments; And gender-responsive recovery.

180. UN Women has been working towards a vision for eliminating discrimination against women and girls, as well as the empowerment of women. In 2012, UN Women initiated a project in Bangladesh to reduce women’s vulnerability to climate change. Two key recommendations arising from this project are: (a) To establish ‘gender sensitive policy measures to mitigate women’s vulnerability to the effects of climate change’; And (b) to have ‘enhanced economic opportunities for women living in areas vulnerable to the effects of climate change’. UN Women engaged with UN partners in supporting the GoB with background studies, in preparation for the seventh Five Year Plan. One of the background studies is ‘Devising of Strategy for Adaptation and Mitigation to Climate Change’. UN Women sees this as an opportunity to advocate for a more gender sensitive climate change policy. Furthermore, NGOs have often undertaken initiatives to train gender focal points to

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239. UN Women. 2014, Review of the Environmental and relevant Policies and Strategies of the Government Bangladesh to identify Gaps and Steps for Integration of Gender Issues and Promoting Gender Role in Addressing Climate Change and Reducing their Vulnerability. Dhaka: UN Women
include gender sensitivities in project design and monitoring. However, gender inclusion has often been slow in projects led by GoB institutions.

181. Other successful projects like the Chars Livelihood project (CLP) funded by DFID provided livelihood resilience support to poor women in the river islands in Bangladesh. Its impact study conducted in 2013 concluded that targeting the women of the household has had a positive impact on their status. Women from core beneficiary households explained that attending weekly social development meetings has helped to develop their confidence to move around the community and visit others. At the core of CLP-1 activities was the Asset Transfer Programme (ATP), which involved an initial injection of capital into selected extreme poor households with no land, jobs or assets. According to the CLP evaluation, there is evidence to suggest greater levels of respect for women in the community and improved intra-household relationship. This finding is confirmed through the FGD conducted during the development of this project (see section 1.4.6).

3.2 Development programmes related to southern coastal states, agricultural livelihoods and drinking water supplies

182. The main bilateral donors in Bangladesh include the UK, US, Canada, Denmark, Netherlands, Sweden and France. Canada is focusing aid on economic growth, supporting efforts to strengthen employment-intensive industries and promoting international trade. Objectives include increasing access to employment skills, particularly for youth, and increasing access to skills training, new technology and information, leading to the creation of new jobs and businesses. The newly released Feminist Policy (released June 2017) focusses on addressing inequality and exclusion, through economic and social empowerment of women. UK priorities importantly include building resilience to climate change, amongst others. Most large donor-funded CCA programmes are implemented in collaboration with GoB. As it is difficult for the central government and sectoral agencies to reach rural poor communities, these projects often work with local CSOs and NGOs. Building the capacity of these implementing organizations and people living in vulnerable areas is therefore essential, and community based adaptation is considered one of the most effective ways of reaching them. Table 15 summarises key rural development initiatives in the past two decades, including projects that are currently on-going. A sector by sector description of these projects follows.
### Table 15: Related development programmes

<table>
<thead>
<tr>
<th>Title of Fund/Project</th>
<th>Total (million)</th>
<th>Duration</th>
<th>Key Focus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Livelihoods focused</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Integrated Fisheries Livelihood Project (Preparatory Phase)</td>
<td>USD 125</td>
<td>2011-2012</td>
<td>Project funded by the World Bank to support the agriculture and fishing sector of the economy of Bangladesh. Only funded for preparatory phase.</td>
</tr>
<tr>
<td>Nobo Jatra</td>
<td>USD 64</td>
<td>2016-2020</td>
<td>USAID’s Nobo Jatra (NJ)/New Beginning, is a Food for Peace Program, implemented by World Vision Bangladesh (WVB), World Food Programme (WFP) and Winrock International in partnership with Bangladesh’s MoDMR. In Khulna and Satkhira District. 856,116 Direct Beneficiaries.</td>
</tr>
<tr>
<td>Integrated Agricultural Productivity Project (IAPP)</td>
<td>USD 63.55</td>
<td>2011-2016</td>
<td>The project was funded by World Bank and it is designed to develop new technologies and boost adoption through the farmer field schools approach (FFS). IAPP has selected the districts of Rangpur, Kurigram, Lalmonirhat, and Nilfamari in the north and the districts of Barisal, Patuakhali, Barguna and Jhalokathi in the south as implementation target areas.</td>
</tr>
<tr>
<td>Targets the Ultra Poor (CFPR-TUP) programme - UK-DFID</td>
<td>USD 35</td>
<td>2002-2008</td>
<td>Assist the ultra-poor to improve their livelihoods and bring about positive economic, social and inspirational changes, and assist them to access mainstream development services.</td>
</tr>
<tr>
<td>Creating Opportunities for the Poor and Excluded in Bangladesh (COPE) UK-DFID</td>
<td>USD 25</td>
<td>2013-2017</td>
<td>Targets the most poor and marginalised people in Bangladesh to provide advice, advocacy support and Rights-awareness, including giving assets and economic opportunities.</td>
</tr>
<tr>
<td>Rural Employment Opportunities for Public Assets (REOPA) - EC</td>
<td>EUR 20</td>
<td>2006-2012</td>
<td>Six districts including Khulna and Satkhira. EC contributed 96.6 per cent of the total. Partners were Local Government Institutions in six districts, UNDP, and four local NGOs. REOPA provided two years employment for destitute women and employment for casual labourers during the lean period. In addition, the women undertook various training sessions on social and legal issues, gender equity, human rights, primary health care, nutrition and income generation. Nearly 25,000 women were employed and more than 500,000 work days for casual workers created. 11,000 women received training on human rights, primary health and income generating activities.</td>
</tr>
<tr>
<td>Agricultural Support for</td>
<td>BDT</td>
<td>2013-2018</td>
<td>Project funded by GoB and Islamic Development Bank (IDB). The project is still on-going in the south-western</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Title of Fund/Project</th>
<th>Total (million)</th>
<th>Duration</th>
<th>Key Focus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small Holders in South-Western Region of Bangladesh</td>
<td>13.980</td>
<td></td>
<td>part of Bangladesh.</td>
</tr>
<tr>
<td>Test Relief</td>
<td>BDT 8.98 (2010) and BDT 10.20 (2009)</td>
<td>2000-2010</td>
<td>A small program supporting activities like cleaning ponds and bushes, and making minor repairs to infrastructure. The main objective is to create employment opportunities for rural poor, wage-labourer and unemployed people through implementation of small rehabilitation projects. In national rural areas under the Directorate of Relief and Rehabilitation (DRR)</td>
</tr>
<tr>
<td>Food Security for the Ultra Poor (FSUP) through WFP.</td>
<td></td>
<td>2009-2012</td>
<td>Seeking to prevent a further deterioration in poverty levels amongst participant households, FSUP also aims to provide the ultra poor with the means to begin lifting themselves out of extreme poverty. Sirajganj, Pabna and Bogra Districts</td>
</tr>
<tr>
<td>Second Crop Diversification Project - ADB</td>
<td>USD 0.5</td>
<td>2009-present</td>
<td>Promotes commercialization of agriculture through interventions to promote diversification into high-value crops (HVCs) and value addition, gender mainstreaming, and climate change adaptation.</td>
</tr>
<tr>
<td>Bagda Shrimp Culture Technology Extension (2nd Phase)</td>
<td>2007-2012</td>
<td></td>
<td>GoB funded project aimed to be implemented during 1999-2004 for providing field training, diagnostic labs for shrimp disease and renovation of ADB shrimp hatchery and Kaligonj DFTC</td>
</tr>
<tr>
<td>Sustainable Agriculture and Production Linked to Improved Nutrition Status, Resilience, and Gender Equity (SAPLING)</td>
<td>2015-2020</td>
<td></td>
<td>Project will improve food security and nutrition, empower women, and build resilience in some of the poorest areas in the Bandarban District.</td>
</tr>
<tr>
<td>Water focused</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

245 Participants received TDK 14,000 in one instalment to purchase a productive asset and later received a monthly subsistence allowance of TDK 500, which was provided for 24 months. During the lean seasons, i.e. a period of two months each year, the amount distributed was increased to TDK. 1,000.
<table>
<thead>
<tr>
<th>Title of Fund/Project</th>
<th>Total (million)</th>
<th>Duration</th>
<th>Key Focus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coastal Embankment Improvement Project - Phase I (CEIP-I) - WB</td>
<td>USD 400</td>
<td>2013-2020</td>
<td>Improving agricultural production by reducing saline water intrusion in selected polders. Specifically, the project development objectives are to (a) increase the area protected in selected polders from tidal flooding and frequent storm surges, which are expected to worsen due to climate change; (b) improve agricultural production by reducing saline water intrusion in selected polders; and (c) improve the Government of Bangladesh's capacity to respond promptly and effectively to an eligible crisis or emergency.</td>
</tr>
<tr>
<td>Khulna Water Supply Project</td>
<td>USD 184</td>
<td>2005-2015; 2011-2017</td>
<td>Water and Sanitation Sector development focusing on infrastructure. Contributions are USD 184.0 million from JICA, USD 75.0 million from ADB, and USD 104.6 million from GoB. Project developed a surface water treatment plant with 110,000 m3/day capacity without increasing the groundwater abstraction and undermining its sustainability by adopting a climate-proof design and adapting to a projected increase of river salinity.</td>
</tr>
<tr>
<td>Vulnerable Group Development (VGD)</td>
<td>USD 130</td>
<td>1973 – ongoing (2009-present)</td>
<td>Large-scale programme of resource transfers and development interventions targeted at the poorest women. Implemented with WFP. Targeted poor and vulnerable women. The goal of the programme is to bring sustainable improvement to the lives of ultra-poor households. Starting with assisting war, famine and flood victims in the early 1970s, the VGD programme has evolved over time to focus on helping poor women graduate out of poverty. Currently about 750,000 women participants (about 3.75 million beneficiaries) from ultra-poor households receive a monthly food ration combined with a package of development services. The development package includes life skills and income generating skills training as well as a personal savings programme and access to micro-credit/NGO membership.</td>
</tr>
<tr>
<td>Project for Rural Water Supply in South Western Part of Bangladesh</td>
<td>USD 88.3</td>
<td>2007-2013</td>
<td>The project is financed by the GoB USD 13.3 million and International Development Association USD 75. The objective of the project is to increase sustainable access to safe water supply and improved sanitation in the rural areas of Bangladesh, focused on supporting the Government in mitigating against deteriorating water quality arising from arsenic, pathogens, salinity and others.</td>
</tr>
<tr>
<td>Southwest Area Integrated Water Resources Planning &amp; Management (2nd Phase)</td>
<td>USD 63.7</td>
<td>2015-2022</td>
<td>Financed by Asian Development Bank loan USD 45 million, Grant by Government of Netherlands of USD 7 million and Government of Bangladesh would cover USD 11.7 million. These additional funds will be used under the project to rebuild or construct new gated water retention structures and flood embankments, and for the re-excavation of clogged drainage and irrigation canals. The expansion will be training farmers for water management services in order to help them in operating and maintaining water infrastructure, and developing integrated water management plans.</td>
</tr>
</tbody>
</table>

248 Project Information Document (Pid) Concept Stage.
## Title of Fund/Project | Total (million) | Duration | Key Focus |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Blue Gold Programme</td>
<td>EUR 57.5</td>
<td>2013 – 2019</td>
<td>Districts of Patuakhali, Khulna and Satkhira are targeted. Reducing poverty through participatory water management in polders and Farmer’s Field School</td>
</tr>
<tr>
<td>Proparco - AFD</td>
<td>USD 45</td>
<td>2013 ongoing</td>
<td>Financing of climate change mitigation and local environment (such as water management), agribusiness industry, microfinance and access to finance. Large infrastructure investments and does not target the coastal areas</td>
</tr>
<tr>
<td>Rural Water Supply and Sanitation Project (RWSSP)</td>
<td>USD 43</td>
<td>2012-2017</td>
<td>Increase provision of safe water supply and hygienic sanitation in the rural areas where shallow aquifers are contaminated (e.g. by salinity) and facilitate early emergency response. In coastal zones affected by salinity and other pollutants. WB funded.</td>
</tr>
<tr>
<td>Southwest Area Integrated Water Resources Planning and Management Project - Additional Financing - ADB</td>
<td>USD 32.5</td>
<td>2005-2015</td>
<td>Enhancing the livelihood of the rural population by improving the productivity and sustainability of existing underperforming flood control, drainage, and irrigation schemes. Funded by the Government of Netherlands USD 12.50 million and loan from Asian Development Fund USD 20 million. Selected subregions in the Southwest Areas of Bangladesh (covering the districts of Faridpur, Gopalganj, Jessore, Magura, Narail, and Rajbari).</td>
</tr>
<tr>
<td>“Bangladesh Rural Water Supply and Sanitation Project” (BRWSSP)</td>
<td>GBP 15.5</td>
<td>1989-1994</td>
<td>DPHE is implementing a large World Bank financed Project covering 383 unions of 20 districts including Khulna and Satkhira. Under this project, 65 DHTWs, 520 RWHSs and 14 PSFs were installed in different unions of Khulna and Satkhira Districts.</td>
</tr>
<tr>
<td>Bangladesh Rural Advancement Committee (BRAC) - UK-DFID</td>
<td>GBP 15.5</td>
<td>1989-1994</td>
<td>Improve access to quality basic services namely health, education, water and sanitation and to help the poorest, most marginalised people across the whole of Bangladesh graduate from extreme poverty.</td>
</tr>
</tbody>
</table>

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250 Programme Document, Blue Gold, GoB and Government of Netherlands, 2017
<table>
<thead>
<tr>
<th>Title of Fund/Project</th>
<th>Total (million)</th>
<th>Duration</th>
<th>Key Focus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Participatory Small-Scale Water Resources Sector Project (3rd Phase)</td>
<td>USD 10</td>
<td>2010-2017</td>
<td>Project funded by International Fund for Agricultural Development (IFAD). The Project will develop 230 new subprojects in 46 out of 61 districts of Bangladesh, excluding three districts of Chittagong Hill Tracts and 15 districts in which similar subprojects are being financed by the Japan International Cooperation Agency. 254</td>
</tr>
<tr>
<td>O'Haridjan drinking water project 255</td>
<td>USD 9</td>
<td>Ongoing</td>
<td>O’Horizon, in partnership with LEDARS, are providing the families of southwestern regions with Safe drinking water access in their homes. They are constructing Wood Molds and BioSand Filters plus installation.</td>
</tr>
<tr>
<td>Rural Water Supply, Sanitation and Hygiene in Difficult and Hard-to-Reach Areas of Bangladesh</td>
<td>USD 7</td>
<td>2012-2014</td>
<td>Eight, particularly hard to reach, districts across Bangladesh, including Khulna and Satkhira. UNICEF was implementing the project as the main partner under the project. The project comprised five key areas: Managed Aquifer Recharge (MAR), Arsenic Safe Villages, WASH in Schools, WASH in Health Clinics and WASH in Refugee camps. Planned beneficiaries are 352,000. Project areas are water quality in Water, Sanitation and Hygiene (WASH) in schools, Health Centres and refugee camps.</td>
</tr>
<tr>
<td>Rehabilitation of Aila Affected Rural Infrastructure (RAARIP) (1st Revised)</td>
<td>BDT 151,000</td>
<td>2011-2015</td>
<td>Project funded by the Government of Bangladesh. The project rehabilitated the 12 districts affected by Cyclone Aila. 256</td>
</tr>
</tbody>
</table>

**Disaster Management and Health**

<table>
<thead>
<tr>
<th>Title of Fund/Project</th>
<th>Total (million)</th>
<th>Duration</th>
<th>Key Focus</th>
</tr>
</thead>
<tbody>
<tr>
<td>USAID Food for Peace Programme</td>
<td>USD 210</td>
<td>2010-2015</td>
<td>Improving Nutrition for Extreme Poor in Bangladesh</td>
</tr>
<tr>
<td>Empowerment and Livelihood Improvement &quot;Nuton Jibon&quot; Project - WB</td>
<td>USD 120</td>
<td>2010-2015</td>
<td>Improve the livelihoods, quality of life and resilience to climate variability, natural hazards and other shocks of the rural poor, especially the left-out poor and vulnerable households.</td>
</tr>
<tr>
<td>Emergency 2007 Cyclone Recovery &amp; Restoration Project (ECRRP): Project Coordination &amp; Monitoring Unit (1st Revised)</td>
<td>USD 109</td>
<td>2008-2014</td>
<td>Project funded by World Bank. The project supports a medium to long-term recovery program developed under the Joint Damage, Loss and Needs Assessment (JDLNA). This covers restoration of the agricultural sector in the cyclone affected areas, and reconstruction of public infrastructure, including reconstruction and improvement of multi-purpose shelters and rehabilitation of coastal embankments with build back better designs. 257 Specific projects include: Emergency 2007 Cyclone Recovery and Restoration Project (ECRRP) (Revised) (01/08/2008-31/12/2017): Emergency 2007 Cyclone Recovery and Restoration Project (ECRRP) (Revised)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Title of Fund/Project</th>
<th>Total (million)</th>
<th>Duration</th>
<th>Key Focus</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Comprehensive Disaster Management Programme II (CDMP II)</td>
<td>USD 76.32</td>
<td>2010 - 2014</td>
<td>Introduced sustainable livelihoods, adaptation interventions, natural ecosystem management, social protection, and early warning community management. Under the CDMP there was the Disaster Risk Reduction Plan under the Ministry of Planning.</td>
</tr>
<tr>
<td>Bangladesh Humanitarian Preparedness and Response</td>
<td>USD 25</td>
<td>2011-2017</td>
<td>Aims to save lives, alleviate suffering, maintain dignity and reduce risk amongst people affected by disasters, including caused by climate change. UK-DFID</td>
</tr>
<tr>
<td>Cyclone Preparedness Programme (CPP)</td>
<td>BDT 26,829</td>
<td>1973-ongoing</td>
<td>Objectives: To raise public awareness, motivate and prepare at the community level.</td>
</tr>
<tr>
<td>EU’s DIPECHO, including the Katalyst Approach (Disaster Preparedness ECHO)</td>
<td></td>
<td>2002-2017</td>
<td>The EU’s DIPECHO (Disaster Preparedness ECHO, the ECHO of which is the European Commission’s Humanitarian Aid and Civil Protection Department) exemplifies good practice, bringing different actors working in DRR issues. Six INGOs have been working with DIPECHO in a concerted way on DRR and Humanitarian Assistance under one umbrella named the NARRI Consortium to ensure that different development actors work together for better synergy and effectiveness from local to national level. The Katalyst Approach is an indirect initiative to bring systemic changes through improving and safeguarding women’s access to income and jobs and enhancing their participation in the male domain, e.g. markets of services, inputs, and products. Some of the good practices of involving women in adaptation activities include: dissemination of early warning by young women volunteers and also work in response and recovery; women are exchanging views with family member and neighbours; Women are planting more trees than before; taking necessary steps for prepare houses before the disaster risk; During the Cyclone Aila most of the women took shelter earlier (SDC initiatives).</td>
</tr>
</tbody>
</table>

258 Funding for the year 2013
3.2.1 Agriculture and livelihoods

183. **Creating Opportunities for the Poor and Excluded in Bangladesh (COPE) programme.** The USD 26 million DFID-funded COPE programme targeted the most poor and marginalised people in Bangladesh to provide advice, advocacy support and rights-awareness. The programme provided services, assets and economic opportunities to people who would otherwise be excluded from development and provide them more autonomy in related decision-making. The programme, implemented through NGOs and CSOs, was due to end (July 2013 to March 2017) and had projects in Satkhira and Khulna.

184. Cooperative for Assistance and Relief Everywhere (CARE) implements the **Strengthening Household Ability to Respond to Development Opportunities 3 (SHOUHARDO3)** Project. The goal of SHOUHARDO3 is to improve gender equitable food security, nutrition, and resilience of vulnerable people in Bangladesh. The project has a strong gender focus in programme delivery.

185. USAIDs **Nobo Jatra** project works in 40 Unions including in Kaliganj in Satkhira District and Dacope in Khulna District. The project is designed to reduce food insecurity and vulnerability for 856,116 households in 4 Unions. WV activities are in water and livelihoods, for example Installation of water systems and to promote livelihoods of the poor. By improving knowledge, capacity, and links to food production and income generation and facilitating improvements in household assets and savings, the project aims to address the underlying causes of chronic food insecurity. It establishes Climate Smart Agriculture plots and engage with local producer groups. It activates or reactivates WASH Committees and community support groups and engage in behavioural change communication activities. The projects install 1-2 water options and 23-25 sanitation options per village. Water interventions mainly focus at the community-level whilst sanitation more at the household-level. There are no water interventions around schools or growth centre/health centres.

186. Helen Keller International (HKI) implements the **Sustainable Agriculture and Production Linked to Improved Nutrition Status, Resilience, and Gender Equity (SAPLING)** Project. The project’s multi-sectoral approach focuses on increased homestead production, consumption of diverse and nutritious foods, improved capacity to mitigate and adapt to disasters to increase food and nutrition security among poor and vulnerable households.

187. The interventions of the **Comprehensive Disaster Management Programme I (CDMP)** included developing livelihood diversification opportunities, plot raising, improving water supplies, undertaking drainage and culvert repairs, shelter rehabilitation (cyclone shelters and other communal structures), developing early warning systems and enabling crop diversification. The project extended with a second phase, with one of the pillars for CDMP II to increase resilience. This included strengthening small-scale water supply projects in order to lessen water crises during disasters and their aftermath. Given that the scarcity of pure drinking water can become a major problem for women it promoted adaptation techniques in agriculture and related small businesses. The CDMP considers gender as a focal theme; In CDMP Phase I, a tool was developed for Community Risk Assessments with specific guidelines on considering gender.

188. **Bangladesh Safety Net Systems for the Poorest.** The objective of the Safety Net Systems for the Poorest Project for Bangladesh is to improve the equity, efficiency and transparency of major social safety net programs to benefit the poorest households. The proposed project includes three components: (i) support to five safety net programs by financing a portion of program costs in line with progress against a set of Disbursement Linked Indicators; (ii) Strengthening of Ministry of  

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260 It will implement in the southwest coastal areas across four geographically contiguous Upazilas (sub districts) under two districts; Dacope and Koyra in Khulna; Shyamnagar and Kaliganj in Shatkhira
261 World Vision Bangladesh, 2017, Development Food Aid Program (DFAP) - Nobo Jatra
http://www.wvi.org/bangladesh/development-food-aid-program-dfap-nobo-jatra
Disaster Management and Relief (MoDMR) program administration and transparency; And (iii) development of the Bangladesh Poverty Database.

189. ADB funds the **Second Crop Diversification Project**. The project fosters commercialization of agriculture through interventions to promote diversification into high-value crops (HVCs) and value addition, gender mainstreaming, and climate change adaptation. The project is market oriented and demand driven, and aims to increase farmers’ incomes and enhance food security in Bangladesh. The Project is consistent with the poverty reduction strategies of the Government and ADB, which recognizes that improving farmers’ livelihood through productivity enhancement, crop diversification and commercialization, and agribusiness development is essential to poverty reduction in the rural area of Bangladesh. The USD 0.5 million project that was country-wide, led by Japan Special Fund started implementation in 2009 and is still ongoing. It supports government policy on agriculture sector growth, particularly for the following intervention areas prioritized in the National Food Policy Plan of Action: (i) agricultural marketing and trade (reducing marketing costs of agricultural products and strengthening value chain integration), (ii) agricultural diversification into HVCs and a focus on involving women, (iii) agricultural credit (increasing formal credit to agriculture, especially to marginal, small, and medium farmers), and (iv) market infrastructure development.

190. The **Rural Employment Opportunities for Public Assets (REOPA)** Project (funded by EU; Supported by UNDP) created employment opportunities for destitute women and the landless poor, which contributed to improving public assets which benefit rural communities and also strengthen the capacity of local government institutions for better management of social safety nets and pro-poor initiatives. The project was operational in six districts including Satkhira and Khulna. REOPA provided two years employment e.g. for road maintenance work. In addition, women undertook training sessions on social and legal issues, gender equity, human rights, primary health care, nutrition and income generation.

191. The project resulted in (1) Two years of regular wage employment for 24,444 destitute women who were the breadwinners for their households, resulting in improved socio-economic conditions and household food security, 2) 1.4 million work days created in 388 UPs for 103,000 poor labourers during agricultural lean seasons, 3) Over 40,000 poor rural households benefitted from improved basic service delivery related to livestock, agriculture, livelihoods support, clean drinking water, and health and sanitation, 4) Livelihoods services were enhanced for poor communities by establishing strong relationships with local service delivery offices, 5) 24,500 km of important earthen roads maintained year-round and over 1500 public assets including embankments, irrigation canals, culverts, roads, markets, and school grounds were rehabilitated, benefitting rural communities in 388 UPs as a whole, and 6) Women were appointed to chairperson positions in over 2000 Project Committees in 388 upazilas.

### 3.2.2 Water resources

192. DFID provided support to **Bangladesh Rural Advancement Committee (BRAC)** development programmes to improve access to quality basic services namely health, education, water and sanitation and to help the poorest, most marginalised people across the whole of Bangladesh graduate from extreme poverty. DFID additionally supported inclusive growth and helped build effective formal and informal institutions. DFID reported providing at least 75,000 people with...
sustainable access to clean water and sanitation and lifting 240,000 women and their families (over 960,000 people) out of extreme poverty. The BRAC programme Challenging the Frontiers of Poverty Reduction was initiated in 2002 and targets the Ultra Poor (CFPR-TUP); Ultra-poors who are too poor to access the benefits from traditional development interventions such as microfinance. It aimed to assist the ultra-poor to improve their livelihoods and bring about positive changes in achieving economic, social and inspirational changes, and assist them to access mainstream development services.

193. The Agence Française de Développement (AFD) started in Bangladesh in 2012 and targets its finances at the development of urban infrastructures, such as providing drinking water, and working alongside and in line with the climate change adaptation strategy of the Government. AFD has a subsidiary dedicated to the financing of the private sector, Proparco. Proparco will focus on the financing of climate change mitigation and local environment (such as water management), agribusiness, industry, microfinance and access to finance. The projects, in partnership with ADB, are large infrastructure investments and do not target the coastal areas.

194. The districts of Patuakhali, Khulna and Satkhira are targeted by the Blue Gold Programme, which seeks to reduce poverty through participatory water management in polders and Farmer’s Field Schools. Similarly, the Feed the Future programme also targets the southwestern coastal regions seeking to increase on-farm productivity, leveraging investments in value chains, boosting smallholder incomes, and enhancing agricultural innovation.

195. The objective of the First Phase of the World Bank funded Coastal Embankment Improvement Project (CEIP-I) was to improve agricultural production by reducing saline water intrusion in selected polders; The project had five components aimed at increasing community resilience to tidal flooding and storm surges through large infrastructure investments and implementing social and environmental management frameworks and plans.

196. The World Bank funded the Rural Water Supply and Sanitation Project. The project closed June 2017. The objective of the Rural Water Supply and Sanitation Project was to: (a) Increase provision of safe water supply and hygienic sanitation in the rural areas of Bangladesh where shallow aquifers are highly contaminated by arsenic and other pollutants such as salinity, iron, and bacterial pathogens; And (b) Facilitate early emergency response. In part, these will be achieved through the introduction of rural piped water supply schemes in approximately 125 locations, as well as further developing public-private participation models for the construction and management of rural piped water schemes in areas where shallow tube-wells are highly affected by arsenic contamination, salinity, iron, and a low water table. A second component focusses on rural non-piped water supplies, targeting unions with severe shortages of safe water supplies due to shallow aquifer contamination, and with population densities that preclude private sector interest in the provision of piped water supply.

197. In rural coastal districts, ADB through the Coastal Climate-resilient Infrastructure Project (CCRIP) is improving rural connectivity in a sustainable and “climate-proof” manner with the aim to reduce poverty and increase incomes. The project involves investments in rural roads, bridges, culverts, cyclone shelters and markets, as well as knowledge management and capacity building.

265 AFD. (2015, October). AFD starts operations in Bangladesh. Retrieved May 08, 2017,
efforts. The USD 150 million project is funded by GoB, IFAD, ADB, and the German Kreditanstalt für Wiederaufbau (KfW)\textsuperscript{268}.

198. The ADB funded Khulna Water Supply Project. ADB has formulated its sector strategy to support the GoB’s policy and programs. The Country Partnership Strategy (2006-2010) includes the PPTA in the 2010 pipelines for non-lending products, which subsequently advanced to 2009. The Project aims to develop a sustainable water supply system in Khulna City, which relies entirely on groundwater by introducing surface water as the main water source for sustainable water resource management. The project’s capacity building component aims to strengthen the corporate management system of Khulna Water Supply and Sewerage Authority, which was established in February 2008.

199. **Supporting the Establishment of the Khulna Water Supply and Sewerage Authority.** Citizens in Khulna City have been suffering from severe shortage of safe water. Quality of water is also an issue due to salinity of the ground water. GoB approved establishment of the Khulna Water Supply and Sewerage Authority (KWASA). While the KWASA was established legally, substantial work is required to develop a modern water utility authority with corporate governance, organizational structure, human resource, and financial management systems. The project aimed, among other objectives, to reduce dependency on ground water and surface water and distributed tube wells.

200. ADB funds the **Southwest Area Integrated Water Resources Planning and Management Project** in Chenchuri Beel and Narail Districts. Additional financing will expand the current project to nearby geographical areas in the southwest of the country, aiming at enhancing the livelihood of the rural population by improving the productivity and sustainability of existing underperforming flood control, drainage, and irrigation schemes. It will address constraints on agriculture, fisheries, and livelihood development through holistic and participatory planning, development, and management of water and delivery of support services.

201. **O’Harijan drinking water project** (implemented by LEDARS) has been initiated two projects to enhance adaptive livelihood capacity and income of target beneficiaries. To reduce climate induced migration, the project introduced integrated a water resource management model through excavated mini ponds and canals in paddy land, established deep tube-wells and supported households to preserve daily waste-water for dry season cropping. The project also increases beneficiary-awareness of how to maximize the use of their conserved rainwater; Which variety grow in less water, and which varieties can grow in brackish water, and how to introduce tools and techniques to adaptive agriculture. The project encourages farmers to practice resilient agriculture by adopting new water management model and for that the project provides incentives like seed, fertilizer and other agriculture equipment distribution.

202. The **Rural Water Supply, Sanitation and Hygiene in Difficult and Hard-to-Reach Areas of Bangladesh** Project, was implemented by UNICEF and addressed water quality issues. Its aim was to address the fact that many people do not practice key hygienic behaviours including the practice of effective handwashing with soap at key times, as well drinking arsenic-safe water and using improved latrines. The project was developed in collaboration with UNICEF, WHO and United Nations High Commission for Refugees with financial support from the Dutch government, to increase the access to, utilisation of, and demand for arsenic-safe water, improved latrines and handwashing in schools, health centres and refugees’ camps, for an estimated 352,000 people in Khulna, Sathkira, Narail, Patuakhali, Bandarban, Khagrachari, Rangamati and Cox’s Bazaar Districts.

203. For discussion of Nobo Jatra’s contribution to water resources and sanitation, see discussion in section 3.2.1 above.

3.2.3 Disaster management and health

204. The Bangladesh Humanitarian Preparedness and Response project is a USD 25 million DFID-funded programme, which aims to save lives, alleviate suffering, maintain dignity and reduce risk amongst people affected by disasters, including those caused/affected by climate change. It achieves this through direct humanitarian assistance, as well as a better prepared humanitarian system. The programme is implemented through WFP and others and is due to end (runs from June 2011 to March 2017), having programmed projects in Satkhira and Khulna.

205. The USAID-funded Food for Peace program in Bangladesh aims to reduce chronic and acute malnutrition and food insecurity and improve resilience to disasters among vulnerable populations. In the 2015 financial year, Food for Peace awarded three development food assistance projects, including USD 64 million for Nobo Jatra in Khulna and Satkhira.

206. The objective of the Emergency 2007 Cyclone Recovery and Restoration Project (Additional Financing - AF II) is to support the government’s efforts to facilitate restoration and recovery from the damage to livelihoods and infrastructure caused by Cyclone Sidr and to build long-term preparedness through strengthened disaster risk management. AF is used to scale up the construction and rehabilitation of critical infrastructure in the coastal areas. The AF will help support the costs associated with facilitating recovery from the damage and losses caused by prominent cyclones that hit the country in 2007 and 2009.

3.3 Climate change projects and programmes related to southern coastal states, agricultural livelihoods and drinking water supplies

207. Table 16 summarises the most important Climate Change initiatives in the past decade, including projects that are ongoing as well as those working in the southern and southwestern coastal districts.

208. The EU’s DIPECHO (Disaster Preparedness of the European Commission’s Humanitarian Aid and Civil Protection Department) exemplifies good practice on DRR. Phase 3 project’s goal was to reach 1.43 million farmers and small and medium enterprises through livelihood interventions. Six INGOs (Action Aid International, Concern Universal, Oxfam, Solidarités International, Islamic Relief) have been working with DIPECHO on DRR and Humanitarian Assistance under one umbrella named the National Alliance for Risk Reduction and Response Initiatives (NARRI) to ensure that different development actors work better together and effectiveness from local to national levels is improved. Within this consortium the Katalyst Approach is an indirect initiative to bring systemic changes through improving and safeguarding women’s access to incomes and jobs and enhancing their participation in male domains, e.g. markets for services, inputs, and products. Through the project, seed companies distributed almost two million mini packs of local and hybrid quality seed throughout Bangladesh, thus penetrating the small and homestead farmers market segment.

209. Some good practices and achievements involving women in adaptation activities include: dissemination of early warning by young women volunteers; Working in response and recovery; women exchanging views with family member and neighbours; Women planting more trees than before; Taking necessary steps to prepare houses before disasters e.g. during cyclone Aila most women took shelter earlier (SDC initiatives). The EU furthermore provides funding to enable


Solidarités International (SI) to implement disaster preparedness initiatives in Satkhira. In collaboration with local communities and authorities, the project focuses on the introduction of resilient agricultural techniques, including integrated farming\textsuperscript{271}, to ensure regular crop production throughout the year.

\textsuperscript{271} Type of mixed farming system that combines crop and livestock enterprises in a supplementary and/or complementary manner.
### Table 16: Key climate change initiatives from past decade

<table>
<thead>
<tr>
<th>Project/Programme</th>
<th>Funding</th>
<th>Period of Implementation</th>
<th>Main Interventions and location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Climate Change Adaptation Project</td>
<td>USD 207</td>
<td>2015-2017</td>
<td>Climate Change Adaptation Pilot Project (CCAPP), financed by Danish Government BDT 141 million and GoB BDT 66 million. Implemented in five upazilas of four Coastal Districts of Patuakhali, Barguna, Noakhali and Lakshmipur.(^{272})</td>
</tr>
<tr>
<td>Coastal Climate-resilient Infrastructure Project (in Khulna Region) - ADB</td>
<td>USD 150</td>
<td>2015</td>
<td>Establish sustainable small-scale water resources management systems in Khulna.</td>
</tr>
<tr>
<td>The Strengthening Household Ability to Respond to Development Opportunities (SHOUHARDO) Project</td>
<td>USD 126</td>
<td>Programme III: 2016 - 2020</td>
<td>Promotion of climate-resilient livelihoods. Funded by USAID under the umbrella Food For Peace, with a 10 per cent contribution from the GoB: combined value of USD 126 million.(^{273}) (Programme I and II 2004 - 2010, and 2010 and 2015). Upazilas: Austagram, Itna, Mithaimain, Nikli, Kalmakanda, Khaliajuri, Madan, District: Mymensingh and Netrokona(^{274})</td>
</tr>
<tr>
<td>Climate-resilient Infrastructure Improvement in Coastal Zone (CCRIP)</td>
<td>USD 118.8</td>
<td>2013-2019</td>
<td>Administered by ADB, it aims to improve livelihoods in rural coastal districts, vulnerable to climate change by enhancing climate resilience of coastal infrastructure in 12 rural coastal districts benefiting poor and women. The Project will enhance the accessibility of the rural people to markets and economic opportunities, and people’s safety in 12 coastal districts within two divisions (Khulna and Barisal) of southwest Bangladesh. The 12 districts are Satkhira, Khulna, Bagerhat, Perojpur, Barisal, Jhalokati, Bhola, Patuakhali, Barguna, Madaripur, Gopalganj, and Shariatpur.(^{275}, , ^{276})</td>
</tr>
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\(^{273}\) TK. 29,24,11,236, source: http://www.ahsaniamission.org.bd/shouhardo-iii/


\(^{276}\) World Bank 2017. Bangladesh: Coastal Climate-Resilient Infrastructure Project.
### Annex II (a) – Feasibility Study
GREEN CLIMATE FUND FUNDING PROPOSAL

<table>
<thead>
<tr>
<th>Project/Programme</th>
<th>Funding</th>
<th>Period of Implementation</th>
<th>Main Interventions and location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bangladesh Pilot Programme for Climate Resilience (PPCR) (^{277})</td>
<td>USD 109.4</td>
<td>2015 - present</td>
<td>PPCR in Bangladesh total USD109.4 million, with USD 572 million in co-financing, for a total portfolio of USD681.4 million.(^{278}) Target areas are rural coastal districts. Project areas are climate smart agriculture technology, coastal protection through climate proofing of coastal embankments &amp; polders, rural infrastructure &amp; greenbelt, water supply &amp; sanitation, drainage and basic urban services, cyclone shelter, emergency access roads, boat landing, growth centre, improve coastal connectivity, climate-resilient housing, livelihood improvement. SPCR objectives include livelihood diversification through adaptive agriculture and scaling up climate-resilient varieties of rice and crops including efficient irrigation system. SPCR accounts for USD3.1 million CIF funds (^{279}).</td>
</tr>
<tr>
<td>“Climate-Resilient Ecosystems and Livelihoods (CREL) project”</td>
<td>USD 32.6</td>
<td>2012 -2017</td>
<td>The Project, with MoEF and funded by USAID (^{280}), addresses environmental, socioeconomic and policy/legal issues that threaten biologically sensitive areas by scaling up proven approaches to increase conservation and resilience to climate change. Southwest Region, including Khulna and Satkhira.</td>
</tr>
<tr>
<td>Local Government Initiative on Climate change (LoGIC) (^{281})</td>
<td>USD 20</td>
<td>2016-2020</td>
<td>Contribution of EU’s GCCA Euro +8m, SIDA’s SEK 85 million; UNDP &amp; UNCDF Co-finance USD 0.40 million. GoB will co-finance BDT 60,000,000. Overall objective is to enhance the resilience of communities vulnerable to climate change and related disaster risks in Bangladesh. The project is designed to support roughly 230,000 most vulnerable households in 100 unions in seven districts, which are highly vulnerable to climate change. It will be implemented in UNDAF priority districts including Khulna (Koirar and Dacope Upazilas) addressing salinity, cyclone and SLR climate hazards.</td>
</tr>
<tr>
<td>“Poverty Alleviation through Social Forestry”</td>
<td>USD 15.6</td>
<td>2012-ongoing</td>
<td>Project has USD 15.6 million and is implemented by the Bangladesh Forest Department (BFD) under the ministry of Environment and Forests (MOEF) funded by GEF LDCF. As part of the current Forest management Plan, under the administration of the Forestry Department, where it is subject to new afforestation and reforestation activities. It aims to integrate community-based adaptation and livelihood diversification options. Chapai-Nawabganj, Rajshahi, Naogaon, Bogra, Joypurhat, Dinajpur, Rangpur and Pabna Districts</td>
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\(^{281}\) Joint Local Government Initiative on Climate Change (LoGIC) in Bangladesh http://mptf.undp.org/factsheet/fund/JBD40
<table>
<thead>
<tr>
<th>Project/Programme</th>
<th>Funding</th>
<th>Period of Implementation</th>
<th>Main Interventions and location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Palli Karma Shahayak Foundation (PKSF)²⁸²</td>
<td>USD 12.5</td>
<td>2014-2016</td>
<td>Target areas are flood prone areas. BCCTF provided BDT 25, 06, 44,000/- to PKSF for funding to 63 NGOs under this project. climate-resilient health services including pre-allocated ten per cent of BCCTF USD 12.5 million; 1,200 members of CHGs received training for protection of human health from the impacts of climate change; 81 tube wells installed on raised places; 29 latrines constructed in communities and institutions; 481 satellite clinics organized to provide SRHR services. PKSF has mapped different rural business clusters for programmes with the objective to develop rural industries. PKSF provided financial assistance, with the International Fund for Agricultural Development for a crab hatchery to be established in Shyam nagar, Satkhira through Nowabenki Gonomukhi Foundation, a partner organization of PKSF under the project titled ‘Promoting Agricultural Commercialization and Enterprises Project. The first batch of crablets produced in the hatchery was released to nursery ponds in February 2017. The project sets up small-scale crab hatcheries at the household-level through micro-entrepreneurs to meet the increasing demand of crablets of the crab culture sector, which is expanding in the coastal districts.</td>
</tr>
<tr>
<td>Community Climate Change Project (CCCP)</td>
<td>USD 12.5</td>
<td>2012 -present</td>
<td>To enhance the capacity of selected communities to increase their resilience to the impacts of climate change. This component will establish a USD 10.40 million fund to finance community-based climate change adaptation projects implemented with the assistance of NGOs. World Bank administering it. The major sectors include Agriculture, Fishing and Forestry; Water, Sanitation and Waste Management South Asia.</td>
</tr>
<tr>
<td>Delta Plan 2100 - &quot;Towards Resilient and Sustainable Delta Management for a Prosperous Bangladesh&quot;²⁸³</td>
<td>Euro 9</td>
<td>2015</td>
<td>The Plan aims to create a long-term vision for delta management, prepare for different scenarios and responses, identify and organize government institutions to address challenges, and create and facilitate a long-term investment program bolstered by private-sector participation and development partners. It will do this by uniting government, international financial institutions, non-governmental organizations and the private sector.</td>
</tr>
<tr>
<td>Community Based Adaptation to</td>
<td>USD 8.55</td>
<td>2009-2015</td>
<td>Diversified livelihood activities through forestry, agriculture, aquaculture and livestock based adaptation measures. It also includes a capacity building component for government officials, support on the policy level, and</td>
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<table>
<thead>
<tr>
<th>Project/Programme</th>
<th>Funding</th>
<th>Period of Implementation</th>
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</tr>
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<tbody>
<tr>
<td>Climate Change through Coastal Afforestation</td>
<td></td>
<td></td>
<td>knowledge sharing within and outside Bangladesh. Located in four coastal districts - Borguna, Noakhali, Bhola, and Chittagong</td>
</tr>
<tr>
<td>Climate-resilient Agriculture and Food Security</td>
<td>USD 3</td>
<td>2013 - 2019</td>
<td>IFC is administrating the project and it promotes climate-resilient agricultural practices in vulnerable areas of Bangladesh. In Satkhira, Khulna[^284^]</td>
</tr>
<tr>
<td>The RESOLVE (Regenerative Agriculture and Sustainable Livelihood for Vulnerable Ecosystems)</td>
<td></td>
<td>2010-present</td>
<td>The programme aimed at demonstrating climate adaptive agriculture and sustainable livelihoods in environmentally fragile ecosystems of Northern and SouthCentral Bangladesh through an adaptive management approach.[^285^] Programme also applied livelihood diversification for climate resilience.</td>
</tr>
<tr>
<td>Strengthening the Resilience of the Water Sector in Khulna to Climate Change</td>
<td></td>
<td>2009-2010</td>
<td>Project financed by the Climate Change Fund (CCF). The overall objective of the project is to assess the impacts of possible climate change on drainage, water availability and salinity situation in Khulna and to advise on how to make the system more resilient for climate change. (Khulna)[^286^]</td>
</tr>
<tr>
<td>The Livelihood Adaptation to Climate Change (LACC) by FAO[^287^]</td>
<td></td>
<td>2006-2010</td>
<td>The project implemented by FAO focused on saline coastal areas with a “learning by doing approach” and a seasonal fine-tuning of the agricultural packages prepared to increase farmers’ resilience to climate change. Adaptation is a social learning process which needs to be based on the existing local knowledge and on applied scientific research. Beneficiaries are Dynamic and poor small and medium scale farmers. Implementing agencies are FAO and Bangladesh Department of Agricultural Extension. The climate change hazards it addresses are extreme events including droughts, floods and Gradual changes such as sea level rise and salinity.</td>
</tr>
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</table>

211. Two DIPECHO Projects implemented are the “PSF development (pond bank raising and tube well raising)” Project in Vamia of Borigualini Union of Shyamnagar Upazila in Satkhira District and the Project “Pond Bank Raising and PSF setup (double and single chamber)” in Faruk arker Bari and Kasmir Kona of Kamarkhula Union of Dacope Upazila in Khulna District.

212. In addition, the GoB is developing a Delta Plan 2100 for the coastal areas including support to ensure safety from floods and climate change related disasters; Water security and efficiency of water usage; Sustainable and integrated river systems and estuaries management; Preservation of wetlands and ecosystems and promote their wise use; And integrated use of land and water resources. Goals include: Create a common and inclusive and documented knowledge base: Create together with main stakeholders a delta vision, delta goals and measures; Facilitate entrepreneurship of the private sector; And, promote regional and sectorial developments on the short-term for future governance of water, land and related resources and spatial planning in Bangladesh delta. The Delta Plan has yet to develop its investment portfolio, however the current priority activities under the Seventh Five Year Plan for Coastal Zones BDP 2100 has suggested programmes such as the Construction of the Ganges Barrage, the Coastal Embankment Improvement Programme, and the Tidal River Management Programme for the southwest region.

213. The Local Government Initiative on Climate change (LoGIC) project aims to enhance the capacity of vulnerable communities, local government institutions and civil society organisations for planning and financing climate change adaptation solutions in selected climate vulnerable areas. The project is designed to support approximately 200,000 of the most vulnerable households in 72 unions in seven districts in Bangladesh. The benefits are expected to come out of climate change adaptation actions at various levels, scaled up through local government institutions incorporating high quality accountability and participation of the most vulnerable people. The project aims to contribute to the reduction of poverty and vulnerability which expected to (1) Strengthen the capacity of vulnerable people and local stakeholders for accountable planning and financing on CCA/DRR actions for building resilience; (2) Enhance access of LGIs and vulnerable households to climate funds; And (3) establish evidence-based advocacy for a mechanism for ‘financing local resilience. This will be done by the following activies: (1) Mainstreaming climate change into local-level planning; (2) Funding local-level resilience building of roads, culverts, market places; (3) Funding resilient housing of the most vulnerable people; And, (4) policy advocacy for allocating budget for LGIs to address climate change. By scaling-up high-quality accountability and participation of the most vulnerable people through local government institutions, it is intended that climate change adaptation actions will evolve at the household and community level.

214. The USAID funded CREL Project was a project to build climate-resilient livelihoods, working in the Munshiganj Union of the Shyamnagar sub-district. The goal of CREL was to increase the capacity of individuals, communities and government to adapt and mitigate the impacts of climate change. The project was completed in 2016.

215. The development objective of the Community Climate Change Project (now closed) for Bangladesh was to enhance the capacity of selected communities to increase their resilience to the impacts of climate change. The first component was a community climate change fund, which established a USD 10.40 million to finance community-based climate change adaptation projects implemented with the assistance of NGOs and managed by the Palli Karma-Sahayak Foundation (PKSF). The second component focussed on knowledge management, monitoring and evaluation, and capacity building.
3.4 Community-based organisations and non-governmental organisations

216. International NGOs working on climate change related issues include: CARE, Action Aid, Oxfam, Practical Action, CARITAS and IUCN. Between 1997 and 2006\textsuperscript{288}, the NGO Forum for Drinking Water Supply and Sanitation installed 1,000 very small rainwater harvesting systems in the rural areas of Bangladesh, namely national level including Khulna and Satkhira. The main objective of the initiative was to improve and facilitate access to safe, clean and affordable water. Rainwater harvesting tanks, which were installed, have a capacity of 500 litres to 3,200 litres of water and their cost varied from USD 50 to 150 per unit. A variety of ferro-cement tanks, brick tanks, poly tanks, RCC ring tanks; And sub-surface tanks, were installed. Part of the initiative was focused on the village of Putia, and nowadays the community is adequately maintaining the pipe-water supply, and the living conditions of women and children have significantly improved\textsuperscript{289}.

217. The Bangladesh Red Crescent Society works to build community disaster preparedness, community-based development initiatives and community-based disaster management. In 2017 BCRS adopted Strategic Plans for 2017-2020, aimed particularly at mitigating the suffering of vulnerable communities most affected by natural and man-made disasters as well as other adverse situations within and outside the country. Oxfam GB Bangladesh’s Disaster and Emergency Response Programme has a strong gender focus in programme delivery whilst facilitating communities to access clean water and safe sanitation facilities as part of its disaster response and preparedness work. Oxfam raise people’s houses above flood levels and provide training on what to do when a disaster strikes. In Cyclone Aila affected areas in the coastal zone, Oxfam is engaging people in cash-for-work activities for thirty days, creating community infrastructure and assets including ponds for safe drinking water, roads, and canals. They have also provided cash grants to people, including for training to help increase their resilience to future disasters by raising their understanding of disaster risk reduction, water sanitation and hygiene, nutrition and child care\textsuperscript{290}.

218. CARE was one of the pioneers working in the field of climate change adaptation in Bangladesh. Reducing Vulnerability to Climate Change (RVCC) was the first project of its kind on Community Based Adaptation (CBA) to climate change, implemented by CARE Bangladesh in the south-western part of Bangladesh in association with seventeen partner organizations\textsuperscript{291}. The project conducted participatory vulnerability and need assessments to deal with climate related problems which will be aggravated in the future due to climate change. The project put importance on diversification of livelihoods options of vulnerable communities, generated useful knowledge on how to communicate climate change (and adaptation) messages at the community level, and produced valuable knowledge and information about community based adaptation to climate change. The project has enhanced awareness among the coastal communities and several organizations involved in promoting and implementing similar activities with coastal communities. CARE Bangladesh implemented as part of a consortium of Partners including Bangladesh Centre for Advanced Studies, Bangladesh Rice Research Institute (BRRI) and CARE Canada are implementing the Reducing Vulnerability to Resilience programme supported by Canadian International Development Agency (Global Affairs) through the Canadian Climate Change Development Fund (CCCDF). The project focuses on three main areas: (1) Raising awareness of the expected impacts of climate change and possible solutions; (2) Building capacity at the household and community levels to identify, plan and implement practical adaptation measures; And (3) advocating with local, regional and national government to take appropriate action to reduce climate-related vulnerability.

\textsuperscript{289} World Water Council (2017). NGO Forum’s Accomplishment through Pipe-Line Supply in Rural Areas.
219. **Action Aid Bangladesh** has been integrating climate change adaptation into their disaster risk reduction programmes. Their project “building community resilience to climate change adaptation and disaster risk reduction” aims to carry out community based action research on climate change adaptation and disaster risk reduction to facilitate communities towards better adaptation for both. ActionAid focuses on a “Rights Based Approach” and works on improving the structural, ideological and practical aspects of women and girls’ lives, enabling them to claim their rights as full and equal citizens\(^{292}\). Furthermore, they have developed a vulnerability index, which is used to assess vulnerability as part of this assessment – see Annex Iib.

220. **Practical Action Bangladesh** has followed the same path of integrating climate change adaptation issues into disaster management. A recently completed project “Mainstreaming livelihood-centred approaches to disaster management” focuses on the roles and linkages between vulnerable communities, district and national level government institutions and humanitarian agencies about disaster preparedness and mitigation\(^{293}\). Furthermore, the Zurich funded V2R and V2R++ projects provide good examples of organizational interventions in climate change adaptation.

221. **UNDP** designed and implemented the **PECM (Poverty Environment and Climate Mainstreaming)** project aimed at reversing environmental degradation and strengthen adaptation in ways that benefit the poor, and that facilitate sustainable economic development at the same time\(^{294}\). The project seeks to improve institutions at different levels, update policies and develop investment environments which may contribute in enhancing pro-poor development and environment. The activities focus on policy advocacy, the development and dissemination of socioeconomic analysis, training, knowledge management, as well as on broadening partnerships. To date, the PECM project integrated poverty, environment and climate change issues in the following:

- The Perspective Plan of Bangladesh (2011-2021),
- The Sixth Five Year Plan (2011-2015),
- The National Sustainable Development Strategy (NSDS) 2011-21,
- The Annual Development Program (ADP) Guideline (2012-13 And 2013-14), and
- The Development Project Proforma for Public sector development planning.

222. The Districts of Khulna and Satkhira, identified as among the most vulnerable districts in Bangladesh due to geographical positioning and climate, remain a key focus of the government and many other development partner organizations’ development interventions for addressing climate change impacts. Most of the large programmes implemented in the South-Western region, including Khulna and Satkhira, are co-funded by the government of Bangladesh with NGOs implementing projects in these regions. Table 17 provides a summary of NGO’s currently active in upazilas within these districts, demonstrating the need for careful coordination with the NGO/CSO sector. For more details see Annex Iib, Livelihoods Assessment Report section 4.2.1 and annex 2.

223. Besides international development organizations, there are some small projects which are addressing climate change issues in Bangladesh under the **Coastal Development Partnership (CDP)**\(^{295}\), a coordinating secretariat for a network of NGOs trying to relieve the sufferings of the people of the waterlogged areas in the southwest coastal region. Relevant projects under CDP are in Table 17.

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\(^{292}\) ActionAid 2012 People’s Action In Practice Report

\(^{293}\) Practical Action 2009 Practical Action 2017 (unpublished) PRA survey to assess climate change adaptive livelihood capacity in coastal districts

http://www.bd.undp.org/content/bangladesh/

Table 17 Relevant CSO/NGO funded projects

<table>
<thead>
<tr>
<th>Title</th>
<th>Implementing entity/ies</th>
<th>Key focus</th>
</tr>
</thead>
<tbody>
<tr>
<td>People’s Empowerment for Addressing</td>
<td>Evangelischer Entwicklungsdiensit (EED)</td>
<td>The PEACE programme is one of the pioneer efforts in Bangladesh to undertake a comprehensive bottom up planning process on climate adaptation starting from village level, directly guided by the most vulnerable groups (extreme poor, marginalized groups, specially women &amp; indigenous people) within the community, being in line with national climate change policy goals and strategies. The process of implementing PEACE is as important as the results because it ensures active involvement.</td>
</tr>
<tr>
<td>Environmental Justice and Climate Justice</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(PEACE)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Awareness Creation among the shrimp</td>
<td>World Fish Center</td>
<td>Awareness Creation among shrimp Farmers on socially responsive and environment friendly shrimp culture in the southwest coastal region of Bangladesh: The project was implemented in 2006</td>
</tr>
<tr>
<td>Farmers</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Contributions to Operationalizing</td>
<td>BOTH ENDS, the Netherlands</td>
<td>The objective of the project is to adapt to climate change, whilst combating land degradation and conserving biodiversity (and synergies between them).</td>
</tr>
<tr>
<td>UNFCCC, CBD and UNCCD</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Save Sundarban: Ensuring Peoples'</td>
<td>ActionAid Bangladesh</td>
<td>In 2001, the project conducted a holistic campaign at local, national and international levels, to conserve bio-diversity and to ensure culture and livelihood opportunities of poor people traditionally dependant on forest related occupations are enabled.</td>
</tr>
<tr>
<td>Livelihood through Rights to Natural</td>
<td></td>
<td></td>
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<tr>
<td>Resources</td>
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</table>

224. Local and national NGOs are involved in additional development activities in the upazilas surveyed as part of the PA report on agricultural livelihoods (Annex IIb), the most notable of which are Pradipan, Rupantar, Shushilan, ASA, Bondhu Kallyan Foundation, CSS, Dolit, Nobolok, Nirjera Kori RRF Rural reconstruction foundation, Srijoni Bangladesh, TMSS, SUS, Mukti Foundation, Grameen Shakti, NariUnnayan Sangstha, Proshika and Uttaran. These organisations work with poor communities on programmes covering health, education, family planning, nutrition, livelihood, micro-finance, biogas, improved cook stoves, legal aid and improving governance. Microfinance organisations have also formed savings and credit groups in almost all villages of the surveyed upazilas.

225. As per the Drinking Water Assessment Report (see Annex IIc), four NGOs with the support from international donors have recently (as of December 2016) completed their drinking water supply programmes in Shyamnagar. The programmes were implemented targeting a total of 3,500 community people, and facilitated communities to install and use RO plants, Rainwater Harvesting Systems (RWHS), and PSF as safe drinking water sources.

3.5 Key planned initiatives and additional requirements to address climate change

226. Two pipeline projects intend to focus on water in the coastal areas and are being developed by Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH with the intention of promoting renewable energy as well as the efficient use of energy through the Renewable Energy and Energy Efficiency programme (REEEP).

227. Among other activities, REEEP has been working in the disaster-affected coastal areas of Bangladesh to provide access to safe drinking water through solar powered pumps and distribution.

296 Namely: 1) Shushilan, 2) Friendship, 3) NGO Forum for Public Health, and 4) LEDARS
systems since 2010 (project “Solar Powered Plant for Reducing Drinking Water Vulnerability for Coastal Communities”). So far GIZ has piloted 122 drinking water pumping and distribution systems, with capacity ranging from 5,000 litres/day to 30,000 litres/day. These plants currently supply 1.9 million litres of drinking water to approximately 63,000 households every day297.

228. The water supply systems draw water from surface ponds, underground sources, and saline water sources. Three different technologies are used, namely Pond Sand Filter (PSF) for surface/pond water, underground water extraction technology for underground sources and desalination technology for saline water sources.

229. Different business models, based on GIZ field experience, have been developed to ensure the sustainability of the plants. Under these business models, the Plant Management Committee, which includes both local government and community representatives, appoints a Caretaker to the water plants, who is then responsible for the overall plant management and maintenance.

230. Considering the high demand and insufficient supply of drinking water, GIZ is conceptualizing a new project under GCF - “Solar Powered Drinking Water Supply in Selected Coastal Areas of Bangladesh”. The project would include another technology, namely Managed Aquifer Recharge (MAR), along with the mentioned three technologies and is expected to meet the water demand of approximately 0.16 million households. Discussions between the team developing this GCF proposal and GIZ have been ongoing and agreement reached that the two proposals are complimentary and that the GIZ proposal can focus on pumping and desalination technologies while this proposal addresses the need for rainwater harvesting.

231. Given the above development projects (section 3.2) that have been and are continuing to be implemented to address baseline activities related to drinking water and agricultural livelihoods there is a clear need to address the expected additional impacts on these sectors through climate change. Many of the projects dealing with water resources involve the construction of large-scale related infrastructure and not supplying drinking water. Of these, the main projects dealing with water supply in the southwestern coastal areas are the ADB fund Southwest Area Integrated Water Resources Planning and Management Project, and the WB funded Rural Water Supply and Sanitation project. These projects both focus on non-drinking water aspects of water resource management and not directly on increasing the supply of safe drinking water, which for example has been undertaken by the NGO forum on drinking water supply and sanitation.

232. Of those projects dealing with agricultural livelihoods, DIPECHO is distributing seeds and promoting mixed farming (livestock and crops) in Satkhira, Nobo Jatra is working across 4 s in both Satkhira and Khulna to promote livelihoods and address water supply issues, and the Second Crop Diversification Project is providing agricultural credit and promoting value chains. The CDMP II furthermore was strengthening both small scale water supply projects and agricultural practices and businesses, but is no longer active.

233. Whilst these projects and programmes cover some aspects of drinking water supply and agricultural livelihoods, not all geographic areas and vulnerable people are covered. This is especially true when we consider the additional impacts expected under climate change (see Chapter 1). The climate change projects explained in section 3.3 often focus on policy, large-scale infrastructure (often coastal protection) and improving the capabilities to prepare and respond to disasters. However, it is notable that the SPCR, along with several NGO’s, is introducing climate-resilient rice and other crops, as well as promoting livelihood diversification. Even so it is clear that there is a need to expand and build on these efforts to enable safe drinking water and climate-resilient agricultural

297 GIZ-UNDP Correspondence 2017
practices for the majority of the extremely poor and vulnerable populations in the southern coastal districts.
4 Gaps and barriers to adoption of climate-resilient agricultural livelihoods and safe drinking water

4.1 Gaps and constraints in coordination, human, financial and technological capacities

234. Over the last decade the institutional landscape of Bangladesh has experienced significant change and growth, with the creation of new institutions within government, the private sector, academia and research, and NGOs. Whilst this has enabled a wider set of activities and priorities to be recognised, it can also lead to overlapping mandates and some institutions receiving or collecting most of the funds dispersed for activities etc. Coordination is therefore a key requirement when implementing activities involving more than one institution (either from government, NGOs or the private sector).

4.1.1 Coordination between institutions

235. GoB recognizes lack of coordination as one of the major limitations of the current institutional set up to address climate change issues. Consequently, CC focal points have been designated in each ministry and relevant agencies and whilst MOEF has trained them so that climate change issues are better integrated at national level activities, the current set up is still weak in terms of human capacity. BCCSAP has duly highlighted capacity building as a fundamental requirement towards addressing climate change nationally.

236. The Ministry of Planning has taken steps towards integration of climate change in national development processes through a coordinated manner. The General Economics Division (GED) of the Ministry of Planning has formed an inter-ministerial body to review the current processes of formulation any development project and found gaps in processes addressing climate change. The inter-ministerial body has recommended changes in how any development project (by any ministry) is designed under the Annual Development Programme and how to integrate climate change, gender, environmental and poverty issues.

237. As summarised in Chapter 3, most project descriptions mention climate change in their design, but will often address development challenges needed to build resilience to climate change, and only focus on one or two aspects of climate resilience. For example, climate infrastructure projects may focus on building the resilience of communities through infrastructure investment and health projects that address climate change impacts, yet may not include in the project design the day to day livelihoods of vulnerable communities, which will deal with the observed and expected impacts. It is important that projects take into consideration impacts beyond the projects’ direct sphere of influence during project design e.g. developing climate adaptive livelihood options and not only focussing on infrastructure. Transparently reporting projects is another way to help address some of these weaknesses.

299 Ibid.
238. Therefore, a key challenge when responding to multi-faceted problems faced due to climate change is the ability to coordinate between institutions. The Climate Public Expenditure and Institutional Review revealed that the GoB typically spends around 6 to 7 per cent of its annual combined development and non-development budget on climate sensitive activities. The amount was estimated at approximately USD 1 billion/annum.\(^{302}\) In addition to government ministries, many local government institutions at and Union Parishad carry out climate sensitive activities, with the disaster management sector generally spending approximately 17.5 per cent of all direct spending on CCA.\(^{303}\) Whilst development partners have been supporting GoB efforts, the adaptation gap is tending to increase, which can only be addressed through increased funding. However, without better coordination and increased efficiencies in how funds are used to tackle development challenges, the funding is likely to remain less than what is required.

4.1.2 Availability and sharing of socio-economic and physical geographic data

239. The availability of physical geographic data (soil/water salinities, cyclone/storm surges and modelling impacts under climate change) is reasonably extensive. However, extensive data on livelihoods and how they are disaggregated into different components within the target areas is not available. Whilst these available data are useful to guide the design of projects to enhance livelihoods, the link between livelihoods and poverty has yet to be examined systematically. More detailed information is required on cropping patterns, demographic projections, appropriate household livelihood models, as well as improved understanding of the sensitivity of physical models (for example crops, groundwater, hydrology) to assumptions and calibration data.

240. The Quick Diagnostic Study, conducted under the Sustainable Development Investment Portfolio,\(^{304}\) identified several water-related information and sharing gaps, as well as factors affecting management of water resources. These included information and data on decreasing water flows in rivers, the lack of water supply infrastructure in rural areas, methods on how to prevent water pollution and preserve water bodies, and a lack of data on current irrigation management procedures. Integrated river basin management is clearly identified as a priority in policies, but implementation is difficult due to a lack of knowledge/data sharing and co-operation among South Asian Association for Regional Cooperation countries.

241. Furthermore, communities perceive that crop yields are shrinking because of increased salinity due to rising water levels in the Bay of Bengal (see Chapter 1). The issue of salinity became pertinent since Cyclone Sidr in November 2007 and Cyclone Aila in May 2009 (see Annex IIb) and GoB has invested in cyclone and flood protecting infrastructure e.g. under CEIP. But many of the data sources listed above are needed to be able to estimate potential itemized damages on agriculture and livelihoods, to justify investment in early warning systems, cyclone shelters, and the incremental costs of adapting to intensified cyclones and related storm surges out to the year 2050.\(^{305}\)

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\(^{303}\) Ibid

\(^{304}\) For example, since the formation of BCCRF, a total of USD 190 million has been given to GoB to tackle climate change, whereas in 2009 GoB indicated a requirement of USD10 billion between 2010 and 2015 - MOEF-GOB, 2009

\(^{305}\) Unnayan Onneshan (2015). Advancing Ideas and Building Constituencies for Social Transformation (Rep.).

4.2 Barriers to promoting a shift to climate-resilient livelihoods and providing safe drinking water under climate change

4.2.1 Lack of knowledge of, and access to tools to enable, climate change resilient agriculture-based livelihoods

242. Climate change affects both the saline and temperature environment under which crops are grown and agricultural livelihoods are practiced. Some livelihood options for example shrimp farming, lead to a deterioration in the local environment preventing other potentially less damaging practices from being used. In the last twenty years, crop production shifted from traditional to progressive farming and, depending on the cropping pattern chosen by the farmer, affected income and thus quality of life. Progressive farming involves using short cycle crops and vegetables instead of Boro rice, which are less affected by salinity and have a higher market price. Short cycle crops and vegetables are more profitable if climate conditions are favourable, sufficient and if good quality irrigation water is available. Vegetables generally have a higher potential yield and ability to increase the revenue of both the landowners and labourers; The latter through higher labour demand. Alternatively, traditional farming may also provide a dependable livelihood in some years depending on climate (rainfall, temperature, potential evaporation), environment (soil salinity, water salinity/availability) and management options (irrigation). Fertilization of crops is important and doses should be based on local soil conditions. Information provided by different organisations are sometimes conflicting and not tailored to the needs of local farmers, thus demotivating them from using inputs for agricultural production.

243. Information on climate-resilient practices are generally not available, preventing farmers from using better quality inputs for agricultural production as well as exploring other potential climate-resilient livelihoods. The public extension service is not actively operating in most of the project areas. Thus, farmers fail to maximise the potential of higher productivity, such as treating saline soils for vegetable cultivation and using proper cultivation techniques. Farmers not able to produce vegetables, or producing poor quality vegetables, make little profit and are less likely to engage in sustainable activities. Appropriate technology is an important determinant of local adaptation to climate change. However, due to a limited view of agriculture approaches and techniques (ignoring crop diversification, saline/drought/submergence tolerant crop varieties or early maturing varieties etc.) and sustainable agricultural practices (for instance, composting, mulching/water retention techniques, pest management, line sowing, floating beds etc.), poor people in the project areas are unable to implement adaptation options that can work for them.

244. Underlying the poor information flow is the limited awareness and knowledge amongst coastal communities and women for making climate risk-informed livelihood decisions. Recent livelihood changes have been maladaptive and have exacerbated vulnerabilities, indicating that there is a limited awareness and knowledge of climate change impacts among local households, particularly women (see Annex IId, Livelihoods Assessment, section 5.1).

4.2.2 Access to markets for climate-resilient agricultural livelihood products

245. Access to a market to sell products is very important for cash crops and fishers. Extreme poor people have limited access and capacity for commercial production and participation in the local market. Most households are homestead level producers, selling only a small part of their produce to traders who visit to them. Increased access to markets and higher prices would benefit these

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households, though distance from market, poor infrastructure, lack of transportation, low prices and poor product quality often constrains farmers’ access (see Livelihoods Assessment Report, Annex IIb). Low prices, limited transportation and poor product quality are common barriers restricting market access. This situation is exacerbated as current value chain structures are often not useful due to changes in livelihood patterns due to salinity. Whilst a stronger road network has helped address deficiencies in traditional value chains, new value chains for saline resistant crops and aquaculture are underdeveloped (besides shrimp farming which has strong markets developed by the private sector and traders).

246. There are currently limited availabilities of saline-resilient crops, as well as crab and brackish-water fish seedlings. The latter is provided through catching seedlings in the wild; A non-sustainable practice with limitations and negative environmental impacts that reduces the wild stocks on which many extreme poor dependents for their nutrition. Whilst there are some fish and crab hatcheries and nurseries, their supply in all projects is limited by low market incentives. Increasing demand could attract investments, lead to improved value chains, and competitive prices for non-natural seedlings.

247. Providing access to markets enables target groups to build skills, gain experience and have livelihood capital thus increasing resilience. For example, crab and fish farmer organisations have used innovative packaging and marketing models, which have enabled them to manage risk in crab- and fish-based livelihoods. In some cases, existing markets may not be sufficient to support target groups, especially if climate-resilient technologies and products are relatively new. In such cases either support to overcome the specific barriers (transportation, marketing, etc) needs to be provided, or alternative livelihood options need to be found.

248. The demand for inputs is often low, although it varies from area to area, resulting in equally low private investment in these regions. Often the private sector is not aware of the potential to cultivate vegetables by treating saline soil, which would enable them to market products. Similarly, farmers are not aware of how best to use high-quality inputs to get the best production from their lands. For marginal farmers, the additional cost of using better inputs is perceived as unnecessary since they are not aware of the potential value addition from higher productivity. Limited access to markets makes farming less profitable and creates pressure to work harder for less reward. Whilst the organisation of farmers and links to markets outside of their communities might help solve some of these problems, solutions will vary in different unions and these organisations do not exist in many communities.

4.2.3 Access to finance to obtain and sustain climate-resilient livelihoods

249. The cost of agricultural livelihood activities is in many cases higher than pre-activity incomes allow for. Therefore, farmers require loans from both informal and formal sources. The unpredictability of climate can put farmers into the cycle of debt unless reserves are built to deal with climate related shocks. One way to address this is through sensible financial services that ensure better loan availability for climate-smart agro-technology. In the project area, farmers borrow money from both informal (relatives, friends, money lenders) and formal loans from the Bangladesh Rural Development Board (BRDB) or NGOs. This loan type is available for agricultural production and to diversify agriculture. The amount of a BRDB loan is generally BDT 10–35 thousand with an annual service charge of 11 percent. The return period is twelve months with a weekly re-payment. The annual interest rate of the BRDB loan is one of the lowest currently available on the market, thus providing a ‘best-case’ scenario. However, landless or marginal farmers do not have easy access to this loan because of membership criteria that targeted beneficiaries often cannot meet e.g. possessing more than two hectares of land.
Formal loans from NGO lenders have normally a twelve per cent annual flat interest-rate and a 12 month return period. The NGOs or MFI loan provision is also easy to access given that the target beneficiaries are part their programme. However, the availability of, and access to, finance cannot be effectively utilized by the target beneficiaries unless they understand basic business concepts, plan long-term investments, understand how a loan and banking system works, and have business skills. Capacity building support in these areas is needed to be integrated with financial services. The poor generally have so few livelihood resources to draw upon or to risk undertaking livelihood development. Agencies need to provide them with a peer-to-peer social support system to help pool the limited resources to achieve economies-of-scale in purchasing, production, sales, and negotiating wages.

4.2.4 Service and coverage of past and on-going projects

Coverage of livelihood projects in the coastal s, where the population is approximately 42 million, varies depending upon the situation. Several large projects and programmes are wide ranging but do not cover all potential beneficiaries in each target region. For example, USAID, under its Feed the Future Programme, covers all nineteen southern districts with their flagship projects on rice horticulture and fisheries value chains, along with agri-inputs value chain development, livestock value chain development and agricultural extension projects. The Blue Gold programme of the Netherlands is another large programme focussing on 24 polder areas (see chapter 3), with the aim of reducing poverty for 150,000 households living on 160,000 ha area of selected coastal polders.

Even though efforts are made by BCCRF to scrutinize projects, provide administrative support for forwarding funds, and monitor and evaluate progress of awarded projects, there remain gaps in its reporting. EMAPS Oxford Sprint, in April 2014, mapped out the distribution of funds by district, division and sector, showing that most of the funds distributed at the time are used for infrastructure, agriculture and general purposes. Several NGO/INGOs supported projects are being implemented in the southwest coastal regions (see Chapter 0). Funds operated by national NGOs are often meant for microcredit projects and very small portions for other priorities. Whereas INGO operated programmes often focus on disaster management and piloting adaptation, but not upscaling successful interventions. Funds used for livelihoods were negligible with livelihood support programmes not necessarily addressing climate adaptation directly.

World Vision Bangladesh implements fifty per cent of the demand-supply gap in drinking water through the Naba Jatra Project. The overall programme objective is to 'improve gender equitable food security, nutrition and resilience of vulnerable people within Khulna and Satkhira Districts in Bangladesh'. Implementation is in the south west coastal areas of Bangladesh, also identified as a Feed the Future Zone of Influence, across four geographically contiguous s (sub districts) under two districts; Dacope and Koyra in Khulna; Shyamnagar and Kaliganj in Satkhira covering 856,116 direct beneficiaries.

World Vision is the leading and the World Food Programme (WFP) and Winrock International (WI) are the sub grantees to the USAID Nobo Jatra programme and it is implemented in partnership with the MoDMR. Nobo Jatra aims include to reach families living under the poverty line to improve knowledge and capacity on Water, Sanitation and Hygiene and Maternal Child Health and Nutrition, increase agricultural activity and generate income, and improve resilience to shocks and

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stresses, incorporating gender equality and social accountability, which combined help form the enabling environment for transformative change.

255. According to research conducted for this report, there is an 87 per cent and 75 per cent gap in drinking water supply in 39 Unions of 5 under Khulna and Satkhira Districts.

256. Screening of existing projects and programmes relevant to the support of women to take up alternative, climate-resilient livelihoods in southwestern Bangladesh, showed that most projects do not only focus on women or do not consider climate change impacts in the project design of women-focused projects. This gap undermines development progress by ignoring the underlying causes and impacts of climate change, especially salinity, on coastal communities.

257. Livelihoods adaptation to climate change needs improvement in technical capacities of people and local institutions for: (i) Improved adaptation to climate variability and change at all relevant levels, addressing climate information needs, knowledge gaps, key skills and competencies, and technology needs; And (ii) implementation of adaptive activities in a participatory manner. Existing projects do not adequately train local-level decision makers on climate change risks and adaptation strategies.

4.2.5 Constraints in cost-sharing and recovery systems

258. There is a lack of willingness at the central level to allow tariffs for water provision to adjust to sustainable levels i.e. levels which will cover the costs for operating and maintaining infrastructure and services. Furthermore, there is an unwillingness of LGIs and political leaders to increase Water Supply and Sanitation Tariffs to provide for more sustainable levels. This situation is exacerbated by a reluctance of service providers to enforce policies and regulations related to cost sharing at different levels, which may be derived from their political will to provide cost-free services to protect so-called vote banks. This is further hampered by the fact that there is no regulatory authority which can facilitate tariff designs and direct implementation by service providers in sparsely populated rural and urban areas, and to monitor the performance of such providers to ensure fairness and provide equitable services to different users and populations.

4.2.6 Institutional constraints

259. Institutions constrain adaptation because they define the processes and rules that govern and regulate access and entitlement to livelihood assets. The ways in which actors can access assets plays a role in determining their vulnerability and ability to cope with and adapt to stress. Institutions can restrict the choice of livelihood strategies for some people; On the other hand, they can open opportunities for others and favour some groups. Further constraints are imposed by institutions’ access to climate change-related finance. In this regard, as of 2013 the Ministry of Local Government, Rural development and Cooperatives had sourced the most (USD 218 million) with the Ministry of Women and Children’s Affairs the least (USD 0.37 million), despite women and children being most vulnerable to the impacts of climate change.

260. Activities to empower women to pursue new livelihoods and leadership in maintaining and operating climate-smart water solutions are often facilitated through support programs from government institutions with varying mandates. Sole interventions by one entity, without

310 PRA process used for identification of gaps in water supply in 39 unions of 5 upazilas under Khulna and Satkhira Districts, and for mapping of functional and potential drinking water sources in the communities at household, community and institutional levels.
311 Community members and Ward members are different, while a UP Ward is a lowest tire of Bangladesh local government structure beyond Union Parishad (a union consists of 9 wards) and constituted by a number of communities/villages.
considering women-specific vulnerabilities or without local backing (e.g. through local-level institutions or community groups) can lead to planning failures and short-lived local support, without resulting in intended transformational changes. Furthermore, transparency in spending and financial management is a key requirement for all institutions e.g. indications that some funds and building materials for reconstruction have been misused in the past.

261. Whilst the oversight of government institutions is often necessary, discussions with the project design team and MOWCA, as well as the Department of Agricultural Extension and fisheries suggested that though they understand challenges such as crop failure, low yields and saline intrusion, they are unable to support their constituents with the required knowledge to enable climate-resilient livelihoods and associated activities. This situation is exacerbated in most project areas where public extension services are not actively operating. Thus farmers, especially women farmers, are not getting information about how to treat saline soil to cultivate vegetables, nor are they using cultivation techniques to ensure high productivity. Farmers are therefore not able to produce vegetables, or they produce poor quality vegetables without making much profit.

4.2.7 Limited availability of freshwater for livelihood activities undermines the resilience of dependent communities

262. Some agriculture based livelihoods have declined over the years because of limited availability of fresh water and the increasing salinity of the environment (especially after cyclones). Increased shrimp farming has aggravated the process of salinity intrusion, increasing risks associated with fresh water based livelihoods as well as agriculture based livelihood activities. Extremely poor households are often unable to adopt risk management strategies because they are too busy trying to meet basic survival needs. Any shock event then leads to further depletion of their asset base, leading to greater poverty and marginalization. Unfavourable economic conditions (denied entitlements and lack of access to alternative livelihood opportunities), social marginalization and exploitation and powerlessness combine to undermine the ability of extreme poor households to build resilience and cope with shocks and stresses. These stresses may range from natural disasters and the effects of environmental degradation to problems of chronic ill-health, violence and abuse, and skewed labour markets.

4.2.8 Limited financial means of coastal households to invest in climate-resilient drinking water technology systems.

263. Rainwater is the most dependable source of fresh drinking water in the salinity affected coastal rural areas. This climate-resilient technology could be used to ameliorate the impacts of dry spells and climate related shortages, but affordability of this technology among those with low incomes is a major concern, largely because the cost of available rainwater tanks is too high for them. There is no specific yearly budget allocation for water supply from the government to support people living in water scarce areas, which affects extremely poor households who cannot afford to buy a large size rainwater tank.

264. In some unions, pioneering households from higher income brackets have adopted climate-resilient water technologies and could potentially be champions to promote these technologies. However, income disparities can be a barrier for poor and extreme poor households to both invest in technologies and accept others as mentors. The atmosphere of mistrust to pool finances and autonomously start public-private partnerships to invest in climate-resilient water technologies is hampered by the lack of community structures and committees mentioned above.
4.2.9 Limited O&M responsibility and capacity within local communities to look after drinking water technologies

265. Whilst 100 per cent of the population have access to some form of drinking water sources, only 61 per cent of the population have access to safe drinking water sources (not all year round), and only 22 per cent of the population have access to year-round safe drinking water. Additionally, community involvement in water management and the design of water solutions is very limited. A screening of common practices undertaken by the proposal design team showed that water management committees and the involvement of women in them, exists on a conceptual level. However, the function of committees, the frequency of meetings, and transparency of decision making processes are not currently sufficient. This constrains involvement of the marginalized and poor, leading to a reduced sense of ownership, which in turn limits the willingness and interest to participate in required O&M activities. Clear and mandated mechanisms are required to strengthen the position of local communities and women in designing and managing drinking-water supplies.

266. Operational and management of drinking-water technology needs to be managed by the local community on a day to day basis. However, often there is a lack of capacity at the local-level to maintain installed water options. Proper technology-management such as protection and water quality at the user-level needs to be given a higher priority by stakeholders, which should be addressed jointly by government and the private sector. Maintenance of the system has been found a major problem, especially for community-scale systems where roles and responsibilities for maintaining the system are not often clearly distributed among the beneficiaries. Inadequate training and awareness raising programs on the long-term benefits of freshwater storage technologies results in a lack of technical knowledge and neglect among the local users. Water quality control is also a challenge for stored rainwater, mainly for two reasons; A lack of awareness regarding the presence of bacteria in stored rainwater, which may be due to bird droppings in the catchment, insects inside the tank, etc.; And the absence of low-cost, easy-to-maintain and effective disinfection technology. These can be addressed through education programs and promoting low-cost disinfection systems.

267. In Deluti Union for example, local people pay a monthly fee (BDT 40.00) to a designated caretaker for maintenance of the community-based tube well and associated storage tanks, including regular water quality control. This was found to work well, but the source gives limited yields of water restricting its use. In other areas pond sand filters are used to remove turbidity and bacteria from pond water, but the removal efficiency of bacteria from pond water is often not satisfactory. Moreover, due to O&M difficulties (e.g. cleaning of filter beds, ensuring water passes through the filter chamber, lack of repair/maintenance funds) most of the pond sand filters in this area were abandoned. Those that were functional were found to be vulnerable to pollution, largely due to a lack of maintenance.

4.2.10 Limited knowledge, skills, capacities for planning and implementing drinking water solutions in light of climate-induced salinity

268. Coastal households, currently, have a limited planning horizon to adequately consider incremental climate change impacts on fresh-water resources and identify resilient solutions for year-round, safe drinking water supply. This can be related to a limited understanding of climate change induced salinization processes and an inadequate exposure to adaptive technological solutions to follow best practices. Adaptive technologies, such as rainwater harvesting at different scales, collection of pond water, and Reverse Osmosis (RO) require technical skills, and an understanding of hydrological characteristics of flow regimes, climate variability (including changes
in monsoon patterns and intensity), and water treatment options. It is costly both to operate and maintain, as well as having negative environmental impacts. The technological means to use rainwater is also costly as it need users to undertake behavioral change as well as undertake costly operations and maintenance activities.

269. Provision of water to households is fairly decentralized and where access to piped water is unavailable, communities, local authorities, and NGOs often apply disparate approaches, as there is limited common understanding and technical skills to plan and implement drinking water provision with climate risks incorporated. Adaptive technologies required to deal with increased salinization of water sources, such as rainwater harvesting, PSF, pond based filtration systems and RO, require advanced technical skills for both operations and maintenance (including knowledge of basic carpentry and plumbing), as well as an understanding of hydrological characteristics of water sources and water treatment options. These skills are often in short supply and there is a need to develop them (for more detail, see Drinking Water Assessment Report, Annex IIc, Chapter 8, Profiles and Proposed Water Technologies).

270. The water scarcity and lack of access to clean water is disproportionately borne by the women in these communities. Access to information, skills, and technical capacity is extremely limited among the extreme poor women preventing investment in and adoption of climate-resilient technologies. By being excluded from water distribution and planning processes, women are further marginalized.

271. Climate Risk-Informed: IPCC GoB Seventh Five Year Plan reflects the words of the IPCC that recommends a need for more climatology research informed by the needs of poor people and vulnerable livelihoods, for instance on the effects of land cover change, and the effects on increasing evaporation and water availability. To be prepared for climate-induced natural disasters like cyclones and sea level rise, stakeholders need to be climate risk informed.

272. To address the barriers regarding information on climate risks, the Progress Monitoring Report of HFA\textsuperscript{313} identifies the solutions as Disaster Risk Reduction knowledge, skills and capacity. Specifically, create capacity and knowledge development opportunities to GoB officials at all levels through pre- and in-service training.

- i) Coordination bodies and their member agencies / departments at the district and sub-district levels and strengthen coordination between GoB and civil society at the district level.
- ii) Encourage the mobilization of informed communities and implement processes for downward accountability to ensure demand for DRR and CCA is met by local authorities.
- iii) Strengthen DDM financial management, monitoring and evaluation and other relevant business processes to deliver DRR, response and recovery services.
- iv) Overhaul the relationship between GoB and civil society on DRR and CCA and start GoB financing of civil society as service providers.
- v) Strengthen disaster information management, analysis and dissemination systems.\textsuperscript{314}


4.2.11 Gender constraints

273. Many projects implemented by GoB agencies do not have any theoretical construct to address gender sensitivity in the project design. MOWCA, under the BCCTF, has helped other ministries to integrate gender considerations, whilst NGOs have similarly taken initiatives to train gender focal points to include gender sensitivity in project design and monitoring. Even so progress has been slow and gender is often a neglected aspect in many projects. Extremely poor women in the target unions are often unable to meet basic requirements (nutrition, health, education, and shelter) and achieve sustainable livelihoods for similar climate change related reasons. However, the impact of climate change combined with specific vulnerabilities experienced by women, such as restricted technical/financial knowledge, limited or no access to resources and assets, markets and services puts women at greater risk. Furthermore, they are unable to engage in capital and asset accumulation or other forms of risk mitigation. Many women in the southern coastal districts have limited literacy and little knowledge and skills on crop/livestock production, marketing, sales, income/expenditure accounting and potential for creating value in derived products, all of which further contributes to their vulnerability.

274. The inequitable distribution of key resources such as land and water bodies or ponds in rural areas make the extreme poor dependent on various forms of exploitative relationships, often involving misuse of power and rights violations, with more powerful actors. For example, sharecropping often involves women selling in advance labour during the lean season, and taking out loans from money-lenders on unfair terms to meet day to day survival needs. In addition, due to limited and fragile livelihood opportunities, women and adolescent girls become natural resource extractors; Women usually collect fuel wood to sell for income or for cooking as there are no alternatives such as gas and bio-gas.

275. The collection of water for drinking and other household purposes are mainly women’s responsibility. Rooftop and local rainwater harvesting systems would reduce this burden on women by being able to store water near their houses. However, women need to participate in the design and sustainability of solutions as they are the main-user group of the system, which is often not the case. Implementing organizations should include women during the project design phase and any system should provide easy access to the water collection point for women and people with disabilities.

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315 Livelihoods Assessment Report, Annex IIb
5 Best Practices and lessons learned from related projects and activities

5.1 Agricultural livelihoods

276. The frequency of exposure to shocks and Bangladesh’s status as one of the most “disaster-prone countries in the world” necessitates a focus on improving household resilience. Households exposed to and the ability to recover from shocks is relatively low. Household asset ownership such as cash savings, remittances and bonding social capital are all important factors that help build resilience. Efforts focusing on developing income generating opportunities, particularly for women, go far to help households increase their assets and savings leading to stronger resilience.

277. Promoting initiatives that enhance and diversify livelihoods can be perceived as ‘business-as-usual’ development, but initiatives which promote climate change resilient options are still uncommon. By addressing local climate vulnerabilities and concerns, and building capacities to deal with them, initiatives can provide practical, effective and contextually-relevant ways to decrease vulnerability and facilitate adaptation to climate change.

5.1.1 Examples of best practice shifts in livelihoods in the coastal zones

278. A UN Women study reported shifting away from on-farm activities to create alternative sources of income in the coastal zone, with a local NGO training individuals in handicraft, embroidery and woodcraft, and supporting the collection of raw materials, as well as linking individuals with buyers and sellers of the resulting products. The three Food for Peace projects, namely SHOUHARDO3, Nobo Jatra and SAPLING funded by USAID, have continued efforts to diversify incomes, reduce poverty, introduce more women into the workforce, increase their earnings, and balance women-earned income with the cash earnings of men, giving women a greater say in household expenditure and decision making. The use of sustainable agricultural practices and technologies also helps improve household food security, as does access to and uptake of agricultural extension services, capital, new methods of cultivation and horticulture, advice on veterinary techniques, and teaching farmers skills to deal with the effects of climate change. Improved women’s participation in agriculture also reduces poverty levels and encourages better nutrition and health outcomes.

279. One successful example of resilient agricultural livelihoods was with farmers in Gomestapur of Chapainawabganj District, that encountered similar issues to the coastal regions regarding water availability. Farmers adopted rice and mango intercropping, and diversified into drought tolerant crop varieties such as Bangladesh Agriculture Research Institute (BARI) Barley-6, BARI Chola-5, mungbean, sugarcane, mango, jujube, pulses and oil crops. An important lesson was that the

316 UN Women. 2014, Review of the Environmental and relevant Policies and Strategies of the Government Bangladesh to identify Gaps and Steps for Integration of Gender Issues and Promoting Gender Role in Addressing Climate Change and Reducing their Vulnerability. Dhaka: UN Women
318 A type of herb
319 Commonly called jujube, or red date, Chinese date, Korean date, or Indian date, it is a species of Ziziphus in the buckthorn family.
Livelihood Adaptation to Climate Change programme by FAO learned that BRRI dhan47, BRRI dhan28 and BRRI dhan29 could be cultivated given improved water management with respect to salinity and stagnation. Fresh water storage in canals and non-flowing rivers (rainwater and river water) also allowed the expansion of Boro culture. BR23 performed well under stagnant water and mild saline conditions prevailing in Dacope, and denser plant population compared to the BRRI practice appears to perform better and might be suggested for future practice in Dacope. Table 18 shows some of the key projects and examples of how they have contributed to understanding good practices when building agricultural livelihoods in the coastal zone.

Table 18 Summary of best practices and lessons learnt from past and present livelihood projects

<table>
<thead>
<tr>
<th>Lessons Learnt / Best Practice</th>
<th>Projects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Training individuals and supporting the collection of raw materials for alternative livelihoods e.g. basket weaving, was successful.</td>
<td>UN Women study</td>
</tr>
<tr>
<td>Enabled systemic changes through improving and safeguarding women's access to income and jobs and enhancing their participation in traditional male domains e.g. markets of services, inputs, and products.</td>
<td>Katalyst Approach</td>
</tr>
<tr>
<td>Demonstrated the need to improve access to and uptake of agricultural extension services, including the need for capital, new methods of cultivation and horticulture, advice on veterinary techniques, and teaching farmers skills to deal with the effects of climate change.</td>
<td>USAID programme²²²</td>
</tr>
<tr>
<td>The average household relies on 2.5 income sources, most of which are in the agriculture sector. Most households regularly struggle to have sufficient cash and increasing efforts to improve women’s participation in agriculture can lead to reduced poverty levels.</td>
<td></td>
</tr>
<tr>
<td>Bina dhan – 8, BRRI dhan - 47 and Bina dhan-10 rice varieties have been cultivated by farmers in Satkhira, Khulna and Bagerhat districts of south-west coastal region during the Boro season. Farmers are happy with these submergence tolerant rice varieties.</td>
<td>PA</td>
</tr>
<tr>
<td>Activities focused on livelihoods and disaster risk reduction help bring changes in coastal communities’ life and quality of living through diversification of livelihoods options of vulnerable communities, generating useful knowledge on how to communicate climate change (and adaptation) messages at the community level, and producing valuable knowledge and information about community based adaptation to climate change.</td>
<td>RVCC (CARE)</td>
</tr>
<tr>
<td>Facilitating partnership formation at local-level strengthens the cooperation among the stakeholders, increases resilience against climate-induced impacts, and increases sustainability of project interventions.</td>
<td></td>
</tr>
<tr>
<td>Diversification, within and beyond agriculture, is crucial for risk reduction and successful adaptation to climate change. A solid monitoring and evaluation system helps in fine tuning implementation and targeting, and generates a better understanding of climate change adaptation technologies.</td>
<td>LACC (FAO)²²⁴</td>
</tr>
</tbody>
</table>

³²⁴ FAO (Food and Agriculture Organization of the United Nations), 2009, Situation assessment report in southwest coastal region of Bangladesh for the livelihood adaptation to climate change (LACC) project. (Report BDG/01/004/01/99).
5.2 Drinking water

280. Several types of water supply technologies are available for use in urban and rural areas. Each solution is most appropriate in different situations depending on the number of people who will be serviced, their livelihoods and income levels, ability to undertake O&M activities, distance to travel, and the quality of the local water supplies. Safe water technologies available in the rural areas typically are:

- Tube wells
- Ring wells
- Pond Sand Filters
- Gravity Flow Systems
- Infiltration Galleries
- Rainwater Harvesting System

281. In rural areas and in places where piped water supply services are not available, people rely on these other sources. Additionally, there are three types of tube wells: Shallow, Deep Set Shallow, and Deep. Tube wells operate either in suction mode (e.g. Shallow Hand Tube Well, Half-Cylinder Hand Tube Well and Deep Hand Tube Well) or force mode.

282. The coastal regions suffer from acute shortages of safe water for drinking and irrigation and several methods have been trialled to address these shortages including: RO to remove salt from ponds (triailed in Debhata, Kaliganj and Ashashuni s); PSF (approximately 2000 households trialled in Shyamnagar , in Shatkhira district); Rainwater Harvesting and tube wells. Details, including technical designs of these existing household and community-based drinking water solutions are presented in the Water Assessment as reported in Annex IIb. Furthermore, there is a history of implementing water solutions and different technologies in several projects in the coastal zone, from which many lessons can be taken. These are summarized in Table 19 below.

Table 19: Summary of best /practices and lessons learnt on drinking water supply from past and ongoing projects.

<table>
<thead>
<tr>
<th>Lessons Learnt / Best Practice</th>
<th>Projects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demonstrated successful utilisation of community management of water technology operations &amp; maintenance.</td>
<td>Pilot Project REEEP (GIZ)</td>
</tr>
<tr>
<td>Community mobilisation linked with supply chain strengthening and coordination with local government institutions. Gender-specific WASH motivation, which included interpersonal communications at places and times suitable to different gender age groups and the poorest: a redesign of the communication strategy, focusing on fewer practices and two-way communication.</td>
<td>BRAC</td>
</tr>
</tbody>
</table>

327 BRAC, 2011. Promotion of Improved Cookstove in Rural Bangladesh. Dhaka: BRAC.
Lessons Learnt / Best Practice

<table>
<thead>
<tr>
<th>Projects</th>
<th>Lessons Learnt / Best Practice</th>
</tr>
</thead>
<tbody>
<tr>
<td>Caritas</td>
<td>Late rainfall means they have to look for other options for drinking water as groundwater is</td>
</tr>
<tr>
<td></td>
<td>saline. The population expect that a 2,000 L capacity tank would store enough water for the</td>
</tr>
<tr>
<td></td>
<td>whole family for the dry period.</td>
</tr>
<tr>
<td>I/NGOs and Government funding</td>
<td>The rainwater harvesting system tank of 18,000 L capacity designed assuming that 75 people</td>
</tr>
<tr>
<td></td>
<td>will need two litres of water per day for drinking where the design period (scarcity period)</td>
</tr>
<tr>
<td></td>
<td>was assumed to be four months. However, this may vary for other areas where people use more</td>
</tr>
<tr>
<td></td>
<td>water for drinking and also collect water for cooking from these tanks. Some organizations use</td>
</tr>
<tr>
<td></td>
<td>longer design period (6-7 months) and assume a demand of 2.5-3 litre water per capita per day.</td>
</tr>
<tr>
<td>Dakua328</td>
<td>Protection of coastal district ponds from hazardous events, both natural and man-made (for</td>
</tr>
<tr>
<td></td>
<td>example washing, bathing, aquaculture, etc.), is very important in order to maintain water</td>
</tr>
<tr>
<td></td>
<td>quality.</td>
</tr>
</tbody>
</table>

5.2.1 Community O&M best practices

283. Existing institutional and community O&M practices are presented in the Drinking Water Assessment Report in Annex Iic. Some of the best practices utilised in existing systems involve the beneficiaries paying a monthly fee for O&M. In 2014, DFID funded a community-based RWH system where local people contributed five per cent of the total installation cost. Typically the beneficiaries pay BDT 25 every month to the caretaker of a system, which can be used to pay the caretaker a salary and pay for any maintenance or repairs, which may be required. The temple authority said that they collect money for maintenance and other causes once in a year now. The system is then managed by a committee consisting of the members of the local temple authority. Some of the members of the committee are also beneficiaries of the system while others have their own rainwater harvesting system.

284. In another community scale RWH system, installed on a school premises in Dacope Union of Dacope under Khulna District, 116 school students and 5 school teachers are the beneficiaries (see Figure 33). Before installation, the school authority had to buy water every week. In 2016, Rupantor (a local NGO) with support from Water Aid installed the system which collects rainwater runoff from the rooftop and stores the runoff in three tanks, each of which has 5,000 L capacity. During the installation of the system, the school committee contributed five per cent of the total cost of the system. People’s perception and acceptance of different RWH systems in the coastal areas in Bangladesh has been found to be very favourable to scaling up of the technology, as rainwater is the main source of drinking and cooking water. Many people also mentioned rainwater as their first choice of water sources.

285. With regard to operations and maintenance, the involvement of the community has proven to be key. Most of the RWH systems are running very well due to high community participation in O&M, and social acceptance of RWH systems is very high in the coastal area. However, people were found more willing to have household rainwater harvesting systems than community based systems as management of community based systems is often reported to have negative impacts on sustainability of the system. Where communities were not found very willing to manage the

330 Rainwater quality is an issue as bacteriological contamination was found in studies of water quality of stored rainwater, as per the findings from different studies local people are not very aware of this problem because of their perception of the visual quality of the harvested rainwater, which is very satisfactory.
331 Respondents of the Water Aid study conducted for this Report, 2017. Unpublished.
systems, these often failed or became the personal property of the land owner, which many development organizations think is a problem for up scaling of community based systems.

Figure 33: Rainwater harvesting system in Dacope union of Khulna District

5.3 Targeting vulnerable members of society

286. A key component of building adaptive capacity is ensuring that women and girls as individuals, collectively as a group or communities and largely as a part of society are actively involved in processes of change\textsuperscript{332}. These processes include changes in knowledge, changes in acquired skills, and most importantly, changes in behaviours and mind-set. Access to appropriate resources and technologies that will enable them to anticipate, cope with and recover from climatic hazards are important to facilitate these changes. Since women’s access to the market place is restricted and frowned upon, their produce (such as milk, eggs or vegetables) must be sold through a male wholesaler or through their husbands or sons. Women from male headed households can at least depend on their male counterparts for the task, but other women are obliged to accept the lower prices they get by selling within the village or to male buyers who approach them.

287. Though women in Bangladesh are more vulnerable than men in general, gender related perceptions are changing in the community. Women’s role outside the home, such as participation in meetings, standing for election, leading community mobilization and associated structures is widely accepted. Community and religious leaders realize that women’s awareness and participation must be increased in important community efforts e.g. for disaster reduction and mitigation activities. Religious leaders recognize that it is best if women can be trained to serve other women such as for early warning dissemination, looking into their specific needs in the shelter\textsuperscript{333}. Opportunities for participation and access to local political power, such as linkages with labour leaders, local government officials, local business people and moneylenders are very critical determinants in shaping women’s coping strategies. Furthermore, during natural disasters, communities cope and recover far better and in a more efficient way, when women are taking an

\textsuperscript{333} Kurshid et al. 2008. Bangladesh Final Report 28 Feb
active part and playing a leadership role in early warning systems and reconstruction. Women tend to be more adaptable and consider climate change, especially when they feel the life and well-being of their families is endangered. They select energy sources which are more environmentally friendly and actively participate in activities related to the well-being of the community. Table 20 summarizes some of the key lessons and best practices regarding the targeting of vulnerable populations.

<table>
<thead>
<tr>
<th>Lessons Learned / Best Practice</th>
<th>Projects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ensure that women and girls as individuals, collectively as a group within communities and as a part of society, are actively involved in the processes of change. The “ownership” of such initiatives and decision making regarding the use of funds being put directly in the hands of women, are all important factors in the success of the project.</td>
<td>ActionAid Bangladesh and local partners</td>
</tr>
<tr>
<td>Targeting the women of households has had a positive impact on their status.</td>
<td>Char’s Livelihood project (CLP)</td>
</tr>
<tr>
<td>Women from the core beneficiary households; Attending weekly social development meetings helped them to develop confidence to interact with the community and visit others.</td>
<td></td>
</tr>
<tr>
<td>The Asset Transfer Programme (ATP), which involved an initial injection of capital into selected extreme poor households with no land, jobs or assets, brought greater levels of respect for women in the community and improved intra-household relationships. It was, however, unclear if women had a greater say in decision making regarding loans and capital expenditure</td>
<td></td>
</tr>
<tr>
<td>Demonstrated the feasibility of a demand driven local climate change action plan, targeting the most vulnerable. A dedicated financial mechanism to cater for the adaptation of women beneficiaries was needed in addition to a general mechanism for vulnerable households.</td>
<td>Local Disaster Risk Reduction Fund (LDRRF)</td>
</tr>
<tr>
<td>Efforts need to be aimed at increasing equally the adaptive capacity of the individual as well as the community. Chronically poor people rely heavily on climate-sensitive sectors including agriculture and fisheries, and are more vulnerable to direct and indirect effects of climate change due to limited assets and capacity. More often located in marginal areas that are more exposed to climatic hazards, climate change public expenditure reviews therefore need to link gender, poverty and social safety net policies.</td>
<td>GoB</td>
</tr>
<tr>
<td>Women play key roles in protecting, managing and recovering their household during and after a disaster. Therefore, it is recommended that policies are enacted to ensure that women’s needs are considered before any decision regarding livelihood adaptation and financing thereof.</td>
<td>Alam K</td>
</tr>
</tbody>
</table>

336 Tanner and Mitchell, 2008
Lessons Learned / Best Practice

<table>
<thead>
<tr>
<th>Projects</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Targeting income generating women’s groups with appropriate gender and disaster training is a strong recommendation by UN Women. Training needs to be linked into wider actions within the community, for example beyond poultry and livestock training into more small business and technical training to ensure it does not further isolate women. Within these groups, preparedness plans should be discussed, and women can freely discuss the gender barriers that need to be overcome to lessen the load they currently carry for family care and household tasks.</strong>[^339]^[340]</td>
</tr>
<tr>
<td>UN Women[^341]</td>
</tr>
<tr>
<td><strong>Minimize reliance on cattle and poultry due to their high risk for all climatic hazards. Provide access to women’s specific and gender sensitive accessible medical care (female doctors, private spaces, reproductive health). Maximize the diversification of livelihoods to increase economic security. New livelihoods for women cannot involve a huge increase in time unless other household members take on other time-consuming activities women currently hold.</strong></td>
</tr>
<tr>
<td>UN Women</td>
</tr>
<tr>
<td><strong>Reviews in the 1990s and 2000s confirmed that the programme was effective, both in terms of targeting extremely poor women and in helping many of them make the transition – ‘graduation’ – from receiving relief to more sustainable and mainstream development activities such as micro-credit programme membership.</strong>[^342]</td>
</tr>
<tr>
<td>VGD</td>
</tr>
</tbody>
</table>

288. **The Local Disaster Risk Reduction Fund (LDRRF) of the Comprehensive Disaster Management Programme (CDMP) has been successful in identifying risks faced by vulnerable communities through Community Risk Assessments (CRA), which are climate change sensitive (risk informed) assessments at the local-level, that are then translated into a Risk Reduction Action Plan (RRAP). Crucially however, the LDPs do not yet incorporate the CRA and RRAP in the comprehensive long-term development planning process. Typically, the schemes and projects of Local Government Institutes, while small, focus on community level infrastructure development. Previous interventions and lessons learned also suggest that local government financing does not directly address climate change adaptation needs of the most vulnerable households. Hence, in addition to support for climate-resilient livelihoods, a dedicated financial mechanism to cater for vulnerable women beneficiaries is often needed.**

289. **ActionAid Bangladesh** and local partners pioneered a women-led emergency response in Kolapara, a sub-district of Patuakhali District that was hit by Cyclone Mahasen in May 2013. Teams of women made up the damage assessment and procurement committees, and subsequently led the budgeting process, selection of vendors, distribution and monitoring of reconstruction efforts. Many of the women in Kolapara then went on to be trained in water and sanitation management, sustainable agriculture, and vegetable gardening, building flood-resilient shelters and rehabilitation, developing new skills and confidence in the process. The “ownership” aspect of such initiatives and decision making on funds being put directly in the hands of women are all important factors in the success of the project: “Women in these communities usually have less influence than men but since they have been included in such projects men in the households have greater respect for them and discuss how funds should be used.”[^343]

[^340]: Mitchell, Tanner et al. 2007
[^341]: UN Women. 2014, Assessment of Women’s Livelihood Needs in Three Eco-Zones of Bangladesh. UN Women.
290. **Chars Livelihood project (CLP)** funded by DFID provided livelihood resilience support to poor women in the river islands in Bangladesh. Its impact review, conducted in 2013, concluded that targeting the women of the household has had a positive impact on their status and that while some women felt that they were consulted more on decisions relating to how money is spent, there was virtually no change in the degree to which women make decisions on expenditure and loans. But in qualitative terms, the same study provided evidence that women were more involved in decision-making. Some studies suggest a more positive picture e.g. Oxfam suggests that livelihood grants exclusively targeted at women do not affect gender relationships at the household-level.\(^{344,345}\)

291. The CLP impact assessment suggested that males and females from core beneficiary households appeared satisfied that the female member was selected and intra-household relationships were not negatively affected. It suggests that programmes with women only targeting criteria and processes did not aggravate community harmony.\(^{346,347}\) There was improved social mobility of women within core beneficiary households and improved interactions within the community.

292. The **Rural Employment Opportunities for Public Assets (REOPA)** Project which created employment opportunities for destitute women and the landless poor, contributed towards improving public assets to benefit rural communities and also strengthened the capacities of local government institutions for better management of social safety nets and pro poor initiatives. REOPA has been recognized for balancing correct targeting, transparent fund management, effective engagement of disadvantaged women and a well-designed graduation policy. This policy includes life skills and livelihoods development training, accumulation of investment capital for microenterprises, access to different service delivery departments, mobilization of social capital, and customized support for successful livelihood activities.\(^{348}\)

### 5.4 Technical capacity building of communities and local government

293. Capacity building of individuals, communities and local government is crucial in Bangladesh as demonstrated by lessons learned in a wide range of projects elaborated in Table 21. The greater the capacity of individuals, the less is the risk during and after climate-induced impacts. Capacity building, through regular targeted training, makes communities confident and optimistic on the benefits of adaptation and better able to cope with disasters, as long as they have resources and possess knowledge and know-how on what to do when faced with weather/climate events and changes (as seen in the RVCC project). This is evident in the lessons learnt through the work of World Vision, especially when each community is capable of mobilising its own resources (materials and money) to address their immediate emergency needs, as well as plan for future investments which may be required to deal with added climate stresses. It is also important to provide incentives and motivation for local communities to save towards emergency plans and locally managed community funds for maintenance of community assets (e.g. Water Management Groups and Associations developed as part of the Blue Gold project). Ensuring the participation of women, girls, youth and people with disabilities in planning and implementation is critical if all members of the community are to benefit from adaptive and resilience building initiatives. Adolescents in particular can play a key role in these initiatives.

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\(^{345}\) The study suggests that women’s participation in a livelihoods programme contributed to reducing domestic violence through economic avenues by reducing household poverty, by increasing husbands’ recognition of women’s financial contributions to the household, and by decreasing women’s financial dependence on men. (Oxfam 2015)

\(^{346}\) International Programme Management 2011

\(^{347}\) Impact assessment of CLP phase - 1

important and active roles in family activities if they are aware and prepared. Adaptive economic opportunities need to be introduced and supported for individuals to enable year-round employment and earning opportunities (see HEKS and Nobo Jatra). Additionally, livelihood support to vulnerable women and their families should be maintained over sufficient time to enable their economic growth to be sustained, including follow-up activities to ensure the productive use of skills and knowledge. It is also clear from these initiatives that local government is a key partner and capacities to promote climate-resilient practices need to be built within its institutions (see Rahmen and Rahmen, LoGiC). Utilising existing user groups and associations (as in the Nobo Jatra project) is preferable to creating new groups and structures where they already exist.

Table 21 Summary of best practices and lessons learnt from past and present capacity building activities

<table>
<thead>
<tr>
<th>Lessons Learnt / Best Practice</th>
<th>Projects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Addressing multiple forms of disasters, frequencies and intensifying hazards, is helped by implementing a harmonized model to strengthen the capacities of local, district and national institutions. Organized communities are more resilient, through the engagement of community committees including community children, who act as change agents on disaster preparedness. Resilience is also enhanced through advocacy for institutionalization within both urban and rural areas (especially at schools and community based organizations), thus ensuring the representation of community committee members in local-level committees.</td>
<td>World Vision 349</td>
</tr>
<tr>
<td>Lessons related to capacity development and partnership: capacity development is a long-term process, and project timelines should reflect this. Undertaking an organizational capacity assessment early in the project assists in identifying strengths and weaknesses. Partner organizations should have a strong background in their particular areas of expertise, though their level of knowledge and understanding of climate change related issues can occasionally hamper project activities. Awareness: As climate change is a technical issue, it is challenging to communicate at the grassroots level in an accessible way. Awareness raising activities should be integrated into other project activities to increase impact.</td>
<td>RVCC 350</td>
</tr>
<tr>
<td>Community mobilisation and institutional strengthening: communities in the polders are organised into Water Management Groups at village level and Water Management Associations at polder level, with the aim to create effective cooperatives that are in a position to formulate community priorities. The capacity development of the cooperatives builds on the training approach and toolkit with women participation.</td>
<td>Blue Gold</td>
</tr>
<tr>
<td>Involve stakeholders from different government departments to create appropriate adaptation measures: identifying different needs and implementing them with multiple perspectives in mind. Stakeholders have a multitude of interests that need to be integrated through communication and coordination.</td>
<td>CBAcC-cf Project</td>
</tr>
<tr>
<td>As land is an important resource for adaptation it is important for coastal people to rearrange and engage its multiple uses in resource management. Institutional support for land access and knowledge transfer of improved crop varieties through training and awareness building can strengthen land use capacity and reinvigorate livelihood approaches. Institutional networking across horizontal and vertical levels is important</td>
<td>NAPA 351</td>
</tr>
</tbody>
</table>

350 Chowhan; SAFE Development Group With support from the RVCC Team; CARE Bangladesh March 2005. The Reducing Vulnerability to Climate Change (RVCC) Project: Reflecting on Lessons Learned
### Lessons Learnt / Best Practice

<table>
<thead>
<tr>
<th>Description</th>
<th>Projects</th>
</tr>
</thead>
<tbody>
<tr>
<td>for design and promotion of cost-effective adaptation interventions. Ownership development is important. Local networks and associations, and the relationships and patterns of reciprocity and exchange, are paramount to building adaptive capacity. The community based livelihood approach can transfer knowledge and best practices and improve risk management capacity for individuals as well. Large-scale actions strengthen local governance and community groups responsible for managing coastal resources, improvements in coastal infrastructure, and migration to non-coastal areas. Medium-term investments in institutional capacity building (i.e., financial planning and management, knowledge and information sharing) and cross-scale linkages are critical to facilitating the success of emerging institutions.</td>
<td>LoGiC</td>
</tr>
<tr>
<td>Scaling up through local government institutions needs to incorporate accountability to and participation of the most vulnerable people. This can be achieved by: (i) Building capacity, awareness and empowerment of vulnerable people to generate plans; (ii) Develop capacity of local government to integrate climate change into their local development plans; (iii) Build capacity and engagement of local actors and government extension workers to drive accountability for climate-related actions; (iv) provide grants to local government as additional resource to climate-proof their investment on community based adaptation work; (v) Provide direct support to the vulnerable households to meet their adaptation needs; And (vi) promote a local climate financing mechanism through evidence based advocacy for delivering climate finance at scale.</td>
<td>Rahmen and Rahman 353</td>
</tr>
<tr>
<td>Develop and train up for capacity building of the local community groups, local government, stakeholders, NGOs and national policy makers and planners involved in coastal urban drinking water resource management activities. Increase public awareness concerning environmental training and education, particularly related to the importance of the sustainable use of coastal drinking water and other natural resources. Ensure community involvement in maintaining and protecting coastal urban drinking water quality and other resource development and management.</td>
<td>Local Climate Adaptive Living Facility (LoCAL) 354</td>
</tr>
<tr>
<td>Soft adaptation measures like awareness raising, training and climate information services are crucial in ensuring that climate change considerations are adequately mainstreamed into local planning processes. Providing knowledge management and capacity building, strengthens local understanding of the benefits of resilient infrastructure.</td>
<td>Coastal Climate-resilient Infrastructure Project (CCRIP)</td>
</tr>
<tr>
<td>Addressing the underlying causes of chronic food insecurity requires improved knowledge, capacity and links to food production, income generation and facilitating improvements in household assets and savings. This is easier to do through existing WASH committees and community support groups, particularly using behavioural change communication activities.</td>
<td>Nobo Jatra</td>
</tr>
<tr>
<td>Capacity building of development partners, service providers and producers improves productivity. As development partners become aware of the potential of the market development approach, they designate existing staff for market development activities, resulting in a significant increase in project capacity.</td>
<td>Das Hilfswerk der Evangelischen Kirchen Schweiz (HEKS)</td>
</tr>
</tbody>
</table>

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6 Recommendations

294. Multi-stakeholder consultations throughout project development included the National Designated Authority (NDA), MoWCA, DWA, DPHE, relevant national government agencies, international partners including donors and multi-lateral agencies, Civil Society Organizations, NGOs, Indigenous people’s organizations, the Private Sector, and communities in Khulna and Satkhira Districts. Representatives from bilateral donors were consulted, including the Canadian High Commission, Royal Norwegian Embassy, Embassy of France, Embassy of Japan, UK’s Department for International Development (DFID). Civil Society Organizations (CSOs) were consulted with the objective of gathering feedback, particularly on gender considerations and gender empowerment strategies in Bangladesh, as well as on the full design of the project and the proposed activities, including the exit strategy. Discussions included the need for greater responsibility and ownership to be given to Union Parishads, with DPHE as an implementing partner for the water component. Several rounds of discussions with NGOs and CSOs have informed the following recommendations, is included in Annex XIIIc.

6.1 Methodological approach to identifying climate-resilient livelihoods and drinking water solutions

295. Based on the exposure to climate-related events and change (see Chapter 1), areas in six districts (namely Khulna, Bagerhat, Barguna, Patuakhali, Pirojpur and Satkhira) are considered vulnerable to salinity impacts on drinking water availability as well as on freshwater based agricultural livelihoods. However, as elaborated in sections 1.5 and 0, the immediate impacts are more apparent and at a critical level in the two most western districts of Khulna and Satkhira. Whilst these two districts are therefore recommended as the immediate focus for this project, it is expected that similar activities and approaches will be equally applicable in the other 4 districts.

296. Communities within these districts have experienced deteriorating freshwater resources which has affected both freshwater-based agricultural livelihoods and access to safe drinking water, and particularly women the most. Therefore, addressing this freshwater deterioration involves addressing both livelihoods and water. Building livelihood resilience helps sustain the assets and management of water infrastructure while provision of year-round safe drinking water helps communities to invest in income generation/livelihoods and education opportunities, whilst improving safety. Given this situation site specific assessments for drinking water provision and agricultural livelihoods were commissioned for the districts of Khulna and Satkhira, in order to inform the design of recommended actions and their scope. The Livelihoods Assessment Report (Annex IIb) details the findings of assessments to identify the most feasible climate-resilient livelihoods for women in the coastal communities in southwest Bangladesh. It was conducted by a multidisciplinary team of experts (on agriculture, aquaculture, climate change, gender and market development) and is based on a mixed-methods approach. This included a literature review, participatory field assessments, remote sensing analyses, stakeholder consultations, and data interpretation and analysis, all of which was used to produce evidence-based and scientifically-based suggestions for climate-resilient livelihoods in each location. Table 22 summarises the process and associated methods.

<table>
<thead>
<tr>
<th>Phase</th>
<th>Applied methods</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

297. Partly based on literature as well as primary data, profiles for all 39 unions were prepared (see Livelihoods Assessment Report, Annex IIb for five of the union reports and for the remaining reports, refer to Annex IId). Data was collected from 353 respondents to: understand their perception of potential livelihoods; Identify their constraints and concerns; And gain an understanding about recent livelihood changes and potential drivers of those changes. Random sampling was used for selecting females between 18 to 49 years. Focus group discussions (FGD), as a PRA tool, were conducted with different union officials and community representatives, including the chairman, members, and secretaries of the Union parishad. Key informant interviews were used to verify the information, and provide insights into existing technologies, capacities, and perceptions on the feasibility to implement climate-resilient livelihoods within the local context (see Livelihoods Assessment Report Annex IIb section 1.1.2. for further details). Transect walks identified market places, housing structures, living conditions of local communities. These data were later consolidated with information from the PRAs, satellite imagery, market analysis, KIIs, and targeted literature reviews.

298. Satellite imagery analysis was used for two assessments during this study: (i) To analyse land-use/cover change; And (ii) to determine the quality of the building structures of local households. A Multi-Criteria Poverty Index (MCPI) was used to identify potential beneficiaries, which were verified through transect walks. GIS maps showed historical trends of land-use changes, key geographic and socio-economic characteristics, infrastructure and market places. A multi-criteria screening and filtering of livelihood options was conducted to identify alternative, climate-resilient livelihoods for women and coastal communities. These livelihood options were screened against salinity tolerance, cyclone resistance and adaptive capacity. Expert judgement was used to decide whether the livelihood was adaptive, non-adaptive, or maladaptive, whether it was gender equitable, its likely profitability and market/value-chain access, identify any further socio-economic considerations and likely community acceptance and environmental impacts. Eight livelihood options were identified as having the highest potential to be alternative, climate-resilient livelihoods for women in coastal communities in southwest Bangladesh.

299. The value chain analysis was based on the ‘Participatory Market System Development’ tool, developed through PRAs, KIIs, FGDs, and transect walks. Five relevant value chains were mapped and assessed to understand their climate change resilience, value chain actors, existing and potential new market linkages, gender-responsiveness and potential for market system development. To promote feasible and adaptive value chains, the potential to include private actors in developing new market structures was assessed and explored.
The Drinking Water Assessment Report (Annex IIc) was developed based on the compiled five reports with the desk review of available secondary references. The assessment used primary research methods e.g. Participatory Rapid Appraisal (PRA), and reviews of recognised best practices, to identify the most feasible interventions. For the PRA, two stages of participatory community consultation were undertaken: (i) Ward level (i.e. ward PRA on water source mapping) with knowledgeable community members (men and women) represented by different social groups, to create socio-economic distribution maps; (ii) The union level with Union Parishad representatives. The need for water-supply points/infrastructure was assessed and Union Parishad representatives attended the PRA process/sessions that were undertaken at both ward and union levels.

Nine ward maps were compiled and on them existing (and potential) water technology options were plotted and gaps identified. (See Annex IIc Drinking Water Assessment Report, chapter 8 for further details). The climate-resilient recommendations were based on: Gender sensitive and sustainable technological options per site, professional judgments of the technical consultants, community preferences and nationally acceptable, appropriate technological options for saline coastal zones of the country.

6.2 Targeting of geographical locations and beneficiaries

Identification of target districts and unions: Within Khulna and Satkhira Districts thirty-nine unions were recommended based on union profile analysis using secondary and primary sources, as they are: (i) Facing the highest levels of experienced and projected salinization; And (ii) having a particular large poor population. (See the Livelihoods Assessment and the Drinking Water Assessment as reported in Annex IIb and Annex IIc respectively).

Identification of targeted wards: Within these districts, wards were analysed to identify: (i) The most climate vulnerable communities; (ii) Highest levels of poverty (percentage of extreme and ultra-poor populations); And (iii) high exposure of beneficiaries to salinity intrusion (both current and projected future levels) due to low elevation. Out of 350 wards in the targeted 39 unions (18 in Satkhira and 21 in Khulna), 101 were identified as potential project areas. Details of the three phased approach to identifying target wards are as follows:

- Maps of soil salinity and future exposure were used to detect those wards most affected by climate-induced salinization processes. Additionally, land-use change data (1995, 2005, and 2015) were used to identify wards where major shifts from agricultural towards aquaculture livelihoods took place, as a potential indicator of salinization.
- A poverty index mapping utilising indicators of: (i) Income poverty; (ii) Percentage of day labourers; And (iii) a satellite imagery analysis of housing structures (see Livelihood Assessment Report, Annex IIb for more details on poverty indexing).
- Wards with a low elevation were considered as being particularly vulnerable to future salinity intrusion through SLR and storm surge.

It is recommended that the final selection prioritises the beneficiaries based on the following criteria: women between 18-49 years old, responsible for water collection and/or able to adopt a climate-resilient livelihood strategy; Adolescent girls that are solely responsible for household income generation; Households with incomes less than USD 1.25 per person per day, having few or no assets; Women-headed households, especially where there are no able male members to earn a livelihood; Women from households where there are a greater number of dependent members (e.g. where household members chronically ill, physically, mentally and visually impaired or disabled); Indigenous (“adivasi”) households; The household possesses less than 30 decimals (1,214 m²) in previously usable agricultural land, and possesses less than 50 decimals (2,023 m²) total land. Additionally, Hindu minority households should be represented in proportion to their overall
305. **Identification of target locations for drinking water solutions:** After selecting the target wards as described above, the remaining steps to calculate the target households per ward and the appropriate water solutions to cover the target households included:

1. For each ward, subtract the baseline coverage of the households with existing functioning non-saline drinking water supply from the total ward population to get the water supply gap (e.g., functioning deep tube wells were included as a non-saline water source but shallow tube wells were excluded from the baseline due to salinity). The baseline does not include water sources that are being used but are saline. Current baseline is 13,122 HHs \((13,122 \times 4.4 = 57,737)\) in the target wards out of a total of 56,298 households as measured through the PRA process. This is equivalent to 23 per cent of the households in the target wards.

2. Multiply the remaining households without drinking water supply in each ward (the water supply gap) by the zone factor where the zone factor is based on whether there are other proposed water supply improvement programmes in that sub-district. The known water supply improvement programmes in the Khulna and Satkhira Districts are the World Vision Nobo Jatra Project and the O’Horizon programme targeting marginalised households. The zone factors for each sub-district are as follows:
   - The factor for Zone 1 is 50 per cent on the following basis: Zone 1 includes wards in the sub-districts of Shyamnagar, Dacope, Koyra. The combined programmes from World Vision and O’Horizon will implement drinking water solutions targeting 50 per cent of the demand-supply gap in these sub-districts. World Vision’s Nobo Jatra Project is proposing to install community level water solutions in 30 per cent of the households. O’Horizon is targeting 20 per cent of the households and is proposing to install household-level water solutions.
   - The factor for Zone 2 is 100 per cent on the following basis: Zone 2 includes wards in the sub-districts of Assasuni and Paikgacha. Neither World Vision nor Oh Horizon are planning to implement drinking water improvements in these sub-districts.

306. In a number of wards in the Zone 1 sub-districts, there were higher household figures being targeted for livelihoods than for water supply improvements, due to existing safe water supplies and the proposed water supply improvements by World Vision. Households being supported with livelihood interventions will therefore have water security, whether through the project or otherwise. See section 6.4.2 for further details on the specific site and beneficiary targeting for drinking water solutions.

### 6.3 Climate-resilient livelihoods and value-chains focusing on women in targeted areas

#### 6.3.1 Existing and potential livelihoods in coastal communities

307. In the Livelihoods Assessment Report, chapter 6 provides a detailed analysis of livelihood options and their potential for climate resilience. It presents thirty-nine adaptive solutions that are able to provide income and livelihood support under increasing levels of salinity and cyclone risk. Each livelihood is assessed for its resilience to climate change impacts, their gender equity/responsiveness, profitability (including a detailed cost-benefit analysis) and access to
markets/value chains, as well as their impact on the environment (including fresh water dependencies) and socio-economic/community acceptance. The results are summarised below.

308. From the initial list of thirty-nine livelihood options, approximately ten are water-based livelihood options, resulting in 2-3 livelihood options for each union. The development of these options considers both commercial activities needed to sustain households (and the available value chains into which these options would need to be integrated) and the resources available to the target beneficiaries and their wider community. A list of existing and potential livelihood options was derived and can be divided into four different categories: (1) Agriculture-based livelihoods; (2) Fisheries-based livelihoods; (3) Livestock-based livelihoods; And (4) others.

309. The livelihood options were further analysed to assess their capability of resisting (resilience) the impacts of climate change identified earlier, namely resilience to salinity increases and ability to withstand cyclone impacts, thus deriving a shortened list of proposed climate-resilient livelihoods which will be more resilient to climate change. Additional livelihood options such as aqua-geoponics and hydroponics, drawn from recognised best practices, are also considered as potential livelihood options (see chapter 5, Livelihoods Assessment Report Annex IIb).

310. A multi-criteria screening (see section 1.2.5, Livelihoods Assessment Report Annex IIb) and filtering of livelihood options was used to identify alternative, climate-resilient livelihoods for women and coastal communities. The screening process was based on existing and potential livelihood options, climate change adaptiveness potential, and gender responsiveness and their contextual feasibility.

311. In a first step a portfolio of potential livelihood options to propose through this project was developed and categorized as either adaptive, non-, or maladaptive. The selected portfolio of livelihood options were screened based on current and future climate resilience of the interventions, in particular resiliency to climate-induced salinity and cyclone impact. (The results of this screening process are summarized in section 6.1 of the Livelihoods Assessment Report Annex IIb for a detailed analysis). All non- and maladaptive livelihoods or livelihoods that could not be considered within the scope of the project were removed as an option. Following this, livelihood options were screened against the criteria of salinity tolerance, resistance to cyclones and capacity to adapt. Subsequently, the livelihoods that were recognised as being resilient and suitable were screened against the criteria of gender responsiveness, profitability and market/value chain access; Socio-economic considerations and community acceptance, and environmental impacts. Fourteen livelihood options have the highest potential as alternative, climate-resilient livelihoods for women in coastal communities in southwest Bangladesh (see the Livelihoods Assessment Report IIb section 6.2 for further discussion). Initially fourteen livelihoods were identified as resilient options that needed to be screened in a second step against sustainability and socio-economic criteria. After this second step, eight options were put forward as proposed livelihood options. These are:

1. Aqua-geoponics;
2. Crab farming and trading;
3. Crab nursery;
4. Fish feed processing;
5. Homestead gardening;
6. Hydroponics;
7. Plant nursery;
8. Sesame cultivation.

312. The value chain analysis was assessed for specific potential alternative, climate-resilient livelihoods as identified in the multi-criteria livelihood screening process. Five value chains were chosen and analysed for their climate change resilience, value chain substance, existing and potential new market linkages, gender-responsiveness, and market system development potential (linkages to
develop sustainable and climate-resilient value chains such as crab hatchery). Additional cost-benefit analyses were undertaken to ensure that there was a clear economic benefit to each option, given the current costs of inputs, production materials, marketing and access to markets. To promote feasible and adaptive value chains, the potential to include private actors in developing new market structures was assessed and explored.

6.3.2 Diversifying vulnerable agricultural livelihoods to climate-resilient livelihoods

313. Table 23 provides an overview of identified climate-resilient livelihoods categories and the proposed alternative livelihoods for each category, given their climate-resiliency to climate change impacts. See the Livelihoods Assessment Report Annex Iib section 6.1 for further discussion on Analysis of gender, market, environmental, and socio-economic consideration of potential livelihood options. Section 6.3 of the Livelihoods Assessment Report Annex Iib details the profiling of the proposed climate-resilient livelihoods including their capacity to adapt, implementation modality and scope, suitability for engaging women, economic and environmental sustainability and profitability potential.

314. While the distribution of livelihoods, based on Union level profiles, has been undertaken as part of project design, and a budget estimated accordingly, participatory beneficiary mapping and livelihood planning should be undertaken during the first year of the project. This is critical to ensure that beneficiary preferences, socio-economic profiles, and equity considerations are taken into account in supporting adoption of climate-resilient livelihoods.
## Table 23: Categories and characteristics of resilient livelihoods

<table>
<thead>
<tr>
<th>Category of climate-resilient livelihoods</th>
<th>Targeted households whose livelihoods by climate-induced salinity and cyclones</th>
<th>Climate-resilient livelihoods and value chain development to be supported</th>
<th>Rationale: how these livelihoods link to the overall Strategy to shift non-adaptive to climate-resilient livelihoods</th>
<th>How these livelihoods and value chains are adaptive in light of projected risks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Category A: Shift towards climate-resilient agriculture-based livelihoods</td>
<td>These opportunities are targeted at households that practice agriculture based livelihoods which are threatened by increased soil salinity (driven by cyclone-related tidal surges and sea level rise).</td>
<td>Climate-resilient livelihoods: Homestead gardening, hydroponics, plant nursery, sesame cultivation</td>
<td>These livelihoods will be based on saline resilient crop varieties and can be established on existing small piece of land of the small landholders. Some production systems (aqua-geoponics) are portable.</td>
<td>Households whose livelihoods are largely dependent on agricultural activities, which are being impacted negatively by climate change, can diversify into producing saline tolerant crops and vegetables; As well as processing, market and trade of agricultural products that are adaptive because they would:</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Enable the beneficiaries to shorten the crop production time through using advanced agricultural technologies to cope with seasonal variations in soil salinity levels</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Utilizes saline resilient crop varieties to cope with projected, increasing levels of soil salinity</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Adopt the climate-smart practice of crop intensity to ensure regular cash flow for the HH by harvesting short duration crops and vegetables</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Utilize less fresh water for irrigation purpose by providing varieties of crops and vegetable that require little irrigation and advanced agriculture techniques such as hydroponics and aqua-geoponics.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Enable the HH to adopt low cost and high yielding organic fertilizer options that reduce the soil salinity.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Adding value to climate-resilient agriculture products strengthens the case for adopting/implementing new practices.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Indicate the importance of adapting to new conditions for HH who are facing the impacts of climate change.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Enable the HH to use technology to adapt to new conditions for HH who are facing the impacts of climate change.</td>
<td></td>
</tr>
</tbody>
</table>

**Climate-resilient livelihoods: Crab and fish feed processing**

These livelihoods support the most marginal community members, without assets to maintain their traditional agricultural based livelihoods, and who work as seasonal agrilabourers, to support income opportunities, that are resilient to climate change driven salinization processes.

**Climate-resilient livelihoods: Crab farming, crab nursery**

These livelihood options will enable HH with pre-existing skills in fisheries management to adapt their species towards saline resilient fish varieties, capable of coping with increasing salinity levels.

**Value chain development: Crab hatchery**

Households whose livelihoods are largely dependent on fisheries activities, which are being impacted negatively by climate change, are able to adapt their fish farming activities because they would:

- Utilize species resilient to high levels of salinity
- Enable the beneficiaries to run shorter production cycles to reduce the risk of seasonal-change or cyclone related impacts on breeding cycles (e.g. the crab fattening is done between 12-22 days, aqua-geophonic within 120 days)
- Empower the HH to maintain their fishery activities in their traditionally used water bodies even with increasing salinity levels

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6.3.3 Recommended climate-resilient livelihood options

315. There are many options identified for change or adjusting and diversifying the means of livelihood in the coastal zone (see the Livelihoods Assessment Report, Chapter 7 Recommended Interventions to Support Climate-resilient Livelihoods Focusing on Women in Targeted Areas for details by ). Each livelihood recommendation is based on the rationale for adopting an adaptive approach that reduces climate-related vulnerability through ecosystem management and restoration activities that sustain and diversify local livelihoods. This requires knowledge, and increasing capacity of all stakeholders involved to understand the benefits of climate-resilient livelihoods. See the Livelihoods Assessment Report, Section 1.6 Methodology for a detailed description of the criteria recommended to select climate-resilient livelihoods. In summary, selecting beneficiaries needs to consider:

1. population exposure to climate change;
2. Water vulnerability (now and projected);
3. Livelihoods vulnerability;
4. Gaps in coverage in other related projects;
5. Access to finance;
6. Physical infrastructure.

316. A summary (Table 24) provides proposed interventions at union level as well as targeted beneficiaries and associated costs using the selection criteria above. The interventions would reach 25,425 direct women beneficiaries (women being part of a women livelihood group) and involve 1,017 new groups. The total direct intervention costs (assets and inputs for the climate-resilient livelihoods) would be approximately BDT 437,061,513. See section 7.2, Livelihoods Assessment Report, Annex IIb for detailed information by upazila. The selection of livelihoods for the different groups will be decided through a participative process during the implementation phase of the project.

Table 24: Overview of proposed climate-resilient livelihood interventions in each upazila

<table>
<thead>
<tr>
<th>Upazila</th>
<th>Livelihood options proposed</th>
<th>No of unions</th>
<th>No. of groups</th>
<th>Women beneficiaries</th>
<th>Unit cost per livelihood</th>
<th>BDT investment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shyamnagar</td>
<td>Homestead gardening</td>
<td>4</td>
<td>23</td>
<td>575</td>
<td>106,850</td>
<td>BDT 2,457,550</td>
</tr>
<tr>
<td></td>
<td>Hydroponics</td>
<td>8</td>
<td>38</td>
<td>950</td>
<td>325,000</td>
<td>BDT 12,350,000</td>
</tr>
<tr>
<td></td>
<td>Aqua-geoponics</td>
<td>2</td>
<td>6</td>
<td>150</td>
<td>518,400</td>
<td>BDT 3,110,400</td>
</tr>
<tr>
<td></td>
<td>Sesame cultivation</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>543,563</td>
<td>BDT 0</td>
</tr>
<tr>
<td></td>
<td>Plant nursery</td>
<td>3</td>
<td>4</td>
<td>100</td>
<td>541,587</td>
<td>BDT 2,166,348</td>
</tr>
<tr>
<td></td>
<td>Crab farm/fattening</td>
<td>8</td>
<td>94</td>
<td>2350</td>
<td>271,264</td>
<td>BDT 25,498,816</td>
</tr>
<tr>
<td></td>
<td>Crab nursery</td>
<td>2</td>
<td>2</td>
<td>50</td>
<td>360,515</td>
<td>BDT 721,030</td>
</tr>
<tr>
<td></td>
<td>Crab feed processing</td>
<td>4</td>
<td>11</td>
<td>275</td>
<td>1,260,250</td>
<td>BDT 13,862,750</td>
</tr>
<tr>
<td></td>
<td>Crab hatchery</td>
<td>1</td>
<td>(1 upgrade)</td>
<td>46,893,921</td>
<td>46,893,921</td>
<td></td>
</tr>
<tr>
<td>Dacope</td>
<td>Homestead gardening</td>
<td>6</td>
<td>44</td>
<td>1100</td>
<td>106,850</td>
<td>BDT 4,701,400</td>
</tr>
<tr>
<td></td>
<td>Hydroponics</td>
<td>8</td>
<td>91</td>
<td>2275</td>
<td>325,000</td>
<td>BDT 29,575,000</td>
</tr>
<tr>
<td></td>
<td>Aqua-geoponics</td>
<td>3</td>
<td>10</td>
<td>250</td>
<td>518,400</td>
<td>BDT 5,184,000</td>
</tr>
<tr>
<td></td>
<td>Sesame cultivation</td>
<td>3</td>
<td>32</td>
<td>800</td>
<td>543,563</td>
<td>BDT 17,394,016</td>
</tr>
<tr>
<td></td>
<td>Plant nursery</td>
<td>4</td>
<td>8</td>
<td>200</td>
<td>541,587</td>
<td>BDT 4,332,696</td>
</tr>
<tr>
<td></td>
<td>Crab farm/fattening</td>
<td></td>
<td></td>
<td></td>
<td>BDT 0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Crab nursery</td>
<td></td>
<td></td>
<td></td>
<td>BDT 0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Crab feed processing</td>
<td></td>
<td></td>
<td></td>
<td>BDT 0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Crab hatchery</td>
<td></td>
<td></td>
<td></td>
<td>BDT 0</td>
<td></td>
</tr>
<tr>
<td>Koyra</td>
<td>Homestead gardening</td>
<td>7</td>
<td>38</td>
<td>950</td>
<td>106,850</td>
<td>BDT 4,060,300</td>
</tr>
<tr>
<td></td>
<td>Hydroponics</td>
<td>7</td>
<td>77</td>
<td>1925</td>
<td>325,000</td>
<td>BDT 25,025,000</td>
</tr>
<tr>
<td></td>
<td>Aqua-geoponics</td>
<td>1</td>
<td>5</td>
<td>125</td>
<td>518,400</td>
<td>BDT 2,592,000</td>
</tr>
</tbody>
</table>
6.3.4 Climate-resilient value chains

317. It is important to support climate-resilient, value chain development in order to enable livelihoods to function at scale. Chapter 6.4 of the Livelihoods Assessment Report Annex IIb provides an assessment of the two most relevant value chains in the region, namely the crab and vegetable value chain. It is based on the market and value chain assessment, as well as local expert and stakeholder consultations (see Stakeholder Engagement Plan in Annex XIIIId). Value chain assessments were conducted in all five targeted upazilas between 4th and 11th February 2017. Through analysis of available options and the value chain assessments the need to upgrade facilities, including crab hatcheries and crab feed processing enterprises, was clearly identified. Demand for these facilities is clearly demonstrated in Annex IIb (crab farming is currently a profitable and thriving industry) and they will enable beneficiaries to enter this market, without causing major environmental and social impacts (including harvesting young crablets from natural sources). The market map shown in Figure 34 illustrates the stakeholders involved with the crab value chain from production to the end-consumer. Section 6.4.1 of Annex IIb provides an assessment of: value addition steps, market system, business environment, business development opportunities, upgrading opportunities and constraints, gender responsiveness, as well as an assessment of demand and supply.

318. There are many stakeholders involved in the vegetable value chain, adding value from production to end-consumption through transportation, bulking and packaging. The market map in Figure 35 shows that relationships between actors are not stable, and that market stakeholders do not organize and tend to do business individually. To strengthen productivity, interventions are required in the dotted areas of the market map. For example, there is a need to develop producer groups and collector groups and the technical and marketing skills of these groups. See Annex IIb (Section 6.4.2) for details of the vegetable value chain assessment.
Figure 34: Crab Market Map for Five Upazilas in the Study
6.4 Climate-resilient drinking water technologies
6.4.1 Existing and Potential Water Technologies

319. A list of potential water supply options was developed primarily from the water supply technologies currently in use in the Satkhira and Khulna coastal communities (as identified through the Drinking Water Assessment Report, Annex IIC). The long-list of water supply technologies\(^{356}\) is as follows:

1. Shallow Tubewell (STW);
2. Deep Hand Tubewell (DHTW);
3. Piped Water System (PWS);
4. Pond Sand Filter (PSF);
5. Rainwater Harvesting (RWH) System;
6. Reverse Osmosis (RO) Plant;
7. Managed Aquifer Recharge (MAR);
8. Pond based filtration treatment system.

320. The first seven water supply technologies in the list were recorded as currently in use through the PRA process. The pond based filtration treatment system was added to the list as an alternative to the PSF for treatment of pond surface water that provides full removal of microbial contamination. Pond based filtration treatment system technologies have been implemented in a number of locations including by the GoB-led HYSAWA project in the Satkhira District (outside the target coastal communities).

321. Two additional innovative technologies were briefly considered but excluded from the long-list. Zero liquid discharge desalination was reviewed but there are no known installations in Bangladesh and this technology would rely on a local application for the salt by-products. Carocell solar purifiers (a low technology form of desalination) was also reviewed but excluded from the long-list due to no evidence of successful reliable installations in the target coastal communities.

322. The current use of the identified water supply technologies primarily depends on the local availability of freshwater sources (surface water, groundwater and rainwater) and the social acceptability of the options. The eight water supply options were assessed using a comprehensive set of evaluation criteria to identify the appropriate water supply technologies for communities under the proposed project districts\(^{357}\) (Khulna and Satkhira):

- Proven local technology (proportion of households that are presently using the options)\(^ {358}\);
- Availability (Reliability to meet demand year-round for water and accessibility of water source);
- Resilience to increased salinity;
- Sustainability of Operation and Maintenance (O&M) (level of technical expertise required);
- Social impact and acceptability;
- Affordability: Economic aspects;
- Provides safe drinking water;
- Environmental impacts.

\(^{356}\) The listed options that are currently being used by local communities are 1 through 7; the additional pond based filtration treatment system option was added as an alternative to PSF that will provide full protection from microbiological contamination.

\(^{357}\) Specifically covers 39 predetermined unions only of 5 Upazilas under Khulna (3 Upazilas i.e. Paikgacha, Koyra and Dacop) and Satkhira (2 Upazilas i.e. Shyamnagar and Assasuni) district (note: these were neither covering all unions under the upazilas nor all upazilas of the districts)

\(^{358}\) Is meant to providing ‘indicative popularity’ of the systems/options as sources of drinking water (except Shallow Tubewells, that are mainly being used for the domestic purposes other than drinking during normal period, while the sources are exceptionally used for drinking purpose during the period of crisis i.e. natural disasters)
The description of each water supply technology option and their applicability in the context of the proposed project area are discussed in the sub-sections 7.2 through 7.8 in the Drinking Water Assessment Report Annex IIC, section 7.2. In the Drinking Water Assessment Report Annex IIC, Chapter 8, Upazila Profiles and Proposed Water Technologies provides the technology design-standards and sites for each type of recommended technology. The schematic diagrams and technical drawings of the water technologies are provided in the Drinking Water Assessment Report, Annex IIC, Chapter 10 Portfolio of Climate-resilient Water Technologies. The evaluation of each option against the above criteria is a multi-criteria assessment (MCA). The evaluation criteria are in line with the GCF investment criteria and MCA results are presented in sub-section 7.3 of the same report. The results of the MCA are presented in Table 25 below.

Table 25 Results of MCA

<table>
<thead>
<tr>
<th>Drinking Water Technology</th>
<th>Proposition</th>
<th>Selected/Not selected</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shallow Tube Well</td>
<td>STWs are not considered as a safe drinking water source due to climate change induced salinity and the DPHE does not promote STWs implementation programmes.</td>
<td>Not Selected</td>
</tr>
<tr>
<td>Deep Hand Tube Well</td>
<td>DTWs are recognised as existing safe sources of drinking water and hence included as improved water source in JMP. All groundwater is considered to be at risk of climate change induced salinity over the long-term. The availability of deep groundwater aquifers is also limited in the target wards and therefore new DTWs were not proposed as part of this project.</td>
<td>Not Selected</td>
</tr>
<tr>
<td>Piped Water Supply</td>
<td>A piped water system would rely on a significant water source such as deep groundwater aquifer which are rare in the target communities. The community-based viable institutional arrangement has not been experienced in the study areas. This is why community based piped water supply system is not proposed.</td>
<td>Not selected</td>
</tr>
<tr>
<td>Rainwater Harvesting System</td>
<td>Due to an abundance of rain water in the coastal area, along with local traditional practice, familiarity with and fascination for the RWH, this option has been proposed as the main technological option. The community expressed a high desire for RWH.</td>
<td>Selected</td>
</tr>
<tr>
<td>Pond Sand Filter</td>
<td>Due to widely-observed maintenance difficulties and test results showing microbiological contamination, PSFs are not proposed for safe drinking water coverage. The community proposed the installation of some PSFs where fresh ponds were available, however these have been replaced with pond based filtration treatment systems to provide safe drinking water.</td>
<td>Not selected</td>
</tr>
<tr>
<td>Pond based filtration treatment systems</td>
<td>Pond based filtration treatment systems are proposed as an alternative to PSF that will treat pond water and provide full removal of microbiological contamination (i.e. meet the GoB drinking water standards and World Health Organisation (WHO) guidelines for drinking water). The filtration treatment technology options for the pond water sources include an improved PSF design or membrane filtration treatment package plants.</td>
<td>Selected</td>
</tr>
<tr>
<td>Managed</td>
<td>Since the potential of MAR and its applicability in salinity affected coastal areas</td>
<td>Not selected</td>
</tr>
</tbody>
</table>

359 Ibid.
## Drinking Water Technology

<table>
<thead>
<tr>
<th>Proposition</th>
<th>Selected/Not selected</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aquifer Recharge (MAR)</td>
<td>region is yet to be proven sustainable over the long-term, it was not considered as proposed technology option for the study area.</td>
</tr>
<tr>
<td>Reverse Osmosis (RO)</td>
<td>Due to the negative environmental impacts and the potential for RO to increase salinity in the receiving environment, this technological option has not been proposed for increasing safe drinking water coverage in the study area.</td>
</tr>
</tbody>
</table>

324. Rainwater harvesting is the preferred option from the MCA analysis due to its resilience to climate changed induced salinity, capacity to provide safe drinking water year-round and lack of adverse environmental impacts. Rainwater harvesting at existing community and institution buildings will have the highest cost efficiency due to economies of scale. Household-level RWH is also part of the proposed solution as it can supply people with no access to community or institution based RWH or pond treatment systems, especially people living far away from these systems, women and adolescent girl headed households, people with disabilities and minority groups.

325. The water supply gap in the target wards (for year-round, safe drinking water) is too large to address solely through installing RWH systems at existing community and institution buildings. The existing surface water ponds are an alternative and popular option of potable water supply in the coastal belt and arsenic prone areas. Ponds typically do not dry up during the dry season and can provide a viable additional safe water source after treatment. The existing Pond Sand Filters (PSFs) are a simple low-cost technology using slow sand filtration, but most existing PSFs have been unable to fully remove microbiological contamination. In addition, inadequate O&M arrangements and inundation of the ponds during high storm surges and damage to filters have left many PSFs in the area unusable. To improve climate-resiliency and prevent saltwater intrusion during intense cyclonic events, selected fresh water ponds (not in the vicinity of / exposed to shrimp farming or other aquaculture), will be supported by raised embankments. The pond selection will also focus on existing ponds that are not saline and can provide year-round water availability. Furthermore, filtration treatment systems will be installed at these sites to provide filtered pond water that meets the GoB drinking water standards and World Health Organisation (WHO) guidelines for drinking water. The filtration treatment technology options for the pond water sources include an improved PSF design or membrane filtration treatment. Filtration treatment modules will be installed in a well-protected superstructure, which are resilient to disaster shocks.

### 6.4.2 Site/Beneficiary Selection for drinking water solutions

326. The targeted households in 39 Unions of 5 upazilas under Khulna and Satkhira Districts will be provided with safe water options through the following systems:

- Household based rainwater harvesting systems;
- Community/Institution based rainwater harvesting systems;
- Community based pond filtration treatment system.

327. The RWH systems were designed at the three levels of household, community and institution. The RWH systems, comprising the roof catchment, conveyance, storage, and the delivery, have been designed to support year-round access to safe drinking water based on the water security target set at a minimum of 2 litres of drinking water person per day. The available rainfall data records were analysed and the worst-case scenario was found to be 180 consecutive days of dry period with no rainfall. The RWH storage tanks have been sized for 180 days. Based on the expressed concerns of the communities and
experiences of local NGOs, simple filtration and/or disinfection methods would be used to mitigate contamination of stored rainwater, along with improved maintenance of the roof catchment.

328. The proposed drinking water supply solutions were then prioritised for the target households based on the following list in descending order of cost effectiveness:

- Community level filtration treatment of pond water supplying 200 households (and including raising embankments to protect the pond water from saline intrusion during storm surge)
- Institution-scale RWH with large storage tanks (supplying 75 households) and very large storage tanks (supplying 100 households) at existing institutional buildings with large roof catchments (schools and colleges)
- Community-scale RWH with small storage tanks (supplying 25 households) and medium storage tanks (supplying 50 households) at existing community buildings (primarily at community buildings such as mosques, temples, cyclone centres, community clinics and other private owned buildings used for community purposes) and existing institutional buildings with smaller roof catchments (primarily in institutions such as schools, colleges, Union Councils and other government institutions)
- Household-level RWH with a 2,000L tank based on a household size of 5 people (the average household size is 4.4 and this was used for design of the community and institution-scale tanks). At least 20 per cent of total target households in each ward will be covered by household based systems.

329. The beneficiaries for community/institution based systems will be selected by the implementing organizations. Since safe distance for water collection has been assumed as 1 km for the users based on preferences of targeted women beneficiaries and their households, the location of the households of beneficiaries for all of the community and institution-scale RWH systems designed and the pond water filtration treatment system will be within 1 km of water point.

330. Priority for selection of beneficiaries for household based systems will be given to people in a manner that is sensitive to marginalization and possible selection bias, by ensuring that the final selection reflects the demographic situation of the districts. Household selection should be done in a manner that religious minorities also have access to community and household interventions (the target districts have an approximate Hindu minority population of 30 per cent), as well as to female-headed households and those with disabilities. Furthermore, ethnic minorities in the area (Indigenous people, known locally as adivasi) who also might not have access to the community water options will all receive coverage, and overall to those people who live outside 1 km radius of the water points.

331. The selection of sites for community/institution-based systems will follow the proposed number of systems for each ward. The total number of proposed community-scale and institutional-scale RWH systems in each ward, union and upazila is provided in the Drinking Water Assessment report – Annex IIC (see annex to report: Union profiles).

332. The community and institution RWH locations have been identified and defined. A building database was developed of community and institution buildings in the target districts. Key parameters recorded included the location name, roof area and the condition of the building and roof structure. The building database was used to identify four sizes of RWH storage tanks based on the roof catchment area.

- Small tank volume of 45m³ requiring a roof area of at least 75m²
- Medium tank volume of 90m³ requiring a roof area of at least 150m²
- Large tank volume of 135m³ requiring a roof area of at least 225m²
- Very large tank volume of 180m³ requiring a roof area of at least 300m²
333. The capacity of the proposed tank sizes to provide the required water supply has been verified through a daily rainwater tank volume analysis over the historical climate record (31 years of daily rainfall data from two weather stations, one in Satkhira District and one in Khulna District) using the assumptions for minimum roof area, maximum households supplied and with a rainfall capture efficiency of 85 per cent. The long-term average rainfall in the Satkhira District during the three wettest months from June to September is 10.8 mm per day. The long-term average rainfall in the Khulna District during the three wettest months from June to September is 11.6 mm per day. The maximum rainfall required to fill each tank and the estimated number of days to fill the tank during the average rainy season are shown below (the maximum rainfall figures are conservative as they are based on the smallest roof size for each community and institution tank).

- A household tank will require 422 mm of rainfall to fill. During the average rainy season in Satkhira this is equivalent to 39 rain days and in Khulna this is equivalent to 36 rain days.
- The community and institution tanks will require a maximum of 706 mm of rainfall to fill. During the average rainy season in Satkhira this is equivalent to 65 rain days and in Khulna this is equivalent to 61 rain days (all of the community and institution tanks have been scaled proportionally.)

334. As discussed in Section 1, climate change predictions are for the peak monsoon months (June, July and August) to become warmer and wetter and the dry winter months (December, January, February) will become warmer and drier. Specifically, a five per cent decrease in rainfall is forecast for the dry winter months by 2050. This would decrease the Satkhira winter rainfall from a long-term average of 46 mm to 44 mm. This would decrease the Khulna winter rainfall from a long-term average of 49 mm to 47 mm. The tanks have been sized to provide sufficient storage for 180 days (almost 6 months) of zero rainfall. The long-term average rainfall for the six driest months is 197 mm in Satkhira and 142 mm in Khulna. Clearly the 180-day design drought period is more conservative than the climate change prediction for a five per cent decrease in rainfall during the dry months.

335. Site surveys were undertaken at institution buildings targeted for the installation of large and very large rainwater tanks (supplying 75 to 100 households). The site surveys included preparation of a site map and data collection on key design parameters including the building dimensions, condition assessment, roof material, site boundaries, percent of roof with existing guttering, roof shape, roof slope, number of households within one km of the building, area of land available for construction of tanks, soil types, site elevation above mean sea level, existing power supply accessibility and availability and preliminary consultation undertaken with stakeholders on installation of RWH.

336. The selection of ponds for installing filtration treatment systems will be confirmed after testing water quality of pond water in laboratory. To improve climate-resiliency and prevent saltwater intrusion during intense cyclonic events, the selected fresh water ponds (not in the vicinity of nor exposed to shrimp farming), will be supported by raised embankments through the project. The final selection of sites and beneficiary households will be carried out by the implementing organization, which will be supported by local government officials (Union Council Chairman, Members, etc.), and the Department of Public Health Engineering (DPHE).

6.4.3 Recommended drinking water technologies and technical designs

337. The following recommendations are based on Annex IIc: Drinking Water Assessment Report, which details the site and beneficiary selection process, as well as reasons for the choice of water technologies in each upazila. Targeted households (those that currently do not have access to non-saline
drinking water sources) in each ward will be provided with safe non-saline drinking water through the following systems:

- Household based rainwater harvesting systems (minimum of 20 per cent of the target households in each ward);
- Community-scale rainwater harvesting systems supplying between 25 and 50 households per site;
- Institution-scale rainwater harvesting systems supplying between 75 and 100 households per site;
- Community pond based systems with filtration treatment supplying 200 households per site.

338. See Annex IIc: Drinking Water Assessment Report, Chapter 8 for a description of the proposed water technologies for each upazila and chapter 10 for the technical designs and diagrams of the technological setup for each different case. The specific design for each location will be dependent on the building construction and layout, but each household-based RWH systems will include construction of a raised platform for a plastic 2,000 L storage tank, new gutters and downpipes, simple sand filter and new Cast Iron (CI) sheet roof catchment for capturing rainwater (Figure 36).

339. The community-scale and institution-scale RWH systems will include construction of a reinforced concrete storage tank (four sizes), new gutters and downpipes, simple sand filter and roof catchment preparation.

340. The pond based systems will include a filtration treatment unit along with construction of a disaster resilient housing and accessories (Solar Panel, battery, solar pump, pipework between pond and unit, small tanks for raw water and fresh water etc. – see section 6.4.3.2 below). To improve climate-resiliency and prevent saltwater intrusion during intense cyclonic events, the selected fresh water ponds
(not in the vicinity of nor exposed to shrimp farming), will be supported by raised embankments through the project. Table 26 provides an overview of the proposed drinking water interventions by upazila.

Table 26 Overview of Proposed Drinking Water Interventions

<table>
<thead>
<tr>
<th>District</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>HH Based RWH</td>
<td>13,307</td>
</tr>
<tr>
<td>Cmmt-Scale 50 HH RWH New Roof</td>
<td>106</td>
</tr>
<tr>
<td>Cmmt-Scale 50 HH RWH</td>
<td>70</td>
</tr>
<tr>
<td>Community Pond Treatment System</td>
<td>41</td>
</tr>
<tr>
<td>Cmmt-Scale 25 HH RWH</td>
<td>36</td>
</tr>
<tr>
<td>Cmmt-Scale 25 HH RWH New Roof</td>
<td>16</td>
</tr>
<tr>
<td>Instn-Scale 100 HH RWH</td>
<td>7</td>
</tr>
<tr>
<td>Instn-Scale 75 HH RWH New Roof</td>
<td>6</td>
</tr>
<tr>
<td>Instn-Scale 100 HH RWH New Roof</td>
<td>5</td>
</tr>
<tr>
<td>Instn-Scale 75 HH RWH</td>
<td>1</td>
</tr>
</tbody>
</table>

Note:
1. Community-scale RWH – Small (for 25 households) or medium (for 50 households) size rainwater storage tanks located primarily at community buildings and smaller institutions.
2. Institutional-scale RWH – Large (for 75 households) and very large (for 100 households) size rainwater storage tanks that are located at larger institutions.
3. Where “New Roof” is not specified, the community and institutional buildings are recorded as having “Good” roof condition.
4. The “New Roof” locations cover community and institutional buildings recorded as having a “Moderate” roof condition where the roof will likely need major repairs to ensure the roof catchment can effectively harvest rainwater. The “New Roof” locations also cover additional buildings not captured in the building database.

6.4.3.1 Technical application of RWHS

341. The coastal region of Bangladesh receives approximately 2,900 mm rainfall every year but more than 70 per cent of this rainfall occurs during monsoon, making rainwater harvesting a potential solution to fulfill the water demand in this region. Rainwater harvesting (RWH) is a widely used term covering all those techniques whereby rain is intercepted and used ‘close’ to where it first reaches earth. RWH is a solution for drinking water crises in areas where there are no possibilities of providing safe water cheaply within a reasonable distance of households, as the ground conditions are unsuitable and surface waters are polluted or absent. For example, the ground may be impermeable (rock/stony layers precluding Tubewell construction), groundwater may be over-mineralized by fluorides, iron or even heavy metals (e.g. Arsenic contamination in Bangladesh), or the aquifer may have saline zones such as in the coastal areas, the aquifer may be too deep to reach or groundwater table rapidly declining. In these situations, the harvested rainwater can be a valuable alternate water supply option. The rainwater is free from arsenic and other impurities. The physical, chemical and bacteriological characteristics of harvested rainwater usually represent a suitable and acceptable standard of potable water.

342. The fundamental elements of a rainwater harvesting system include:

- **Collection/Catchment Surface**: The collection surface from where the rainfall runs off.

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Rahman and Akhter, 2011
Conveyance: Roof runoff is typically conveyed to a rainwater collection system via gutters with downspouts or roof area drains with leaders. Filtration devices are often used to remove particulate contaminants en route to storage. In some systems, a first-flush method is used to completely bypass an initial amount of roof runoff so that it cannot enter storage.

Storage: Tanks or cisterns are used to store harvested rainwater, which may be placed in various locations. A number of processes automatically occur within the tank itself such as settlement, flotation and pathogen die-off. Finally, some technique of disinfection (such as chlorination, solar disinfection or use of a ceramic filter) may be employed to the water after it is drawn from the tank.

Distribution/delivery system: Using harvested rainwater to fulfil designated uses normally requires filtering, treating, controlling flow to end-use, monitoring storage tank levels, and/or controlling the need for switching to backup/bypass/makeup water.

343. A catchment is an exposed surface area on which precipitation falls and flows towards a draining point. The volume and rate of rainwater runoff are functions of catchment area, intensity and duration of rainfall, slope of the surface, and type of surface material. Roofs are considered as the most effective choice for catchments. Water quality from different roof catchments is a function of the type of roof material, climatic conditions and the surrounding environment. Thin metal sheets (galvanized iron, mild steel etc.), often corrugated, are the most commonly used roofing material in rural areas. Because of the smooth texture, the rainwater collection is very efficient. Some caution must be exercised regarding roofing surface paints. Asbestos sheeting or lead-painted surfaces should be avoided by all means. Rainwater collected from roofs with copper flashings may cause discoloration of porcelain fixtures. Roofs made of clay or concrete tiles deliver rainwater which are suitable for both potable and non-potable use, but may contribute as much as a 10 per cent loss due to rough texture, obstacles in flow, evaporation and porosity. Bacterial growth is encouraged in rough surfaces and dirt may be accumulated on the corner of the tiles. To reduce water loss and prevent growth of microorganisms, tiles are painted or coated with a sealant. In this case, special sealants should be used containing little or no toxic materials. Roofing materials made of asphalt shingles (tar-like hydrocarbon speckled with coloured small ceramic granules) are prone to leaching of toxins from coloured shingles and the harvested water may not be appropriate for direct consumption as potable water.

344. Rainwater is typically conveyed from the collection surface (roof) to a storage tank or cistern in two ways:
   1. A sloped roof typically drains to gutters and downspouts at the outer edges(s) of the structure. Scuppers, oversized gutters, and other methods are employed for overflow protection.
   2. A flat or semi-flat roof may use roof area drains that connect to leaders (downspouts/ rainwater downpipes). Particularly for horizontal surfaces there shall be parapet around the surface to prevent free-fall of rainwater.

345. While the tank is the largest component of storage, there are numerous supporting components that are fundamental to the functioning of this element. The components of a storage system include the following (Figure 37): (1) Tank, (2) Rainwater Inlet from Conveyance (may enter the tank from top, side), (3) Calming Inlet (minimizes disturbance of sediment at bottom of tank by reducing agitation from the incoming water), (4) Intake (usually provides extraction of water from a location below top surface), higher water quality is found below the top surface and above the very bottom of the tank, (5) Overflow (excess water flows out of tank to grade), storm water sewer, storm water control devices, or other
appropriate path as per local requirements (6) Vent (provides ventilation for stored water and pressure relief from incoming water), and (9) Tank Access (should be secured to prevent unauthorized access).

![Diagram of rainfall cistern components]

Figure 37: Different components of a rainfall cistern

346. The distribution system is made up of the elements responsible for delivering water with the appropriate quality and pressure. All components in the distribution system need to be chosen carefully for compatibility and application purposes. Distribution is affected by factors such as location of the tank and the water supply expected from the rainwater system. In rural contexts, at the household, water can be collected and used from the storage tank directly, which may undergo a certain form of treatment/disinfection (UV, chlorination, etc.) in a separate container.

### 6.4.3.2 Technical application of Pond based systems

347. A membrane filtration unit filters raw water and makes the output one hundred per cent free from coliform/bacteria, and turbidity. It has a filtration unit through which raw water passes by gravity force and produces fresh water at the output. The preferable source of raw water could be fresh surface water from ponds, rivers, and lakes. Membrane filtration typically produces safe drinking water without the need for chemicals. The Schematic diagram of a filtration package plant system is shown in Figure 38.
Figure 38: Schematic diagram of a filtration package plant system

348. The filtration treatment will be selected for each site to ensure that the treatment will remove biological contaminants and pathogens making water safe to drink. The filtration treatment will remove turbidity and dirt from water however the flow output and maintenance requirements depend on the incoming turbidity. The filtration treatment will not remove salt, dissolved chemicals and minerals from water, therefore pond suitability will be confirmed by water quality testing.

6.5 Institutional capacity building and knowledge mechanisms for resilient livelihoods and drinking water solutions

6.5.1 Community mobilization and group-based planning, operations and management for resilient livelihoods and drinking water solutions

349. Both climate-resilient livelihoods and drinking water solutions have been designed as coordinated and complementary support mechanisms, with priority given to provide access to year-round, safe water to livelihood support beneficiaries. It is, therefore necessary that the groups formed to support each solution will be linked through their formulation and subsequent planning efforts, so that investments support each other. Adoption of climate-resilient livelihoods will increase incomes and assets, enabling sustained management of the drinking water provision (see section 6.6 below). Peer to peer learning and training of trainers approaches will be critical for sustainability of these groups.

6.5.1.1 Organisational structures for resilient livelihoods - Women Livelihoods Groups (WLGs)

350. To ensure continuation beyond the project’s lifetime, the project needs management structures within each producer group, which will provide material support, and at a later stage link individuals, groups or sub groups of 4 to 5 members with each other, to help problem solving and enable the possible development of their own support structures. Whilst providing technical and business skill training to members of the producer groups is important, it will be critical to have follow up and peer-to-peer training to retain acquired skills. Furthermore, it will be necessary to ensure that groups do not become dependent on 1 or 2 members for critical functions, and that group sustainability and management is able to continue if key members either leave or are unable to perform their functions. Producer groups will need to meet
periodically in order to fulfil their role as enablers of local-level knowledge exchange (both within and between groups), and as focal points for engagement with value chains and the private sector.

351. A total of 198 aquaculture-based and 819 agriculture-based Women Livelihood Groups (WLGs) are proposed to be formed for the project (see section 7.7.1 of Annex IIb). Initially WLGs of 25 women will be organised at the ward level for each proposed livelihood option. Existing women’s groups will be incorporated into the WLG or rehabilitated if they are dysfunctional. Group members should be clustered according to existing capacities (financial and technical) and their geographic location in order to avoid creating mobility barriers, such as long commutes. A participatory market mapping exercise can introduce the proposed livelihood options and identify market potential, implementation barriers and mitigation options, current capacities and needs for support. WLGs should further collaborate with Union disaster management and Paani Committees to: (i) Develop and disseminate awareness materials; (ii) Display local activities/land use and climate related hazards on GIS maps; (iii) Conduct awareness raising activities at public gatherings and cultural activities. The WLGs should meet on a regular basis to create strong linkages between the women and on-going training with different foci (as outlined above). Additionally, WLGs should be supported by local institutional structures including the Women Standing Committees (WSCs), which are established structures that operate at the Union level and comprise of local extension support (LGI) staff. The WSCs can support WLGs in addressing institutional barriers and enhancing coordination with upazilas and districts.

6.5.1.2 Organisational structures for drinking water management - Water User Groups (WUGs) and Water Management Committees (WMCs)

352. In order to ensure smooth implementation of the proposed freshwater technologies, the participation of user groups as well as officials from local government and DPHE is critical. These committees/groups should be formulated to promote equality and considering the local political economy; Two types of groups/committees are envisaged:

- User groups at the household-level;
- Water management committees at the ward level.

353. Additionally, these groups/committees will need to communicate and coordinate with the LGI at the Union level. In each of the targeted wards in 39 Unions, one water management committee should be formed whose main responsibility be to look after the water options provided to ensure proper management of the systems. Management committees will need to be formed prior to installation and commissioning of water options. The members of the management committees will comprise of:

- Local government representatives (Ward Councillor)
- Representative from DPHE
- One representative from each of the community/institution based system (rainwater tanks/pond based systems)
- One representative from each of the user groups
- Local expert(s) with knowledge of water management

354. The responsibilities of the water management committees in each of the targeted wards include:

- Adaptive water distribution planning
- Planning of adaptive operation and maintenance of water options, including water quality monitoring

- Development of fee-based model and financial management system
Addressing the problems/issues raised by user groups
- Monitoring of caretakers' performance to operate the community/institution based water options
- Contacting the suppliers and taking necessary steps for system troubleshooting, any repair or maintenance works
- Re-organization of the committee as per requirement

355. Water management committees should be responsible for arranging the quarterly meetings once in each quarter of the year after its formation. User groups should be formed comprising of one member (a female beneficiary) from each of the targeted households, in clusters based on their proximity to the water source and the type of water option received. Each group will gather every three months to discuss the supply of water in their households and any water related issues (e.g., water quality, availability of water year-round, hygiene practices, etc.). The implementing NGO will facilitate user group meetings and will need to be responsible for providing support to address the problems discussed in user group meetings.

6.5.2 Institutional capacity strengthening

356. The project will need to work on capacity development of staff within implementing organizations and the target households, carefully considering the following institutions, actors and technical requirements.

357. **Private sector market development actors** such as business service providers, traders and retailers are important to engage and work with to ensure that inputs for climate-resilient livelihoods are accessible at fair market prices, that marketing and value chains for products locally accessible, and that supplies and spares for drinking water solutions are readily available. Public-sector organisations including agricultural extension services and fisheries, will need to be engaged as part of developing skills for targeted households – this is important to ensure long-term sustainability and the potential for building training skills which can be utilised later in other areas. Institutional training will also be needed to support PPIs, value chains, and market linkages (e.g. DWA and LGIs coordinating with SME foundation): (i) District and upazila level Government officer training on PPIs/ PPPs; (ii) O&M of value chain facilities. The proposed construction and/or rehabilitation of crab hatcheries will require extensive engagement with PPIs and associated value chains. Crab hatcheries will need to be operated under the Bangladesh Fisheries Research Institute (BFRI) – a government entity with experience in operating hatcheries for the aquacultural sector. The hatchery confirmed that they would prioritize the supply of crablets to women beneficiaries targeted in the proposed project. The crab hatchery needs to be upgraded to ensure the biosecurity of the facility and to expand production capacity to ensure the sustainability of this climate resilient livelihood pathway over time. Technical skills training of staff from the hatchery should be provided at comparable and well-established hatcheries in another Asian country, such as the Philippines.

358. **Strengthen skills and capabilities around assessing climate change risks and scenarios**, and to develop the toolkits on climate risks and impact scenarios related to various livelihoods and water supply, climate-risk informed livelihood and water supply planning, cost-benefit models, programme design and management, and M&E approaches to assess adaptive capacities and impacts of livelihood programs and to plan and implement solutions. Fundamental to this is however, having awareness and knowledge to

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361 MoWCA needs to facilitate public sector engagement including SME foundation and UNOs
enable LGI and government departments to take decisions that are adaptive and climate-resilient. It will be necessary to codify and integrate knowledge products, such as climate risk and scenario analyses, design and implementation tools and products for climate-resilient livelihood and drinking water solutions, and best practices and lessons learned into institutional platforms, training modules for academic institutes, and a web-portal for wider dissemination. Capacity building on climate change risks and scenarios for both livelihoods and drinking water will require: (i) Development of adaptation planning scenarios for both livelihoods and drinking water; (ii) ToT on CC risks/impacts to enable further dissemination and communication with both LGI and communities; (iii) ICT software and training; (iv) Development of climate risk models and analyses.

359. Technical assistance to coordinate and to provide dedicated support for climate change program priorities. As DPHE has personnel at district level and below, coordinating strengthening mechanisms need to be introduced at the local-level and climate change included in the work of other government institutions in order to be effective in including climate change considerations in planning. In particular, the capacity to design and implement innovative/climate-resilient solutions, such as RWH and pond based systems, needs to be developed to enable DHPE to support these types of investments and technologies in the future. A regional database should be established to map water supply sources and infrastructure, which can support effective coordination across implementation efforts and investments: tackling real issues from the sectors and territories on the ground and elaborating on the knowledge, attitude and behaviour of the community before and after the use of each technology. Moreover, for the project to have an impact, it needs to ensure that this information is provided to local systems and mechanisms to ensure local ownership and avoid perpetual dependency on international institutions and resources in order to maintain the information system. MoWCA will need to improve cross-sectoral coordination to support integration of gender and climate change into other socio-economic activities, through development and dissemination of a ‘Gender Sensitive Climate Change Adaptation’ training module and training of staff in mainstreaming gender and CC across sectoral policies and programs. Additional research and innovation will also be needed to: (i) Assess the feasibility of long-term water options, such as RO and MAR; (ii) Understand surface water availability through modelling (also needed to develop climate risk scenarios below); And (iii) training on planning/modelling solutions.

360. Strengthen institutional mechanisms from national to local-level: Local government representatives have demonstrated an awareness of salinity impacts, indicating that storm surges reduce pond water quality, and that crop choices need to change due to the intrusion of saline water in cultivable land. However, understanding how these effects and impacts will adversely affect the lives and livelihoods of their respective constituencies and how to appropriately respond, is another step which needs addressing at the local-level. Local government institutions should be empowered to conduct climate integrated community risk assessments with local citizens to identify their own location-specific adaptation plans. At both national and local-levels government officials will need training which enables them to integrate climate change in future work, allowing for redundancy in the case when individuals may be transferred from their respective positions. Strengthening governance and coordination between ministries/departments (e.g. between MoWCA and DHPE) will also improve water management at the institutional level. This will further develop and promote knowledge of challenges related to water supply and help to develop strong water management strategies. The promotion of cost-effective and adaptive water management as well as technology transfer, would also encourage the leverage of additional funds through both increased national budgetary allocations and innovative funding mechanisms. Strengthening implementation capacities for MoWCA, LGIs, and NGOs will be needed, particularly around: (i) Training for MoWCA, DWA, LGIs (extension staff) supporting implementation on climate-resilient
livelihoods; (ii) DWA/LGIs training on result monitoring and social auditing of climate-resilient livelihoods through a ToT approach.

361. **Build the capacity of local organizations on climate change**: Local organizations such as NGOs and CBOs need to be provided support to enhance their analytical capacity to develop and apply their own climate change integrated development plans. Greater coordinated efforts need to be considered to build further capacity of NGOs and CBOs, including the exchange of good practices and lessons learnt through working with stakeholders, including local authorities, civil society and communities, to develop specific strategies for risk awareness that include the most vulnerable groups. Capacity building will be needed for stakeholders in water supply management, to monitor the condition of infrastructure, plan O&M and garner user feedback: help develop the database for registration of related infrastructure; Utilise equipment for water quality testing and monitoring; O&M tools/kits, training and workshops on monitoring and O&M. Engagement with national and international agencies that either implement interventions, or work in target locations and have standing within communities, should also be undertaken at the start of project activities to ensure local buy in. This will also foster communication and knowledge sharing, particularly of lessons and best practices. Sessions will need to be facilitated during group meetings or any other occasions when all group members are present, to improve KAP (Knowledge, Attitude and Practices) of their members with regards to climate adaptive practices and management of associated risks.

362. **Improve gender-responsive, actionable EWs and climate information** through engagement of women and girls in the dissemination of currently circulated warnings. The purpose of this intervention is to ensure that precautionary measures are taken by people to reduce their vulnerability, losses and damages. Communities should be able to use early warning systems to minimize damage to water supply infrastructure and harvest all stock to minimize losses. In particular, there is a need to increase women’s role in monitoring and maintenance of infrastructure (early warning, embankment breach, river erosion, infrastructure breakage). Women and community’s access to early warning and their capacity to respond to disasters including evacuation, water security, community resource management and planning, similarly require women’s decision-making authority and engagement at the local-level. Thereby increasing women’s participation in decision-making through contingency planning for disaster and resilient livelihoods, water provision, disaster preparedness committees and early warning systems.

363. **Establish longitudinal impact monitoring mechanisms** for gathering valuable data and lessons to enable evidence-based policy, planning, and implementation of climate-resilient programs for livelihoods and water supply. In addition, an impact evaluation should be designed and beneficiary selection criteria modified if necessary. Knowledge and technical skills for the technical support staff, research and development staff, implementation support staff (including LGI staff), and gender focal points will need to be built to provide enabling support for the interventions, including gender responsive actions and coordination with existing initiatives. Knowledge that can be used for evidence-based learning will need to be generated. Strengthened technical capacities combined with knowledge and learning will help promote replicability and scalability. By focusing on the younger generation, the project could enhance climate change resilience through transformative adaptation for the long-term. The project should help establish real time efficacy and longitudinal impact monitoring mechanisms to gather lessons and policy evidence. Part of this can be through randomized control trials, or other impact evaluation methods, to assess the efficacy of actions. In particular, it will need to: (i) integrate knowledge, good practices, tools, and approaches within academia, schools, training institutes; (ii) mainstream adaptive livelihood planning into appropriate curricula; (iii) mainstream planning and tools for climate-resilient water solutions into BUET and RDA; (iv) target learning for marginalised groups, including girls, on climate risks and impact.
6.5.3 Awareness-raising, skills development, and linkages for climate-resilient livelihoods and value-chains

364. The following recommended actions are suggested to develop the implementation of climate-resilient livelihoods, utilising the above-mentioned committees and user groups, through which women can exert greater collective influence than through traditional mechanisms or individually. The first set of actions will build and improve the knowledge-base and technical capacity of women to plan, lead, and take ownership in their selection of climate-resilient livelihoods, as well as diversification of current livelihood activities. As a first step, it will be necessary to undertake participatory beneficiary mapping and livelihood planning initially at project start up to ensure that beneficiary preferences and equity considerations are taken into account at the outset. Working through the WLGs will help to ensure cost-effective approaches and enable economies of scale to build bargaining power when WLGs engage in value-chain related activities and with markets. Further support will be needed to WLG in procuring and leasing land for communal ponds and lots, so that poorest households benefit from community-based facilities. A key requirement will be that WLGs and WUGs work together and coordinate their efforts to ensure that each set of group activities supports the other. It will also be necessary to support women with the necessary assets and skills to start new livelihoods, though a phased approach should be considered i.e. build the financial capacity to procure their own inputs. Technical training and community sensitization campaigns will be needed for transfer of skills, promotion of best practices; And awareness raising on fair working conditions, land tenure arrangements and negotiation. The sustainable management of inputs and production will need to be promoted, including management of wild crab stocks and crab fry, use of hatcheries and alternatives to mangrove fuel wood, and effluent management.

365. In order to facilitate the development of profitable value chains for climate-resilient products it will be necessary to build and improve the capacity of WLGs to access markets and financial resources. This will involve raising awareness on the value addition of products e.g. through the construction of crab hatcheries, and transporting to markets; training for hatchery technicians and on crab processing; training and support to develop and understand the importance of scheduled O&M tasks, marketing of products, developing business plans, and the advantages of co-management strategies for community resources. A networking platform as a means to engage different value chain actors through PPIs should also be promoted where possible, as well as strengthening the capacity of women groups and value chain actors to access finance (including through financial intermediaries).

366. An additional set of activities should also build and improve the knowledge-base and technical capacity of actors involved in the value chain of climate-resilient livelihoods, to incorporate climate-risks in decision making processes and operations. This involves raising awareness and capacity building for WLGs and value chain actors on climate and disaster risk management for livelihoods, including all parts of the value chain, not just production but also transport to markets, risks to inputs etc. Private sector market development actors such as business service providers, traders, retailers, and public-sector organisations will need to be engaged for skill development of the targeted households.

367. Community groups will need further training and awareness activities on being able to evaluate gender norms and inequities in gender expectations, stereotypes, and discrimination, and their impact on male and female relationships. Training would need to include skill building for women beneficiaries on
how to negotiate ownership of assets, equipment, and/or land. The training and community sensitization activities should also target male family members to make sure they do not compel women members to transfer the ownership of assets to their male counterparts.

6.6 Operations and Maintenance (O&M) of livelihood infrastructure and drinking water technologies

6.6.1 Post-project operations and maintenance for livelihoods infrastructure

368. Beneficiaries should be responsible for the operations and maintenance of livelihood assets and technologies promoted. With support and capacity building on the management of the assets and technologies, as well as on marketing and financing plans, beneficiaries will be able to re-invest part of their income into continued provision of inputs and up-keep of livelihood assets. It is recommended that GCF finance is used to develop O&M plans during the project implementation, recognising that more intensive O&M will be required for the crab hatchery. Due to the ownership situation of the two facilities to be upgraded, while the responsibility for O&M will remain with BFRI, the project should still support the initial development of an O&M plan.

6.6.2 Operation and Maintenance of the Drinking Water Technologies

6.6.2.1 Management System for Water Supply Operations and Maintenance

369. The Feasibility Study proposes a three-tiered operations and maintenance (O&M) system (based on community consultations as well as discussions with LGIs and DPHE) based on consultations and findings from the Drinking Water Assessment Report.

- Tier 1: Beneficiary households and Water User Groups (WUGs)
- Tier 2: Union Parishad and ward level Water Management Committees (WMCs)
- Tier 3: DPHE

370. The regular planned O&M will be led by the WUGs and the WMCs (Tiers 1 and 2), apart from any third-party contract for the filtration treatment technologies, which will need to be the responsibility of DPHE (Tier 3). The WUGs (Tier 1) will be formed comprising members from each of the targeted households (with women as a priority) and will be clustered based on their access to the identified drinking water solution sites. It is expected that the average size of a WUG will be 50 households. For WUGs covering institution RWH systems, the WUGs will include beneficiary households and members of school management committees.

371. In each of the 101 targeted wards in 39 Unions, one WMC (Tier 2) will be formed whose main responsibility will be to look after the water technology solutions provided to ensure proper management of the systems. The WMCs will be formed at the ward level and will comprise local government representatives (Ward Councillor/representative from the WATSAN standing committee), representative from union level DPHE, representatives from associated WUGs, owners/representatives (at least 2) from each of the institutional/community buildings/facilities, and the technician/caretaker for the cluster of water solutions.

372. The O&M responsibilities for each of the three tiers are explained below.

- **Tier 1**: WUGs will need to be responsible for daily and/or monthly monitoring of the water supply systems, in particular, the household-level RWH (HH RWH), community-scale RWH
systems and the daily operations of the pond treatment systems. The WUGs together with
the school management committees will be responsible for the institution-scale RWH
systems. The WUG responsibility includes minor maintenance tasks as well as distribution of
water to the households from the community-scale and institution-scale RWH systems and
pond treatment systems. The project will initiate and facilitate, through capacity building and
peer-to-peer learning activities, continued monitoring of the availability and quality of the
systems, simple O&M needs, and collecting the nominal fee per household. The household
fee will cover the materials for regular minor maintenance as well as a contribution towards
the caretaker’s salary. The beneficiary households of the HH RWH will need to undertake the
minor maintenance with support from the caretakers as required. The fee paid by households
with HH RWH will cover the cost of a water tap, adhesives and thread tape for repairing minor
leaks in the joints (elbow and T joints) as required. The fee paid by households with HH RWH
does not include the cost of materials for cleaning their HH RWH roof catchment/tank/filter
materials, which will be the responsibility of the households. For RWH systems located at
educational institutions, Tier 1 includes co-management by WMC and the school
management committee. The school management committee will assist with operations and
maintenance of the school based RWHs.

- **Tier 2:** WMCs (at the ward level) will staff a technician/caretaker for each ward. The WMC
  have backstopping support from the WATSAN Standing Committee (WSC) at the Union Level.
  Each caretaker will be responsible for providing maintenance support to the household RWH
  systems and to the WUGs leading the operations and maintenance for the community and
  institution-scale water supply points. The caretaker will need to be responsible for an
  associated cluster of WUGs including WUGs for nearby household RWH systems. Co-financed
  by the WUG (through the nominal fees collected from every beneficiary household), and the
  Union Parishad contributions, this resource would be available to support daily operations
  and minor repairs including maintenance of pond treatment systems (excluding the annual
  third party module maintenance which is under Tier 3) and maintenance of RWH systems
  including roof catchment cleaning, tank cleaning and minor repairs of taps, joints, gutters and
  pipes.

- **Tier 3:** DPHE co-financing will phase in to backstop and cover the O&M costs related to
  replacement/major repairs of community and institution system infrastructure (e.g.
  conveyance systems including gutters and downpipes which have an expected life of 5 years),
  and potentially full system rehabilitation in case of unanticipated cyclonic shocks. For the
  pond-based systems that have filtration treatment package plants installed, installation with
  warranty would be procured to ensure robust technical support for long-term viability of
  these solutions. DPHE will also be responsible for the third party contract for filtration
  treatment plant package (for example change of membrane and filter materials). The third-
  party contract for package plants will need to include a fixed rate for the supply of
  replacement parts over the full lifecycle of the membranes. Post-project O&M would
  continue to be supported through community and DPHE financing and the commitment
  letter indicates the O&M and replacement/major repair costs to be covered by DPHE beyond
  the project lifetime.

373. The project will support capacity building for all the stakeholders in participatory, community-
based water access, distribution, and delivery planning and implementation to ensure gender-targeted,
inclusive, and equitable access to safe, year-round drinking water. WUGs will be facilitated to meet,
discuss, and plan for water supply for their households, including continuous monitoring of water availability and quality as well as peer-to-peer learning on safe health practices.

374. In case of major rehabilitation or infrastructure replacement, DPHE should rebuild or repair the systems (Tier 3). In this case, DPHE will include these costs in their regular development programme and ensure the maintenance is carried out. To ensure regular O&M, the Union Parishad can use their WATSAN allocation (up to 500,000 BDT or USD 6,230 per year) to contribute towards the annual O&M costs including the caretaker salary and water quality reagents. They will undertake small repair schemes under their Test Relief/ Food for Work/ ADP allocation/ LGSP allocation/ 80 days work schemes. In each programme, the WATSAN committees have provision for such maintenance work.

6.6.2.2 Fee Based Model

375. The provision of and access to water will need to be anchored in a fee-based model (based on existing practices) that will engender ownership and commitment to securing drinking water for the targeted households. The fee should be based on affordability considerations and financing available. The average annual operations and maintenance cost (excluding major repairs and infrastructure replacement) per household is discussed further in Annex IIc.

376. The fee can be standardized according to the water supply technology with one fee per HH for HH RWH, one fee per HH for Community/ Institution-scale RWH and one fee per HH for treated pond water (the fee could be different from one ward to another but not from one RWH site to another RWH site within the same ward). The fee will need to support basic operation needs including simple cleaning and minor repairs and will be used as an O&M fund to collectively contribute to the staffing of a technician/caretaker maintained as part of each WMC. RWH systems entail low operation and maintenance costs; However, the pond-based solutions entail higher technical complexity and a need for robust O&M support. The pond-based treatment solutions will need to have regular maintenance by a local caretaker and could be managed by a third-party service contract provider with a contract jointly signed by the Union Parishad and DPHE.

377. All stakeholder capacities (including LGI and DPHE) to develop and implement O&M plans and sustain, continuous adaptive planning in light of evolving climate risks will need to be improved. In particular, adaptive water distribution planning and management of drinking water solutions will need to go through WMCs, including: planning of adaptive operation and maintenance of water options, water quality monitoring, development of fee-based model and financial management system, resolution of the problems/issues raised by WUGs, staffing and monitoring of caretakers’ performance to maintain the community/ institution based water options, identifying the suppliers and taking necessary steps for system troubleshooting, any repair or maintenance works, and renewal of the committee itself periodically. DPHE capacities will also need to be strengthened to provide backstopping and major O&M support as outlined in the O&M plan. DPHE’s District/ Upazila Assistant Engineer will oversee the technicians/mechanics assigned to each of the Union Parishads as support under LGIs.

378. There is proven experience of two-tier community involvement for water supply points from water interventions implemented by WaterAid in Satkhira and Khulna. The WaterAid approach has been to have regular maintenance supervised by a Management Committee (Tier 1 equivalent to the proposed WUG) with oversight and strategic decisions regarding the water point provided by the Ward Development Management Committee (Tier 2 equivalent to the proposed WMC). In 2016, WaterAid conducted a study to analyze the sustainability of the water interventions including those built in Satkhira and Khulna. The Tier 1 Management Committees have played a pivotal role in ensuring proper
maintenance, by regularly raising funds from local beneficiaries. The members of management committees have identified increasing awareness among beneficiaries, lack of access to alternate drinking water sources and saline intrusion as the main reasons behind beneficiaries regularly paying for maintenance.

6.6.2.3 Maintenance Tasks for Rainwater Harvesting Systems

379. The success of the RWH systems to provide safe drinking water will be dependent on how well the system is maintained. The RWH collection system and tank should be designed to make maintenance as easy as possible to increase the likelihood that those responsible for the systems will follow proper maintenance protocols. Downspout filters should be installed at a location easily seen and accessed by system users to facilitate frequent inspection and cleaning. The treatment filters should be easily accessed and cleaned. Storage tanks should have access ways and drawdown valves should be installed to make tank cleaning and sediment removal easier.

380. Tasks that should be performed regularly include cleaning the catchment surface, gutters, and storage tanks; Cleaning filters, first-flush diverters, and debris screens; And inspecting the system for possible points of entry for mosquitoes and vermin. These tasks are described further in Table 27. The importance of maintenance to the overall success of the rainwater harvesting system should be conveyed to the households (for household-level RWH), WUGs, WMCs and caretakers. Establishing a maintenance contract between the owner and the system provider (wherever applicable) can reinforce the necessity of timely and through maintenance practices and protect the designer from system problems that arise due to lack of maintenance. Additionally, an owner’s manual should accompany every rainwater collection system and should include detailed troubleshooting guidance, maintenance tasks and frequency, and replacement part component details. Water safety plans will be developed for effective risk management.

381. Table 27 outlines the required regular planned maintenance tasks for RWH systems and the recommended frequency. The beneficiary households will be responsible for carrying out the regular planned maintenance tasks for the household RWH, with support from the ward level caretaker. The WUGs will be responsible for carrying out the regular planned maintenance tasks for the community and institution RWH with support from the ward level caretaker. Repairs (both minor and major) are unplanned maintenance tasks and will be additional to the regular maintenance tasks. Repairs will be carried out on an as needed basis.

Table 27: Planned Maintenance Tasks for RWH Systems and Recommended Frequency (from WaterAid 2017, adapted for rural conditions)

<table>
<thead>
<tr>
<th>Task</th>
<th>Description/Details</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clean roof surface and gutters</td>
<td>Manually clean rooftops, gutters and downspouts by hand, with hand tools, brooms and rakes. If using water to flush rooftops, gutters, or downspouts, be sure to divert this debris-laden water so that it does not flow into downspouts, filters or the tank. Inspect gutters for leaks and holes; Repair as needed. This is especially important after leaf fall.</td>
<td>A minimum of once per month. For sites with over hanging vegetation, after each significant rainfall event.</td>
</tr>
<tr>
<td>Inspect and clean debris filter(s) and first-flush diverter(s)</td>
<td>Disassemble, clean and replace screens on all inlet filters as needed. Disassemble and clean as needed. Inspect all downspouts, clean any obstructions, inspect all inlets and overflow pipe assemblies to ensure they are unobstructed</td>
<td>After each significant rainfall event</td>
</tr>
</tbody>
</table>

362 School management committees will also provide support for Institution RWH maintenance
6.6.2.4 Planned Maintenance tasks for pond based systems

To operate the pond based filtration treatment system, a trained caretaker with good knowledge of the system will be required. Therefore, one caretaker will be trained on operational maintenance of the system at each site, who will be responsible for maintenance of the system. The caretaker will also be responsible for regular communication with the suppliers of the materials that will be needed on a regular basis to keep the system functional. The regular planned operations and maintenance tasks required for the pond based systems are shown in Table 28. The filtration package plants are expected to should function for the design life provided that the regular maintenance is undertaken (particularly the manual cleaning procedure). The daily maintenance tasks will be undertaken by the WUGs with support from the ward level caretaker. The caretaker will be responsible for the monthly and annual tasks.

Table 28: Planned Maintenance Tasks for Pond Based Systems and Recommended Frequency

<table>
<thead>
<tr>
<th>Task</th>
<th>Description/Details</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manual cleaning of filters</td>
<td>Manual cleaning of the filter modules is required followed by backwash of dirty water. This manual cleaning procedure is essential to maintain the correct flow of drinking water and prevent the filtration module from clogging. For the slow sand filters, manual cleaning involves actively managing the top layer of sand through gentle agitation.</td>
<td>At least daily and preferably more often depending on site conditions. Every few months for sand filters</td>
</tr>
<tr>
<td>Solution cleaning of the membranes</td>
<td>Solution cleaning removes accumulated organic matter and other contaminates from the membranes not removed by the regular manual cleaning. A diluted chlorine solution would be used to remove deposits of organic matter from inside the filtration unit.</td>
<td>Weekly or monthly</td>
</tr>
<tr>
<td>Check operations of solar pump</td>
<td>The solar pump will have a sensor that will start the pump once water inside the raw water tank goes below a certain level. Check that this is working properly</td>
<td>Twice daily at the beginning and end of operations</td>
</tr>
<tr>
<td>Check hand pump works</td>
<td>Use the hand pump and ensure that it can pump water up to the header tank. A hand pump is provided with the system to be used as a backup for rainy days and emergency situations, when the solar pump cannot be run.</td>
<td>Weekly</td>
</tr>
</tbody>
</table>
6.6.2.5 Design Life for Water Supply Infrastructure

383. Table 29 provides the design assumptions for the replacement frequency of the water supply infrastructure.

Table 29: Assumptions for Water Supply Infrastructure Replacement Frequency

<table>
<thead>
<tr>
<th>Infrastructure type</th>
<th>Expected useful life</th>
</tr>
</thead>
<tbody>
<tr>
<td>Household roof catchment</td>
<td>5 years</td>
</tr>
<tr>
<td>Household concrete platform</td>
<td>5 years</td>
</tr>
<tr>
<td>All gutters and downspout pipes</td>
<td>5 years</td>
</tr>
<tr>
<td>Community and Institution building roof catchment</td>
<td>20 years</td>
</tr>
<tr>
<td>Filter materials</td>
<td>5 years</td>
</tr>
<tr>
<td>Rainwater tanks</td>
<td>40 years</td>
</tr>
<tr>
<td>Pond based filtration treatment system</td>
<td>10 years</td>
</tr>
<tr>
<td>Pond embankment</td>
<td>10 years</td>
</tr>
</tbody>
</table>

384. Table 3 shows that regular replacements (every five years) are expected for household-level RWH roof catchments, concrete platforms, filter materials, gutters and downspout pipes (but the largest cost item of the tanks are expected to last 40 years). Similarly, regular replacements (every five years) are expected for community-scale and institution-scale RWH filter materials, gutters and downspout pipes. The pond based filtration treatment replacements will depend on the selected technology and will vary from five years (improved pond sand filter) to ten years (membrane filtration). Ten years has been assumed for the filtration treatment system, along with the higher capital cost associated with membrane filtration.

6.6.2.6 Training for Users and Caretakers

385. The caretakers of community water systems and users of the water technologies (WUGs) will need to be trained on proper way of operation and management of the systems. The user training should be conducted once every year for the users of household based systems and the user groups of community and institution systems (including the school management committee members). The training will focus on hygienic practices for water storage, collection, transportation and use. The water quality management of drinking water should be discussed in the training sessions and the caretaker will also be monitored by
the safeguards staff to ensure that there are no issues with inequitable distribution of water, particularly to marginalized groups.

386. Caretaker training be done once every year where the caretakers of different community systems (rainwater harvesting and pond water treatment) will be trained on operation, maintenance and management of the water systems. For the caretakers of pond based filtration treatment systems, the suppliers of any filtration treatment package plants will train the caretakers. Caretakers will also be trained on water quality testing using the toolkits. One set of water quality test kits will need to be provided to each of the Unions which can be used to test pH, Turbidity, Total Dissolved Solids, Electrical Conductivity and Faecal Coliforms. Caretakers and/or WUGs will also need to be responsible for performing water quality tests of their systems.

6.6.2.7 Water Quality Management

387. The design includes simple sand filters for all the rainwater systems and the pond based systems will have filtration treatment to provide water that meets GoB drinking water standards. There is the possibility of water getting contaminated during transportation of water and storage in house. Therefore, in the training sessions, water quality management of stored rainwater and the importance of disinfection by boiling before drinking water will need to be discussed. Two disinfection techniques could be given priority considering the local context: boiling and simple solar disinfection systems. During the training sessions, the trainers will discuss these other methods of disinfection and will encourage users to disinfect water before drinking.

6.6.2.8 O&M material requirements

388. Table 30 shows the description of each of the water supply annual O&M activities and financing assumptions. Table 31 shows the description of each of the water supply renewals that will occur within the 10-year post project period.

**Table 30: Description of the Water Supply Annual O&M Activities and Costs**

<table>
<thead>
<tr>
<th>Tier</th>
<th>O&amp;M activity</th>
<th>Description of O&amp;M activity</th>
<th>Financing assumption</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tier 1</td>
<td>Annual O&amp;M materials associated with household RWH systems</td>
<td>Minor maintenance performed by household members (e.g. cleaning roof catchment, gutter, downpipes, repair of water taps, cleaning of filter media)</td>
<td>Households with HH RWH undertake minor maintenance and pay a fee to cover materials and contribution to the caretaker</td>
</tr>
<tr>
<td>Tier 1</td>
<td>Annual O&amp;M materials associated with Community-scale RWH systems</td>
<td>Minor maintenance performed by WUG (e.g. cleaning roof catchment, repairs of water taps, replacement of filter media)</td>
<td>Cost covered by household fee.</td>
</tr>
<tr>
<td>Tier 1</td>
<td>Annual O&amp;M materials associated with Institutional-scale RWH systems</td>
<td>Minor maintenance performed by WUG and school management committees (e.g. cleaning roof catchment, repairs of water taps, replacement of filter media)</td>
<td>Cost covered by household fee.</td>
</tr>
<tr>
<td>Tier 1</td>
<td>Annual O&amp;M materials associated with pond embankments and filtration systems</td>
<td>WUG will be responsible for battery maintenance, yearly maintenance of accessories and embankment</td>
<td>Cost covered by household fee.</td>
</tr>
</tbody>
</table>
Table 31: Description of the Water Supply Major Repairs/Replacements

<table>
<thead>
<tr>
<th>Replacements</th>
<th>Timing</th>
<th>Financing assumption</th>
</tr>
</thead>
<tbody>
<tr>
<td>Partial replacements for household RWH system components: roof catchments and conveyance elements (5-year expected life)</td>
<td>Within the 10-year post-project period</td>
<td>75% of the cost would be covered by households, 25% by DPHE (based on DPHE funding 50% of the replacement cost of the roof sheet and gutters/downpipes)</td>
</tr>
<tr>
<td>Partial replacements for community-scale RWH systems: conveyance elements (5-year expected life)</td>
<td>Within the 10-year post-project period</td>
<td>DPHE to fund 100%</td>
</tr>
<tr>
<td>Partial replacements for institution-scale RWH systems: conveyance elements (5-year expected life)</td>
<td>Within the 10-year post-project period</td>
<td>DPHE to fund 100%</td>
</tr>
<tr>
<td>Replacements for pond embankment raising and filtration systems (10-year expected life)</td>
<td>Within the 10-year post-project period</td>
<td>DPHE to fund 100%</td>
</tr>
</tbody>
</table>

389. Forecasts for the expected annual O&M costs, along with infrastructure replacements at the end of the expected useful lives (partial replacements of the rainwater harvesting systems as described in Table 31) are presented in Chapter 10 of the Drinking Water Assessment Report (Annex IIc), for the O&M and renewal unit cost estimates (including contingency).

6.7 Recommendations to improve uptake and sustainability

390. As noted above, GoB intends to scale this project to other districts further east, which have been identified as being vulnerable to the same climate change impacts on salinity, agricultural livelihoods and drinking water as Khulna and Satkhira. Any funded project could support the development of a roadmap to assist GoB in identifying key needs and sustainable financing mechanisms for the future. In particular, the following activities advance the potential for uptake and sustainability:

- Supporting diversification to climate-resilient livelihoods through formation of Women Livelihood Groups (WLGs) and value-chain actors promotes community-based enterprises, economies of
scale, and an adaptation market place for resilient technologies, products, and services. Improving the capacity for income generation can enable scale-up of livelihoods through micro-credit and financial mechanisms.

- Training of trainers and peer-to-peer learning approaches for promotion of resilient technologies, business development, and livelihood management skills can support replication to other wards across the Unions. Development of MoWCA and LGI capacities (including Women Standing Committees) for climate-risk informed implementation and management of resilient coastal livelihoods supports livelihood interventions in other districts.
- The establishment of women and girl volunteer groups at the ward level enables last-mile dissemination of EWs for enhanced resilience. By training and promoting learning exchange for the Union level DMCs and CPP volunteer groups, the project enables replication of the women and girls volunteer mechanisms to other wards.
- Community-centred investments in resilient drinking water technologies, co-managed by WUGs and WMCs at the Ward levels, have the potential to be replicated to other communities across the non-targeted wards of the 39 Unions. DPHE’s national and sub-national technical capacities on climate risks and drinking water impacts, design of resilient technical solutions (connecting with engineering institutes), and community-centric management of drinking water solutions will also be enhanced.

### 6.7.1 Sustainability

391. To ensure sustainability, a range of different strategies need to be followed and mechanisms established, including: (i) Gender responsive decision-making processes; (ii) Developing the organisational structures of community groups and stakeholder engagement; (iii) Building capacity for financial management and economic sustainability; (iv) Developing and supporting public private initiative platforms; (v) Introducing new adaptive technologies and interventions; (vi) Improving environmental management; And the (vii) sensible expansion of climate-resilient markets and value chains. Additionally, the introduction of new approaches to integrating climate change and developing the adaptive capacity of vulnerable women will have multiple benefits, which extend beyond the lifetime of this project.

392. **Economic impact:** Targeted households will benefit economically, in many cases rising above the poverty line and linking via existing value chains to markets. Household risk management and adaptive capacity in the face of change and rising income levels is expected to increase and sustain livelihoods beyond the project. Greater access to markets for climate-resilient products will be secured and reflected in an increased number of women producers, buyers, and retailers and the number of new value-added products sold in local and national markets. The development of assets, leading to economic empowerment and market led approaches will support these changes, whilst trading platforms and collective trading points will act as vehicles for excluded groups to trade with the market. Economic mainstreaming of the targeted households is important and these platforms should provide the basis for achieving these gains. Community groups can help with the provision of credit to individuals, groups or sub groups of four to five members, from banks or microfinance institutions providing specialized loan products or services. Targeted training on financial management and access should be provided to community groups, where follow up peer-to-peer training is encouraged to reach beyond immediate beneficiaries and group members. For an indepth recommendation, see section 7.7.1, Livelihoods Assessment Report Annex IIb.
393. **Financial management and economic sustainability:** Improving the abilities of the women to create sustainable income and manage the gained finance will be another objective of the project. During the WLG meetings and organised thematic workshops, women would learn basic business and financial management skills. As literacy rates among targeted households might be low, appropriate support will need to be given to those with specific needs. If the interventions involve sharing profits and operating a community-level enterprise (e.g. larger crab pond), those women with the highest capacities in the WLGs would be selected and trained to handle finance or fulfil different other functions in the group. The financial support (in form of assets and inputs) for the women and groups will be phased out throughout the projects lifetime to increase the sense of ownership and responsibility by the beneficiaries. The development of assets and steady income will lead to economic empowerment and established market linkages allow women to identify and realise opportunities beyond the project’s lifetime.

394. **Public private initiative platforms:** Public private initiatives (PPI) are relatively new concepts in climate-resilient development projects in Bangladesh. The project will need to establish PPI platforms at the upazila level that will enable women beneficiaries to interact with relevant value chain actors (public and private stakeholders) and jointly work on developing new sustainable markets, and strengthen existing linkages within the value chains as well as jointly identify and address barriers. Initially, MoWCA is recommended to host the platforms, while the responsibility would gradually be handed over to private business and the women livelihood groups.

395. The PPI platform will form collaborations based on negotiating scenarios and shared value. At the ward level, the WLGs have the incentive to obtain services and information based on their feedback. At the union level the WLG committees and the local-level government officers would have the incentive to easily monitor the status and situation of the WLGs. At the upazila level, the government agencies have mandates of providing timely delivery of services which can be easily facilitated by this platform. Moreover, the private sector would be enabled to reach out to the last mile consumer and increase their customer base. PPI platforms can further act as feedback mechanism at which local concerns or best practices can be brought to attention of value chain actors and upazila level LGIs, potentially leading joint problem-solving processes.

396. In each of the 5 targeted upazilas, one PPI is recommended to be established that can create an enabling environment, promote climate-resilient livelihoods and value chain governance and development, and, ultimately, act as an effective collaborative mechanism as part of the project’s exit strategy.

397. **Introduction of new adaptive technologies and interventions:** The project will introduce new technologies like hydroponics and aqua-geoponics at individual and community levels, which will need to be long-lasting and can be used after the project terminated. These technology-focused livelihood interventions are designed to withstand sudden and incremental climate change impacts, should be located in proximity of the women’s households, and can increase their productivity of the women producers when compared to traditional technologies used. The technologies, apart from the ones used at crab hatcheries, are easy to maintain and apply. Women should be trained to maintain and operate the technologies to develop new skills and ensure their ability to continue using the technologies after the project’s lifetime.

398. Through different workshops with value chain actors and at the ward level itself the WLGs would be exposed to roadshows of different adaptive technologies and innovations in their respective livelihood. This enables a flexible adjustment of their production techniques in the event that new adaptive
technologies enter their value chains. Access to information about new technologies would ensure the uptake of best-suited technologies to adapt to increasing climate change impacts as well as keeping their production competitive.

399. **Environmental sustainability:** The livelihoods support and expansion of value chains has made explicit consideration of reducing environmental impacts and enhancing environmental benefits. Improved agricultural practices, including training in organic and pesticide free techniques, will lead to a significant reduction of the use of chemical fertilizers and pesticides in homestead and community agriculture, with multiplier effects on public health and water quality. The interventions will also lead to the introduction of optimized aquaculture techniques, essential in a context of rapidly expanding small-scale aquaculture in the area, which will include the incorporation of a range of environmental management practices. Currently, small-scale semi-intensive aquaculture in Bangladesh does not make adequate use of effluent management techniques. Given the pressures on wild stocks in Bangladesh, both from collection of wild fry from mangrove areas, as well as the use of by-catch for feed processing, the project will need to address both these factors by building crab hatcheries for the supply of crab seed and introducing a low-fish meal formulation of the fish feed in aquageoponics and crab farming. To strengthen the impacts of these interventions, the project will need to provide regulatory support to GoB on environmental management in aquaculture (ensuring no expansion of small-scale farms into areas close to mangroves or agricultural land), as well regulatory support to shift away from wild fry collection to hatchery produced stock. Introducing modern technology and implementing water treatment facilities would vastly improve the biosafety and environmental management of hatcheries. The fish species used for aquaculture have been selected to avoid ecosystem-impacts from the introduction/promotion of invasive species and avoids carnivorous species, which would require a much higher weight of fishmeal for feed. These improved practices will directly contribute to long-term environmental sustainability, inspite of climate change worsening the associated climate stresses.

400. **Institutional and social:** Organization of the poorest community groups can provide them with a peer-to-peer social support system. This is important as the extremely poor generally have only few livelihood resources to draw upon and cannot risk undertaking livelihood development. The community adaptation groups can form stronger bonds with the private and public sectors and enable them to develop organizational structures, financial management, governance, human resource management, communication strategies and decision-making processes for mobilisation of resources from both private and public sources through negotiation and bargaining. Having the support of the wider community will increase their confidence. Through their collective voice, a systemic change can be initiated in the surrounding market and social environment. Women livelihood groups need to be enabled with a peer-to-peer social support system, as extremely poor women generally have only few livelihood resources to draw upon and cannot risk undertaking drastic livelihood changes. It is recommended to establish an organisational structure promoting women representation at different levels in their economic sectors.

401. **Technical capacities:** The capacity to adapt to new ideas, livelihood options and new technologies needs to be strengthened at individual, group and community levels, in order for communities to develop their own adaptation options in the future. Creating market channels and reducing the difference between market and offered (by intermediary traders) product prices will help to increase wages, access to jobs, as well as business related opportunities. Since targeted households will need to be linked with private sector businesses, services are expected to continue after the project. These will help to improve product quality, as well as reduce risk and discrimination. Improved climate-resilient and environmentally safe products, access and marketing will help to improve beneficiaries’ social dignity
and means of inclusion. Additionally, improved agricultural practices and aquaculture techniques will reduce the use of chemical fertilizers, external inputs and water, thus contributing to long-term environmental sustainability, despite worsening climate-related stresses.

402. **Sensible expansion of climate-resilient markets and value chains:** Expansion of climate-resilient livelihood options should be taken up by sector stakeholders (private/public) after the project finishes. Basically, two mechanisms can be expected to work in favour of 'self-propagation': (i) Neighbours of women beneficiaries might copy and uptake innovations, if they see that they are indeed profitable; And (ii) It is expected (and has been proven in previous interventions) that service providers do crowd-in, if they see a profitable business opportunity being taken up by a competitor. The intervention strategies will be to initially ensure a livelihood option is workable with defined target groups and close monitoring of the livelihood options defined above for each location. The appropriate mix of options will need to be modified based on uptake and market linkages, with the aim to maximise coverage, scale and impact. The idea is to develop appropriate business models, induce adoption of new methods and technologies, and trigger behavioural changes that are adaptable to the different circumstances of beneficiaries.

403. For more details on recommendations for livelihood interventions, see section 7.7.1, Livelihoods Assessment Report Annex IIb.

6.7.2 Access to finance

404. Access to finance is important in enabling targeted households to invest in the start-up phase of a new livelihood project, as without it extremely poor women of these households may be unable to take a new activity forward. One way of ensuring access to finance of targeted households or the lower layer actors of value chains is to organize groups, cooperatives or associations. This enables them to start savings programmes, link with specialized banks and specialized micro-credit organizations for financial services, as well as agricultural and SME loans programs. Such loans may be used to create facilities for storage, post-harvest processing and refrigeration, as well as encourage shared transportation on a collective basis. Groups organised through this project can negotiate with financial institutions to set up service centres to channel credit to targeted households, as well as try to ensure collateral free loans are available for the poorest recipients. Even local intermediaries should be helped to access credit, as the impacts are expected to benefit groups and beneficiaries (as in where loans are used to build infrastructure and facilities mentioned above). Repayment systems should be flexible and reflect the likely cash flow of associated livelihood activities. The project will emphasise bank finance as the interest on bank loans is cheaper than from microfinance institutions. Annual repayment systems for banks is better for beneficiaries as they can keep and use loan amounts for the whole year and run 2 or 3 production and marketing cycles.

405. **Gender responsive decision-making process:** Community groups will need to be trained to evaluate gender norms and inequities in gender expectations, stereotypes, and discrimination, and their impact on male and female relationships. This evaluation is important as it will enable men, women, and adolescent girls to participate equally in agricultural, fisheries/livestock production, income generation, and household activities, to the maximum benefit of households. These training will also include skill building for women beneficiaries on how to negotiate ownership of assets, equipment, or land. The training and community sensitization activities will also target male family members to make sure they do not compel women members to transfer the ownership to their male counterparts.
6.8 Cost-effectiveness

406. During the lifetime of the project, activities will need to be undertaken to ensure sustainability and a smooth exit-strategy. In order to achieve this, it is essential that solutions are cost-effective, meaning they are most likely to be continued after the project finishes. Therefore, drinking solutions should be implemented in collaboration with the local government and the private sector, with direct involvement of community groups. These solutions have been carefully surveyed and assessed for each location, ensuring that drinking solutions are sustainable and cost effective. The criteria for drinking-water supply solutions included preferences to preserve and protect what already exists (i.e. ponds from increasing storm surges) and to bring existing potable sources nearer to vulnerable populations, as well as prioritising community-level solutions over household where possible. The project will develop technological O&M guidelines, provide support for O&M of each solution, support local-level functional mechanisms for O&M including O&M fund development, and establish links between O&M service providers. In the long-term, successful O&M strategies are likely to reduce the need for large capital expenditures in the future, and hence contribute to keeping the overall long-term costs low (hence improving cost-effectiveness).

407. For populations to be targeted for the livelihood component, the project identified existing non- or maladaptive livelihoods that need to be switched away from. The climate-resilient livelihoods were chosen based on a cost-estimate and cost-benefit analysis. The cost-benefit analysis for each livelihood reflects the total cost for a single unit of the livelihood option and the benefits of one production cycle; the potential total revenues, profit margin and cost-benefit ratio. Based on the two-phased screening process for agriculture-based and aquaculture based livelihoods, eight identified climate-resilient livelihoods were chosen based on a criterion that included sustainability and profitability potential. The budget includes the cost for capacity building and overhead costs for project implementation for the livelihood component. (See Section 6.2 of the Livelihoods Assessment (Annex IIb) for further discussion).

408. Moreover, the benefits of the livelihoods and water interventions accrue to the same communities (with significant overlap between the beneficiary HHs) ensuring that the benefits are synergistic and promote cost-effectiveness of the interventions. This project has been designed in line with accepted best practices. At the national and international level, several projects can be used to assess the cost-effectiveness of this project (see Table 32). These are not entirely comparable in terms of technologies and livelihoods, nor geographical coverage, though they provide rough estimates for comparison. The cost of comparable projects in the coastal districts of Bangladesh and GCF projects in water and livelihood sectors worldwide, range from USD 15 (Nobo Jatra) per direct beneficiary to USD 1,714 (O’Horizon). Nobo Jatra is the most like-for-like project and works in the same geographic area: Satkhira and Khulna Districts. It has both a water and livelihoods component, valued at USD 15 and USD 67 per beneficiary respectively. Activities include installation of water systems and to promote livelihoods of the poor. It will establish Climate Smart Agriculture plots and engage with local producer groups.

409. Within the water supply and sanitation element, two Nobo Jatra activities (one for water supply and one for sanitation) out of six activities provide hardware. The Nobo Jatra project uses primarily simple designs such as sun-powered desalination and household-level simple latrines. Its water supply investments are not costly due to several reasons. Firstly, the project rehabilitates and/or develops water supply facilities such as deep tubewells and pond sand filters through co-investment schemes. As the project primarily rehabilitates existing water-supply facilities, the costs are significantly less than for a project that is installing new systems. Secondly, Nobo Jatra is installing deep tube wells and PSFs, both of which cost significantly less than rainwater harvesting and pond based advanced filtration
treatment, which were selected in this project for their climate-resilience attributes. Thirdly, the calculation of USD 15 per beneficiary includes 167,000 beneficiaries for the water component and the remaining beneficiaries (approximately 108,000) for the less costly sanitation component (of which approximately 9,000 will receive subsidies for new latrines).

410. All solutions have been tried and tested either in the region or the project area. For example, there are membrane filtration package plants available that have been designed for emergency, humanitarian and disaster relief situations, therefore are climate-disaster ready. The project addresses the technical and coordination capacities of MoWCA and DPHE, by incorporating capacity building at all levels (national, regional and local) such as facilitating knowledge generation and exchange, and establishing learning frameworks to sustain, replicate, and scale up resilient solutions. The capacity building will ensure that DPHE is able to directly support the targeted communities and local government staff with the implementation and sustained Project O&M. To address the lessons from LoGiC approach, the project will scale up through local government institutions, incorporating high quality accountability and participation of the most vulnerable people.
## Table 32 Relevant national and global projects with costs and beneficiaries

<table>
<thead>
<tr>
<th>Project Sector</th>
<th>Project Title</th>
<th>Project Focus</th>
<th>Country or Districts (BGD)</th>
<th>Financing (USD Million)</th>
<th>Beneficiaries (No of persons)</th>
<th>Direct Beneficiaries Dollar spend per beneficiary</th>
<th>Total Beneficiaries GCF Dollar spend per beneficiary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Livelihoods</td>
<td>Increasing the Resilience of Ecosystems and Communities through the Restoration of the Productive Bases of Salinized Lands in Senegal</td>
<td>Ecosystem based Adaptation</td>
<td>Senegal</td>
<td>8,160,000</td>
<td>20,769</td>
<td>366.41</td>
<td>58.63</td>
</tr>
<tr>
<td></td>
<td>Agricultural Sector Capacity component</td>
<td>Nobo Jatra - LH</td>
<td>Khulna &amp; Satkhira</td>
<td>NA</td>
<td>53,000</td>
<td></td>
<td>67.00</td>
</tr>
<tr>
<td></td>
<td>Climate-resilient agriculture in three of the vulnerable extreme northern crop growing regions (CRAVE)</td>
<td>Agriculture</td>
<td>Namibia</td>
<td>10,000,000</td>
<td>8,000</td>
<td>1187.5</td>
<td>452.38</td>
</tr>
<tr>
<td>Water</td>
<td>Water Supply and Sanitation component</td>
<td>Nobo Jatra - W</td>
<td>Khulna &amp; Satkhira</td>
<td>NA</td>
<td>285,200</td>
<td></td>
<td>15.00</td>
</tr>
<tr>
<td></td>
<td>Strengthening the resilience of smallholder farmers in the dry zone to climate variability and extreme events through an integrated approach to water management</td>
<td>Water and Climate resilience</td>
<td>Sri Lanka</td>
<td>52,084,000</td>
<td>770,500</td>
<td>49.43</td>
<td>19.53</td>
</tr>
<tr>
<td></td>
<td>Supporting Vulnerable Communities in Maldives to Manage Climate Change-Induced Water Shortages</td>
<td>Water - Health, food and water security</td>
<td>Maldives</td>
<td>28,299,000</td>
<td>105,000</td>
<td>225.1</td>
<td>80.12</td>
</tr>
<tr>
<td></td>
<td>Our BioSand Filter Projects</td>
<td>O’Harijan/O’Horizon</td>
<td>Coastal</td>
<td>9,000,000</td>
<td>5,250</td>
<td></td>
<td>1,714.00</td>
</tr>
</tbody>
</table>
6.9 Exit Strategy

411. The project will provide financial support to bolster climate adaptation, in the form of additional equipment for climate-resilient livelihoods and drinking water supply, as well as training and capacity building for targeted beneficiaries and organisations. Securing the development of vulnerable women and girls, in areas highly vulnerable to future increases in salinity, enables them to take climate smart decisions and, in the course of their lifetimes, pass on climate smart practices to their children and grandchildren. Utilising locally-based NGOs further provides opportunities for sustained follow-up of livelihood support.

412. The work to promote climate-resilient livelihoods and drinking water solutions has been designed in consultation with local communities, NGOs/CBOs, traders’ associations and government agencies. These consultations were used to identify women-friendly climate-adaptive livelihood options and interventions that will need to be implemented by MoWCA through engagement with local communities, sub-contracting NGOs and government officials in the targeted districts, upazilas and unions. The project is centred on community participation and engagement with producer groups – to foster ownership and empowerment of poor women for implementation of project interventions. This will promote the integration of climate-adaptive practices into water-based traditional and non-traditional livelihoods, facilitating adoption of such practices in the long-term. Targeted capacity-building and training will inform planning, design, and implementation of adaptation measures based on the local socio-economic and environmental contexts. As part of its exit strategy the project will undertake the measures highlighted in section 6.7.1 above, which will promote the long-term sustainability of project activities. These include:

413. **Development of producer and water-based groups.** To ensure continuation beyond the project lifetime, the project will ensure a management structure of the producer groups for provision of material support and at a later stage linking individual, groups or sub groups of four to five members with each other to help problem solving and the possibility of developing their own support structures. Furthermore, it will be necessary to ensure that groups do not become dependent on one or two members for critical functions, and that group sustainability and management is able to continue if members undertaking critical functions either leave or are unable to perform their functions. It will be necessary to provide on-the-job support to the above committees/groups, private entrepreneurs and plant operators enabling them to provide sustainable O&M of all technologies and equipment. Establishing links between the committees/private entrepreneur and technical organizations/private O&M service providers, will help to ensure continued technical back-up and support.

414. **Climate-resilient and sustainable community livelihoods.** This support will need to enhance the financial viability of proposed climate-resilient livelihoods, resulting in sustainability and greater access to finance in the long-term. The support for production and business plan development as well as the financial and socio-economic benefits will need to incentivize beneficiaries to sustain the selected livelihoods, while promoting replication.

415. **Introduction of new technologies.** The project will need to introduce new technologies like hydroponics, aqua-geoponics. As long as targeted households improve their product quality, reduce risks and obtain fair prices for their products, these technologies can be sustainable beyond the initial project funding and capital investment. Reliance on project funds to sustain livelihoods therefore needs to decrease throughout the project lifetime, with only minimal funding provided during the last year of implementation. Interactions with a wide range of organisations and networks will need to help ensure long-term economic mainstreaming. Similarly, the proposed technologies for drinking water solutions should be implemented by the national government agency, the DPHE, in collaboration with the local government (upazila) and private sector with direct involvement of community or institution-based
committees. The household based RWH option should be implemented in collaboration with the upazila. The upazilas will identify the extreme poor, poor, women-headed households, who fit the prioritized beneficiary selection criteria. The community options, like RWH and pond based systems, should be implemented either directly by the implementing agency with involvement of a CBO committee formed by upazila. The institution-based RWH should be implemented in collaboration with the upazilas, with direct involvement of institution based management committees. After successful implementation of the water provision infrastructure, the implementing agency should hand over the installed facilities to the upazilas, the respective committees and the households selected, and will withdraw from the intervention process. However, before withdrawing it will be necessary to implement O&M guidelines, including WSP for the households, water user groups, water management committees and third-party service providers and provide necessary training and orientation to the UPs, water management committee members, plant operators and caretakers.

416. **Access to finance.** One way of ensuring access to finance of targeted households is to organize themselves into groups and start savings programmes, which will need to ensure finances are available to continue group activities, as well as develop a pool of finance which can be used to make small loans to group members when either climate or financial conditions are difficult. The project will need to assist beneficiaries to have access to finance initially, but will need to encourage savings and investments in the long-term, especially during productive years. This will be necessary to provide support for developing local-level functional mechanisms for O&M of equipment and tools, including O&M fund development.

417. **Uptake:** Sector stakeholders (private/public) will use various mechanisms for uptake. Basically, two mechanisms will work in favour of uptake or self-propagation. The first is on the level of individual targeted beneficiaries, where the copying effect will play a role in that neighbours will adopt innovations, if they see that they are indeed profitable. Secondly, service providers involved in input-output trading will play a vital role by supplying finance, quality inputs, information, knowledge and skills for uptake. The project will identify scale agents and their incentives which will ensure that the successful pilots will be replicated and scaled up. The scale agents include private sector companies, Banks, micro-finance institutions. The project has support provision for financial market analysis, financial service linkage workshop and orientation on financial linkage for group leaders. This will leverage loan finance for climate-resilient livelihood activities, supporting ongoing implementation and upscaling beyond the project lifespan.

418. **Contingency planning for producer and water-based groups.** Support will be needed in the case of loss and damage, due to either excessive droughts/floods, or a damaging cyclone. MoWCA, with the assistance of subcontracted NGOs, will need to help each of the producer groups develop emergency contingency plans to manage risks to livelihood options in such events. Technical support will need to be provided to the groups for developing/revising contingency plans, as well as developing recovery plans which enable livelihoods to recover with minimal disruption and cost. These plans should be linked to any group/community saving schemes that are developed, and set out how best to use different levels of available funds to recover from such impacts.
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