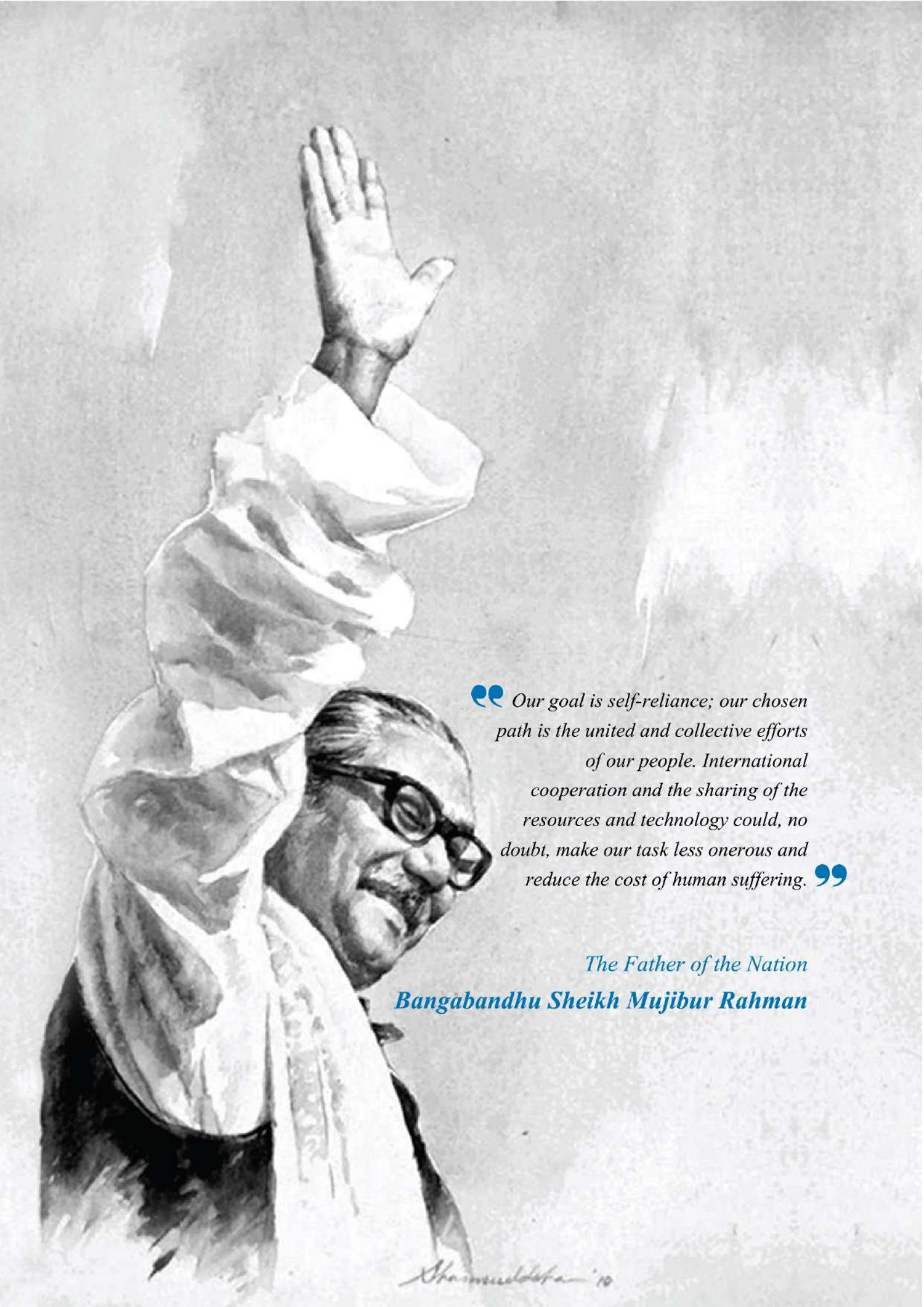
Ministry of Environment, Forest and Climate Change
Government of the People's Republic of Bangladesh

National Adaptation Plan of Bangladesh (2023-2050)

October 2022



Our goal is self-reliance; our chosen path is the united and collective efforts of our people. International cooperation and the sharing of the resources and technology could, no doubt, make our task less onerous and reduce the cost of human suffering.

The Father of the Nation

Bangabandhu Sheikh Mujibur Rahman

Despite our responsibilities and resources constraints, we have adopted exemplary initiatives to tackle climate change. However, developed countries should fulfil their commitments of providing 100 billion dollars annually with a 50:50 balance between adaptation & mitigation.

Sheikh Hasina

Honorable Prime Minister of Bangladesh

at COP26 in 2021, Glasgow

National Adaptation Plan of Bangladesh
(2023-2050)

© CEGIS

Published by

Ministry of Environment, Forest and Climate Change, Government of the People's Republic of Bangladesh

Photo

CEGIS, Web

Executive Summary

Bangladesh is high on the list of countries most vulnerable to climate change, ranking seventh on the 2021 World Climate Risk Index. Among the countries most affected by extreme climate conditions, it only contributes a small share of global emissions. Climate change-induced natural disasters plague Bangladesh due to its geographic location and flat, low-lying topography. High population density, poverty and reliance on climate-sensitive sectors for water and food security, particularly water resources, agriculture, fisheries and livestock, increase its vulnerability to climate change. Climate-induced disasters such as tropical cyclones and storm surges, monsoon floods, flash floods, droughts, sea-level rise, salinity intrusion, ocean acidification, etc. are exacerbating stresses on the country's otherwise tremendous development trajectory, impeding socioeconomic progress and human well-being.

Bangladesh has been proactive and adept in climate change adaptation, mandated by the ***Constitution in its 15th amendment, Article 18A*** [1] on the protection and improvement of the environment and biodiversity. Over the decades, Bangladesh has advanced substantially in building adaptive capacity and resilience through formulation and subsequent implementation of required policies and regulatory frameworks for enabling climate resilient sustainable development. Landmark achievements such as formulation of National Adaptation Programme of Action (NAPA, 2005), Bangladesh Climate Change Strategy and Action Plan (BCCSAP, 2009), Bangladesh Delta Plan 2100, Mujib Climate Prosperity Plan, climate inclusive updated National Environment Policy (2018), updated Standing Order on Disaster (2019) etc. have paved the way for effective climate change adaptation and has propelled Bangladesh as a pioneer in the global arena. Parliamentary Standing Committee on Ministry of Environment, Forest and Climate Change (MoEFCC) has separate resolution for active involvement for climate actions. It joined the global declaration on 'Planetary Emergency' to counter climate adversities.

Bangladesh has also demonstrated success in disaster preparedness through functioning of initiatives such as the Cyclone Preparedness Programme (CPP) established by Father of the Nation Bangabandhu Sheikh Mujibur Rahman with world's largest gender balanced volunteers (76,000+) group. Cyclone and flood shelters inclusive of gender and persons with disabilities, boat ambulance, relief warehouses & digital information center, Mujib Killa etc. have been built, substantially reducing disaster death tolls and damages. Evacuating a total 2.4 million people within 5 days after super cyclone 'Amphan' demonstrated strong

[1] *The Constitution of the People's Republic of Bangladesh' (Act No. of 1972), Article 18A: The State shall endeavor to protect and improve the environment and to preserve and safeguard the natural resources, bio-diversity, wetlands, forests and wild life for the present and future citizens [accessible at: http://bdlaws.minlaw.gov.bd/act-367/section-41505.html]*

capacity for emergency responses and disaster risk reduction. “Khurushkul Special Ashrayan Project”, one of the biggest housing projects in the world for climate refugees has been functioning tirelessly to rehabilitate affected vulnerable landless and homeless families out of harm’s way. Advances in agricultural research has made possible the development of stress tolerant crop varieties, widely practices of floating agriculture and effective irrigation methods thus contributing to year-round vegetable farming, multiple crops cultivation to ensure food & nutrition security. Innovations for climate smart fisheries, aquaculture & livestock development and improved post-harvest facilities, silos for food storage etc. are all contributing to making the resilient food production system, thus reinforcing food security. Integrated and participatory water management with strengthened early warning system, irrigation, flood and erosion protection schemes have enabled an intricate blending of both structural and nature-based interventions to bolster disaster preparedness in increasing climate resilience. Coastal afforestation programmes have been undertaken to stabilize the coastline and create green belt through engaging community people. Transformation in developing climate resilient infrastructures, improved public health and enhanced urban resilience is underway. The BCCT has undertaken more than 800 projects with sole focus on effective climate adaptation and mitigation. Bangladesh is also advancing in global climate change forums and has established a strong legacy of climate change adaptation. The Government of Bangladesh presently spends approximately 6-7 percent of its annual budget on enhancing climate resilience through adaptation initiatives, among which seventy-five percent cost comes from domestic resources.

However, the changing climate regime and the unique geographical setting is exerting considerable stress on Bangladesh's economy and the advancement towards sustainable development. The future will be more uncertain and extreme. Tackling such unprecedented repercussions would bring unimaginable hardship for the country and serious threats to its development aspirations. Redemption can only be ensured through swift and effective climate adaptation practices, backed by enhanced climate finance from promised development support & cooperation.

In 2010, the Sixteenth Conference of the Parties (COP16) of the United Nations Framework Convention on Climate Change (UNFCCC) emphasized enhanced action through the Cancun Framework to reinforce the global drive towards climate adaptation. It established the National Adaptation Plan (NAP) process to identify and address countries’ medium- and long-term adaptation needs, facilitate effective adaptation planning and integrate climate change adaptation within national development processes. The Paris Agreement, adopted at the Twenty-first Conference of the Parties (COP21), reinforces adaptation planning as vital to socioeconomic development and integral to the global response to climate change. It calls on all countries to initiate the preparation and implementation of NAPs to further reinforce climate adaptation actions.

Acknowledging that effective medium- and long-term adaptation strategies are crucial to reducing the negative impacts of climate change and promoting sustainable planning for future development routes, the Government of Bangladesh initiated the formulation of its NAP under the Ministry of Environment, Forest and Climate Change (MoEFCC), aiming for a viable path to climate-resilient development and reduced climate risks and vulnerabilities. The NAP formulation follows the NAPA and the BCCSAP, aiming to further streamline and reinforce adaptation efforts. Developing the plan has been a continuous, iterative and progressive process that is country-driven; responsive to gender, older age groups and disability; participatory; and based on both the latest science and indigenous knowledge. The process has been fully transparent.

The NAP has relied heavily on extensive stakeholder consultations for feedback and shared views on climate change effects. The opinions of local people, women, people with diverse gender identities, persons with disabilities, youth, ethnic communities, children, elderly people, vulnerable communities, the private sector and disadvantaged groups were given high priority to develop the NAP in a participatory and

inclusive manner. More than 35 stakeholder consultations and over 100 key informant interviews and focus group discussions took place, involving approximately 5,000 people across the country at the local, district and national levels from January 2021 to June 2022. The formulation process considered and followed the Sixth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC), the panel's reports from Working Groups I and II, scientific and indigenous knowledge, locally led adaptation practices and standardized international guidelines by expert groups on the least developed countries as well as experts from the UNFCCC, the Global Programme of Research on Climate Change Vulnerability, Impacts and Adaptation, the Sendai Framework for Disaster Risk Reduction 2015-2030, the United Nations Environment Programme (UNEP), the Food and Agriculture Organization (FAO), the International Union for Conservation of Nature (IUCN) and the World Health Organization (WHO). The new Shared Socioeconomic Pathway (SSP) scenarios of SSP1-2.6 (2030) and SSP5-8.5 (2030, 2050) were considered following the Coupled Model Intercomparison Project (Phase 6) models for scientific assessments.

The NAP primarily encompasses eight distinct sectors: water resources; disaster, social safety and security; agriculture; fisheries, aquaculture and livestock; urban areas; ecosystems, wetlands and biodiversity; policies and institutions; and capacity development, research and innovation. Infrastructure, water and sanitation (WASH), health, gender, youth, the elderly, persons with disabilities, ethnic communities and other socially disadvantaged groups, and the private sector are cross-cutting issues and part of identifying appropriate strategies aligned with national aspirations.

The key risks and vulnerabilities of climate change in the eight sectors will pose disproportionate and severe impacts on Bangladesh's resources, water and food security, infrastructure, livelihoods, ecosystem health and biodiversity. The number of internal climate migrants may reach 19.9 million by 2050, comprising half of those in the entire South Asian region. The current rate of annual loss to gross domestic product (GDP) of approximately 1.3 percent due to climate-induced disasters may rise to 2 percent by 2050 and over 9 percent by 2100 under extreme scenarios.

With an underlying objective of reducing risks and vulnerabilities to climate change impacts, the NAP envisions building a climate-resilient nation through effective adaptation strategies that foster a robust society and ecosystems and stimulate sustainable economic growth. Six national adaptation goals have been set to achieve this vision: Goal 1: Ensure protection against climate change variability and induced natural disasters; Goal 2: Develop climate-resilient agriculture for food, nutrition, and livelihood security; Goal 3: Develop climate-smart cities for improved urban environment and well-being; Goal 4: Promote nature-based solutions for conservation of forestry, biodiversity, and well-being of communities; Goal 5: Impart good governance through integration of adaptation into the planning process; and Goal 6: Ensure transformative capacity building and innovation for CCA.

The NAP implementation will seek to realize these six goals through 23 broad-scale strategies and 28 outcomes encompassing diverse aspects of safeguarding against climate-induced disasters. It will develop climate-resilient agriculture, infrastructure and other socioeconomic sectors through implementing inclusive and ecosystem-based adaptation, improved governance, enhanced climate finance and transformative capacity-building, and innovation.

The NAP considered 11 climate stress areas in devising 113 interventions based on developed adaptation pathways and sectoral adaptation requirements. These interventions are aligned with the global Sustainable Development Goals (SDGs) and 52 climate adaptation projects of the Bangladesh Delta Plan 2100 (BDP2100). They ensure the inclusion of women and people with diverse gender identities, the elderly, persons with disabilities, youth, ethnic communities and other socially disadvantaged groups throughout the NAP process. Recommended interventions are envisaged as being implemented in an integrated and coordinated manner through programmatic approaches instead of ad-hoc, project-based, short-term initiatives. This will increase the effectiveness of adaptation in advancing systems transitions

while avoiding overlaps and/or misuse of investment and reducing maladaptation. Programme-based implementation will allow stakeholders the flexibility to select locally led adaptation actions from the 113 interventions and implement them based on local priorities.

An appraisal of the cost of the 113 interventions, including 90 high-priority and 23 moderate-priority ones, defined a total investment of BDT 20,037 billion (equivalent to US $230 billion) for 27 years (2023-2050), an implementation period that runs until the 13th Five Year Planning cycle of Bangladesh. The NAP proposes to mobilize around 72.5 percent of the total investment cost by 2040. Developing climate resilience will require seven times the current spending to transform adaptation, at a rate of $8.5 billion per year, with $6.0 billion per year from external sources or international climate funds and development partners. Private sector investment potential is estimated to be 5.1 percent of the total investment at an annual rate of $0.42 billion. Prioritization of finance to facilitate extensive research, capacity development and innovation is recommended. Successful implementation of the NAP will complement the national development vision of becoming a high-income country by 2041 and achieving the SDGs by 2030.

The NAP implementation will require a hefty investment that must be harnessed at an accelerated pace from global climate funds, and from accessing readiness support and seeking development assistance from bilateral and multilateral partners, in addition to domestic sources. Bangladesh will need to ensure investment from the private sector to support the Annual Development Programme, the Bangladesh Climate Change Trust Fund (BCCTF) and other domestic funds. Capacity-building for institutions and exploration of innovative financing windows will be immediate steps towards resource mobilization. Other requirements looking forward will be to revisit and relax the fiduciary standards of international climate funds like the Green Climate Fund (GCF) for highly vulnerable countries like Bangladesh. A simplified approval process and increased budget quota under the Private Sector Facility need to be introduced and popularized as part of supporting national readiness and fulfilling the pledge of the Paris Agreement and COPs to support climate change adaptation in vulnerable countries.

Implementation of the NAP will protect 1.1 million hectares of croplands from storm surges/flood inundation, sea-level rise and salinity. Annually, this will result in the production of 10.3 million additional tons of rice. Nutrition uptake will increase from livestock and fisheries. Critical infrastructure will be better protected from frequent climate-induced disasters; 30 million people in urban areas will benefit from improved drainage and fewer problems with heat islands, with expected cost reductions of 10 percent for transport and 15 percent for preventing water-borne diseases. There would be a projected 30 percent increase in income for marginal urban communities; the vulnerabilities of 15 million climate migrants will decline significantly. Tree coverage will grow by 5 percent, boosting ecosystem health and human well-being, alongside enriched biodiversity. Blue economy will be flourished for protecting marine ecosystem and resources under ocean. Carbon sequestration will increase, reducing emissions.

The NAP offers a multilevel, inclusive institutional structure based on the existing institutional framework. It defines horizontal and vertical linkages to scale up locally led adaptation to the national level and vice versa. The National Council on Environment and Climate Change will be responsible for overseeing the strategy, policy-level progress and the outcome of implementation. The Interministerial Steering Committee on Climate Change will guide implementation and regularly conduct inter-ministerial coordination meetings. A separate National Technical Advisory Committee has been proposed for coordinating the NAP implementation and addressing gaps and challenges to ensure smooth implementation; it will be supported by the Technical Working Group on NAP Implementation. The existing district development coordination committees will have scope to stocktake, guide, supervise and administer climate change adaptation-related initiatives in coordination with upazilla or union level committees, district disaster management committees, and representatives of marginal communities, women and people with diverse gender identities, people with disabilities, youth, non-governmental

organizations (NGOs) and civil society organizations (CSOs). The proposed institutional arrangement will ensure the mainstreaming of the NAP into the development planning cycle of Bangladesh in alignment with the BCCSAP, BDP2100, draft Mujib Climate Prosperity Plan 2030, Perspective Plan, SDGs and other development agendas. Obligatory climate impact assessments as part of feasibility studies have been proposed to complement the Development Project Proforma approval process and climate-resilient development. Required policy and institutional reforms to support the functionality of the proposed institutional arrangement are given a high priority.

Private sector engagement in financing adaptation will accelerate through developing an enabling environment and the necessary skills, awareness and capacity among larger companies; cottage, medium, small and microenterprises (CMSMEs) and entities in the informal sector. The Bangladesh Bank will undertake appropriate policy and regulatory reforms, and the National Board of Revenue and other relevant authorities will introduce attractive incentives and innovative financing instruments for the private sectors in consultation with large industries, the Bangladesh Securities and Exchange Commission (BSEC), the Ministry of Finance (MoF), the Ministry of Industries (MoI), the Ministry of Commerce (MoC), the Bangladesh Economic Zones Authority (BEZA), the Bangladesh Export Processing Zones Authority (BEPZA), the Federation of Bangladesh Chambers of Commerce & Industries (FBCCI), the Bangladesh Investment Development Authority (BIDA), Public-Private Partnership Authority (PPPA), the Bangladesh Garment Manufacturers and Exporters Association (BGMEA), the Bangladesh Knitwear Manufacturers and Exporters Association (BKMEA) and others. The private sector is envisaged as investing in extensive research and advanced technologies, developing bankable products and exploring new markets for goods and services with co-benefits in terms of adaptation and mitigation, and that may generate higher returns and build climate resiliency.

Climate financing will be mobilized through blending climate finance, private sector investment, innovative financing such as green or blue bonds, risk transfer mechanisms or insurance, green transformation and a boost in harnessing global climate finance such as through the GCF and bilateral and multilateral funds. Efforts to build capacity and strengthen national implementing entities to gain direct access to international climate funds will involve both the public and private sectors. Necessary capacity-building initiatives will be socially inclusive and responsive to gender dimensions and persons with disabilities.

The NAP implementation process will adopt a monitoring and evaluation (M&E) framework based on a combination of both simple and comprehensive monitoring approaches to identify and assess outcomes. The framework involves a threefold system at the strategy and policy, planning, and programme/project levels, based on a theory of change. The system will build on existing and SMART (specific, measurable, achievable, relevant and time bound) indicators to support results-based monitoring, evaluation and learning, and synchronization with similar initiatives such as the Integrated Budget and Accounting System (iBAS++), the SDG tracker, the M&E framework of the BDP2100 and the National Priority Indicator. The NAP M&E framework will include a web-based, innovative tool and offline apps for easy operation. Standardized data collection, processing, uploading and sharing protocols will be developed. Comprehensive capacity development will assist relevant stakeholders to operate and routinely generate a threefold M&E report. Strategic data and knowledge management in collaboration with existing data-generating agencies will be emphasized to support M&E, data collection by implementing entities and overall NAP communication to wider audiences and the UNFCCC.

An annual national climate status report will share information on changed risks and vulnerabilities, adaptation progress and challenges, M&E findings, financing status and so on with global audiences and stakeholders. The NAP will be considered a living document with a planning horizon until the 2050s, with at least a five-year updating/revision cycle aligned with Bangladesh's five-year development planning process.

Contents

© CEGIS

Introduction

1. Introduction

1.1 Context

Bangladesh is considered one of the most climate-vulnerable countries due to ensuing natural calamities and slow onset adversities. Despite seemingly insurmountable afflictions, Bangladesh has steadily progressed in making a mark on the global economy and pioneering efforts to address climate fallout through effective adaptation strategies. A rapidly escalating development trajectory in the last one and a half decades has seen economic growth of more than 7 percent per annum. Per capita income increased to $2,824 in 2021-2022 from $300 in 1973. Rice production grew from 12 million tons in 1973 to 37 million tons in 2021, fisheries has ranked third in open water capture production, and additional livestock production generated nearly 30 percent of employment. Consequently, food security has been ensured & livelihood security enhanced.

Such remarkable advances have been possible through prudentially management of climate change impacts and subsequent losses and damages under a strong legacy of adaptation. Bangladesh has been striving towards achieving climate resilience, mandated by the ***Constitution in its 15th amendment, Article 18A*** [2] on the protection and improvement of the environment and biodiversity. The Government of Bangladesh presently spends approximately 6-7 percent of its annual budget on enhancing climate resilience through adaptation initiatives (MoF, 2021), among which seventy-five percent cost comes from domestic resources; despite the fact that Bangladesh contributes very little to rising global emissions. The Second Perspective Plan (2021-2041) envisaged Bangladesh as becoming a developed country by 2041, with a per capita income of over $12,500 at today's prices. It also projected that the extreme poverty rate would drop to less than 1 percent and the economic growth rate would climb to 9.9 percent by 2041.

Already a pioneer in the global arena, climate change adaptation got its first break in Bangladesh through formulation of the NAPA in 2005. The updated NAPA in 2009 and the subsequent formulation of the BCCSAP (also in 2009) further streamlined and reinforced climate adaptation efforts in the succeeding decade. The National Environment Policy was updated in 2018 with specific directives on climate change preparedness in its Section 3.19. Towards addressing long-term climate change uncertainties for water resources management and developing a more prosperous nation, Bangladesh recently formulated a strategic Delta Plan 2100. The Mujib Climate Prosperity Plan 2030 (MCPP, 2021) has been drafted with Bangladesh as chair, for Climate

[2] *The Constitution of the People's Republic of Bangladesh' (Act No. of 1972), Article 18A: The State shall endeavor to protect and improve the environment and to preserve and safeguard the natural resources, bio-diversity, wetlands, forests and wild life for the present and future citizens [accessible at: http://bdlaws.minlaw.gov.bd/act-367/section-41505.html]*

Vulnerable Forum (CVF) countries. Also, policy initiatives such as the Climate Fiscal Framework (2014); National Disaster Management Plan (2021-2025); updated Standing Order on Disaster (2019) etc. highlights the strength of Bangladesh currently possesses in dealing with climate adversities.

However, the changing climate regime and the unique geographical setting is exerting considerable stress on Bangladesh's economy and the advancement towards sustainable development. Bangladesh suffered approximately $11.3 billion in losses in 2021 due to climate-related natural disasters (WMO, 2021a) which is roughly 2.47 percent of total GDP of FY2021-2022. According to the 2021 global Climate Risk Index, Bangladesh ranks 7 in the top 10 most affected countries (2000-2019). Constantly aggravating climate-induced disasters, coastal tropical cyclones, monsoon flooding, flash floods, droughts, sea level rise, salinity intrusion, urban floods, etc., are causing catastrophic losses to many socio-economic sectors.

Despite the relentless efforts for climate adaptation, future is projected to be far more extreme and uncertain by the IPCC in its Sixth Assessment Report. The Bangladesh Delta Plan (GED, 2018a) projects that the combined effects of climate change could range from a loss of 1.1 percent of GDP per year in a moderate climate change to 2 percent per year in extreme climate conditions. The BDP2100 also indicates the possible impact on overall rice production, predicting a declining rate of 17 percent by 2050, which would impede food and nutrition security. Tackling such unprecedented repercussions would bring unimaginable hardship for the country and serious threats to its development aspirations. Redemption can only be ensured through swift and effective climate adaptation practises, backed by promised enhanced climate finance mobilization from developed countries.

Effective medium- and long-term adaptation strategies are crucial to reducing negative climate impacts and providing a viable path towards resiliency. Planning for a future development trajectory necessitates addressing medium- and long-term climate adversities and their simultaneous mainstreaming into national planning. The current drive towards planning and implementation is thus more focused on medium- and long-term climate change adaptation along with concrete strategies for governance and climate financing.

Addressing medium- and long-term climate change impacts further requires a coordinated strategy document for implementing climate change adaptation. This would ensure collaborative efforts to reduce climate risks and vulnerabilities, increase resilience and minimize maladaptation, while paying heed to both soft and hard adaptation limits. This would increase capacity and resilience, bring about transformation and system transitions, take measures to uphold sustainable human and ecosystem health and gender-inclusive socio-economic well-being, and reduce losses and damages.

1.2 Portrait of Landmark Achievements towards Climate Resilience

As a global pioneer in climate adaptation, Bangladesh has advanced substantially in building adaptive capacity and resilience for coping with various climate change impacts across sectors and levels. Ministry of Environment, Forest and Climate Change (MoEFCC), Ministry of Disaster Management and Relief (MoDMR), Ministry of Agriculture (MoA), Ministry of Fisheries and Livestock (MoFL), Ministry of Water Resources (MoWR), Ministry of Local Government, Rural Development and Cooperatives (MoLGRDC), Ministry of Food (MoF) along with other relevant ministries/divisions and respective agencies, are working hard to make the country climate-resilient. Over the last seven years, the climate-relevant budgetary allocation has doubled, increasing from $1.44 billion in FY2015-2016 to $2.96 billion in FY2021-2022, which is 0.73 percent of GDP for FY2021-2022 (MoF, 2021). Some landmark initiatives and success stories are as follows:

Policy Response at National Level

Bangladesh has made commendable efforts in creating required policies and regulatory frameworks for enabling climate resilient sustainable development. The Parliamentary Standing Committee on MoEFCC is actively involved in accelerating adaptation and mitigation processes', mandated by separate resolution; joining the global declaration on 'Planetary Emergency' to counter climate adversities. Over the years, the Government has formulated policies, plans and programme including the National Adaptation Programme of Action (NAPA, in 2005 and later updated in 2009), Bangladesh Climate Change Strategy Action Plan (BCCSAP) in 2009, Bangladesh Climate Change Trust Act in 2010, Bangladesh Climate Change Gender Action Pan in 2013, Climate Fiscal Framework in 2014 & updated in 2020, Roadmap for formulating National Adaptation Plan in 2015, Nationally Determined Contribution (NDC) in 2015 and later enhanced & updated in 2021, Bangladesh Delta Plan 2100 in 2018, Climate inclusive National Environment Policy updated in 2018, updated Standing Order on Disaster in 2019, Mujib Climate Prosperity Plan 2030 (Draft) etc., which have paved the way for effective climate change adaptation and has propelled Bangladesh as a pioneer in the global arena.

Mujib Climate Prosperity Plan

As Chair of the CVF, Honorable Prime Minister H.E. Sheikh Hasina launched a program to develop "Mujib Climate Prosperity Plan" for Bangladesh for mobilizing financing, primarily through international cooperation, for implementing renewable energy and climate resilience initiatives, thus contributing to both climate change adaptation and mitigation. The draft plan identifies several key initiatives, which focus on renewable energy, energy storage infrastructure, power grid modernization, establishing carbon market regime etc. for future-proofing locally-led adaptation outcomes, and enhancing MSMEs.

Bangladesh Delta Plan 2100

The Government has recently adopted the Bangladesh Delta Plan 2100, aimed at gradual, sustainable development through adaptive delta management approach. The plan identifies climate change as a significant future challenge and reaffirms Bangladesh's commitment to both reducing GHG emissions as well as lays the foundation for climate adaptation initiatives for the following decades. It specifically identified 52 climate change adaptation projects for enhancing climate resilience of the delta.

Food Security and Climate Smart Agriculture

A well-coordinated effort of MoA, MoFL, MoWR, MoFood, MoDMR, MoEFCC and others is facilitating to maintain the food system climate resilient for ensuring food & nutrition security. Agriculture researches have advanced impressively since independence and contributed a lot to the food and nutrition security of Bangladesh. In the early 1970s, Bangladesh was a food-deficient country with a population of about 75 million. Today, the population is more than 160 million, and Bangladesh is self-sufficient in rice production, which has tripled over the past three decades. Government is providing research grants that enabled creation of more than hundreds of high yielding modern rice varieties that are saline tolerant, submergence tolerant, less water intensive, cold tolerant and heat tolerant high yielding varieties. Multiple crops and year-round vegetable farming is now possible instead of cultivation in single season. Floating cultivation is being widely practiced specially in the southwestern, northwestern and northeastern regions of the country tackling recurrent floods but allowing integrated farming. Initiatives are undertaken by Ministry of Agriculture for extension of water saving technologies in drought prone areas, harvesting rainwater in canals or reservoirs for enhanced irrigation, increasing overall irrigation efficiency through improved distribution network, integrated farming of rice and vegetables in waterlogged coastal areas, extended use of solar powered portable irrigation

pump, improved water management in *haor* areas, improvement of surface water & sprinkler irrigation, integrated organic and inorganic fertilizer management for increasing soil carbon, use of Unmanned Aerial Vehicle (UAV) technologies for drought monitoring and irrigation management etc. Furthermore, promotion of Climate Smart Agriculture such as Alternating Wetting & Drying (AWD) & Nature based Solutions such as floating cultivation agriculture practices are highly emphasized in development agenda to ensure food & nutrition security, environmental sustainability and societal development.

Ministry of Water Resources is playing pivotal role in improving the surface water irrigation system. Ministry of Fisheries and Livestock (MoFL) is striving towards making the fisheries and livestock production system resilient to climate change through extended climate research for stress tolerant fish species, conservation of *Hilsa* fishes, developing more resilient open water fisheries, extension of aquaculture, strengthening early warning and climate information system and advisory services, improvement of value chain & post-harvest facilities and capacity building of fishing communities with special emphasis on women. Ministry of Food (MoF) has undertaken initiatives for establishing 8 steel silos with modern facilities, renovating old food silos and ancillaries, capacity building and research on food safety, distribution of 55 kgs rice storage capacity 0.3 million household level silos for poor, ethnic community and vulnerable families of disaster-prone areas, improvement of distribution system etc.

Integrated Water Resources Management

Ministry of Water Resources is contributing to improve lives, livelihoods and environment for secured investment of the country through its adaptation initiatives. Implementation of integrated water resources management for climate resilient delta with conducive regulatory and planning tools like Bangladesh Water Act 2013, Bangladesh Water Rule 2018, Haor Master Plan, Bangladesh Delta Plan 2100 etc. is given high priority by the ministry. Building 5,816 km of coastal embankment in 139 polders, 2,728 km submersible embankment in haor areas and 7,984 km flood protection embankment in the country, maintenance of total 16,528 km embankment, protection of 1,457 km river bank and 31 districts from erosion, increasing navigability and water storage through 4,375 km river dredging and excavation, restoration of wetlands ecosystem and biodiversity, basin wide management and freshwater flow increase, irrigation of 16.49 lac hectares of land & additional 1.15 crore MT additional food production through construction of 5,355 irrigation canal, 3,613 km canal dike and 4,502 km drainage canal, construction of 5 rubber dams, implementing 5 days' monsoon flood forecast in the country and 3 days' flash floods forecast in *haor* areas through community, SMS and smartphone apps, annual erosion prediction among stakeholders and communities, collection and monitoring of surface water and groundwater hydrology, river bank stabilization and 1,086.2 sq km of land reclamation, shadow water pricing etc. are noteworthy achievements made by the MoWR in last few decades. Engagement of community for integrated water resources management is being ensured through formulation of Integrated Water Resources Management Guideline (2020) and establishment of Water Management Organizations (WMO) at local levels. As a cross cutting issue, managing the water resources in integrated manner is not only contributing towards achieving the sectoral development goals but also water & food security, enhanced DRR & livelihoods security, sustainable development goals and climate resilience.

Disaster Risk Reduction

Bangladesh has time and time again, demonstrated success in disaster preparedness and climate resilience. Cyclone Preparedness Programme (CPP) established by Father of the Nation Bangabandhu Sheikh Mujibur Rahman currently has 76,020 volunteers (of which around 50% are women) dedicated to Disaster Risk Reduction.

Additionally, 46,000 urban volunteers are also working for urban safety and resilience. A total of 4,530 cyclone shelters have been constructed across the coast.

The Ministry of Disaster Management (MoDMR) have constructed 340 flood shelters across the country with additional 393 shelters under construction. A total of 550 Mujib Killas, specially designed on raised land, have been constructed to provide shelter for the people and livestock in coastal regions during the cyclone/tidal surge, 60 multipurpose rescue boats have been built for persons with disabilities. Consideration for gender and persons with disabilities have been mainstreamed into new design guidelines of cyclone shelters. A total of 65 Disaster Relief Warehouse-cum-Disaster Information Center have been established along with 18 community radio (FM) networks for the coastal people and fishermen. The government has planted 5.4 million Palm trees to reduce the risk of death due to lightning. ICT based early warning and dissemination system has been strengthened through operating dedicated Interactive Voice Response (IVR), increasing flood forecast lead time from 3 days to 9 days, developing and piloting Dynamic Flood Risk Model (DFRM) etc. Coverage of social safety net has been increased for securing lives and livelihoods through blending traditional initiatives such as Employment Generation Programme for the Poorest (EGPP), Kabita (Cash for Works), KABIKHA (Food for Work), Test Relief (TR). Standing Order on Disaster is updated in 2019 and National Plan for Disaster Management (2021-2025) is formulated to reinforce these efforts. Gender gaps have been minimized in disaster risk management through implementing DRR activities focusing on person with disability, senior citizens, women, and children, gender responsive and inclusive budgeting.

Decreasing human deaths during cyclone is one of the proven indicators for enhanced disaster preparedness. For instances, preparation of 6,816 cyclone shelters and keeping standby 1,343 emergency medical teams in 14 coastal districts for emergency evacuation and managing the "double-trouble" severe cyclone 'YAAS', during the COVID19 pandemic, saved thousands of lives. Similarly, evacuating around 2.4 million people and half a million livestock in less than 5 days during super cyclone 'Amphan' in May 2020 and later managing flash floods in northern and haor region in the same year also reflects the long experiences of emergency disaster management, saving of lives of millions of peoples. Overall mortality rate has been reduced due to disaster, particularly from cyclone which is now single digit from 6 digits compared to 1970, 1991.

Ashrayan: Climate Resilient Shelter for Displaced People

Prime Minister Sheikh Hasina had undertaken the Ashrayan project in 1997. Under the scheme, a total of 538,139 families have been rehabilitated since 1997, totaling 3,700,160 inhabitants. Specially designed *Machang* & houses for hilly and char areas are considered in this scheme along with housing for other vulnerable areas. The government is implementing "Khurushkul Special Ashrayan Project" launched in 2014-15, which is one of the world's biggest housing projects for climate refugees. Under this project, 139 five-storied buildings with modern facilities have been set to be constructed in Cox's Bazar, with a capacity to rehabilitate 4,409 climate refugee families. Till date, 20 buildings have been constructed and a total of 640 climate victim families have been allotted a 406 sq. ft. flat each in its first phase. Training programmes and loan disbursements are going on to make the rehabilitated families financially self-reliant. The project also focuses on mitigation through plantation of 1.5 million trees, rainwater harvesting, the solar panel based alternate power sources, improved cook stoves etc. Besides this, 50,104 families have been rehabilitated under the "Guchchhogram" project, where 455,000 trees have been planted.

Climate Resilient Infrastructures, Improved Public Health and Urban Resilience

Transformation for climate resilient infrastructures, improved public health and urban resilience is going on with remarkable initiatives

by the Ministry of Local Government, Rural Development and Cooperatives, Ministry of Road, Transport and Bridges, and Ministry of Housing and Public Works. In last 13 years, 4,407 km urban drainage construction, 11 urban cyclone shelters construction, 47 slum development and rehabilitation, 378.51 km water supply pipe construction, 92 women sections establishment in markets, 719 water resources related sub-projects implementation, 166 cyclone shelters construction or rehabilitation, 6569 km length of tree plantation. 16845 km bridges/culverts construction, highway side tree plantation, research for climate resilient houses and shelter development, research for innovating climate resilient WASH technologies and expansion of WASH infrastructures, rehabilitation of climate rural water & disaster management infrastructures etc. have been implemented to facilitate disaster risk reduction, improvement of public health and climate resilience.

Afforestation and Greenbelt Development

Ministry of Environment, Forest and Climate Change (MoEFCC) has developed capacity of its forestry sector to engage in adaptation and mitigation co-benefit via developing monitoring system and adopting National REDD+ Strategy for adaptation, reducing emission and enhance forest carbon stocks. Tree coverage once was only 7%, which has been increased to 22%. The National REDD+ Strategy further targets to restore all degraded forest and bring all newly accreted coastal lands under afforestation and thereby increase tree cover of Bangladesh from current 22% to 25% by 2030. Bangladesh completed its first National Forest & Tree Inventory in 2019 and assessed a carbon sequestration capacity of 1275.54 million tons (all five carbon pools, soil up to 30 cm). To commemorate the birth centenary of the Father of the Nation Bangabandhu Sheikh Mujibur Rahman, the Government planted 10 million trees in 2020.

Coastal afforestation programme has been undertaken to stabilize the coastline and create green belt through engaging community people. Coastal afforestation with suitable mangrove and non-mangrove species provides variety of useful ecological and bio-physical functions, protects inland habitats as a natural storm surge barrier, alleviates environmental degradation, acts as highly efficient carbon sink, offers habitat and breeding ground for wildlife and fisheries, and improves recreational value of coastal area. It also offers socio-economic benefits to the coastal community through widening the opportunities of harvesting non-timber forest products. Community people are getting chance to improve their livelihoods. For greenbelt development and afforestation around 11.5 million trees have been planted. This community-based adaptation technique is unique and can contribute in enhancing climate and disaster resilience of coastal islands.

National Climate Finance Mechanism-BCCTF

Government of Bangladesh established BCCTF under MoEFCC in FY 2009-10 from its own resources, establishing itself as a pioneer among the developing countries. The BCCT has undertaken more than 800 projects so far with the investment of around $480 million to implement strategic actions of the BCCSAP which mainly focus on adaptation, mitigation and climate change research. Noteworthy adaptation projects undertaken through BCCTF include construction of 231.40 kilometers of embankments, excavation/re-excavation of 590.60 km of canals, construction of 1,43,463 cubic meter water combined capacity reservoirs, construction of 14 schools cum cyclone shelters, construction of 483 rainwater reservoirs, establishment of 17 pure water supply systems, installment of 12 pond sand filters, training of 14,205 Volunteers and Coastal fisherman for Cyclone preparedness programme, production and distribution of 19,428 metric ton of stress tolerant seeds, construction of 8,529 climate resilient houses, establishment of 12,900 floating vegetables bed in 210 villages, building 3 rubber dams and reconstruction of 2 spars. Through research projects 12 heat and stress tolerant crop

varieties were introduced. Approximately 71.15 million trees were planted and 6,921.7 hector of forest land was brought under afforestation, 2,451 water purification solar plants were established, 20 solar irrigation pumps were mounted and 7,901 biogas plants were installed at Household level along with 13 community biogas plants, 2 eco-parks reconstructed and developed contributing to both mitigation and adaptation.

GCA Regional Center for South Asia

In recognition of the country's progressive role to address climate change, the Global Commission on Adaptation established a GCA Regional Center for South Asia in Bangladesh. Hon'ble Prime Minister of Bangladesh, H.E. Sheikh Hasina, and the 8th UN Secretary-General Ban Ki-moon jointly inaugurated GCA regional office at the Department of Environment in Dhaka on 8 September 2020. The center will exchange knowledge, experience, and best practices on adaptation among 8 (eight) South Asian Countries and support their efforts to accelerate climate adaptation.

1.3 NAP Foundation

COP16 in 2010 emphasized enhanced action on adaptation through the Cancun framework by establishing the National Adaptation Plan (NAP) process, which will facilitate effective adaptation planning, resources mobilization and integration of CCA in the national development process. The framework prioritizes medium- to long-term adaptation through strategic and programmatic approaches over ad hoc, short-term initiatives, towards making people, places, ecosystems and economies more resilient to the impacts of climate change. COP16 also established the Green Climate Fund (GCF) as an operating entity of the financial mechanism of the UNFCCC. The GCF was launched at COP18, which requested its board to balance allocations of resources between adaptation and mitigation activities. COP18 in Doha in 2012 highlighted the need for developing NAPs in LDCs and developing countries. The Least Developed Countries Expert Group (LEG) prepared a technical guideline for NAPs in 2012 (LEG, 2012a).

In 2015, the then Ministry of Environment and Forest published a roadmap for developing a NAP in Bangladesh (MoEF 2015). The Paris Agreement, adopted at COP21, reinforced adaptation planning processes as vital to social and economic development and central to the global response to climate change. Article 7 of the Paris Agreement calls on all Parties to engage in adaptation planning, including to formulate and implement NAPs and improve the "effectiveness and durability" of adaptation actions. Subsequently, the Government of Bangladesh conducted the Stocktaking for National Adaptation Planning (SNAP) process in 2017 and identified priority areas for adaptation in its Third National Communication (MoEFCC, 2018b) submitted to UNFCCC. This paved the way for initiating the formulation and advancement of the NAP process in Bangladesh. This NAP will accelerate the present adaptation strides and support the implementation of planned medium- and long-term adaptation with adequate financial resources mobilization to tackle uncertain and stressful future due to climate change.

This NAP comprises structured and persistent pathways for transformation in climate change adaptation and climate resilient development towards fulfilling the dream of 'Sonar Bangla'. It will act as the important tool for climate negotiation to manage climate finance as per Article 7 and Article 9 of the Paris Agreement (2015). It will elaborate strategies to communicate adaptation status and best practices globally, recognizing stress in COP26 (2021) on all countries to produce an 'Adaptation Communication'. It will monitor and evaluate progress towards set adaptation goals.

1.4 Vision and Goals

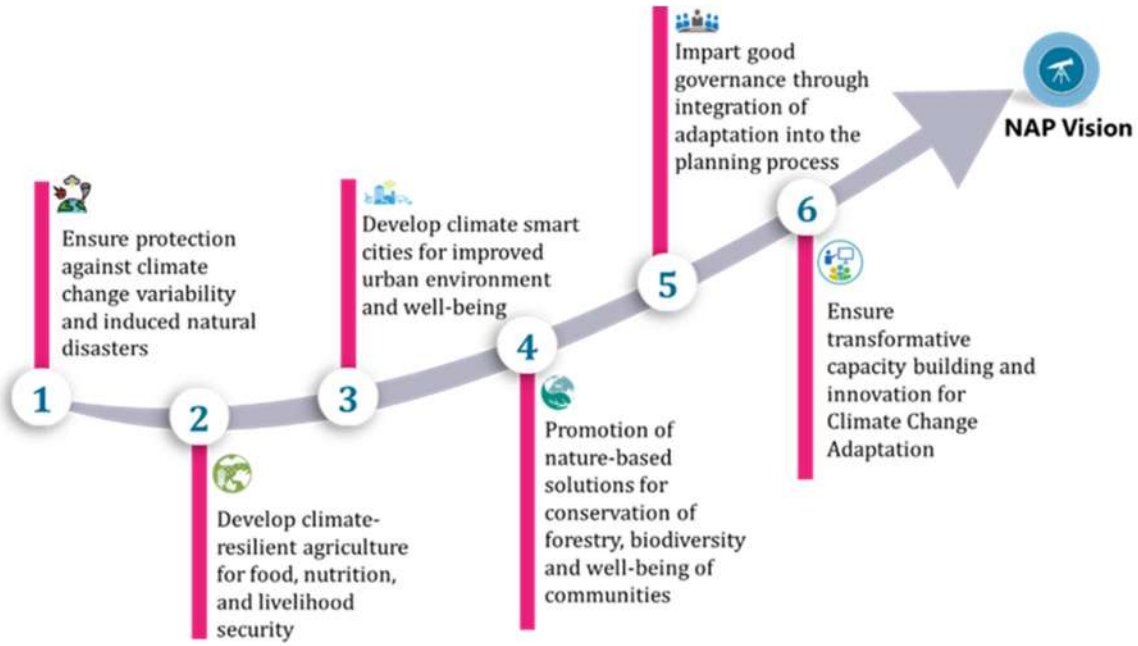
The NAP vision has been conceptualized based on the plan's underlying aim, which is to reduce risk and vulnerability due to the adverse impacts of climate change, and to help fulfil Bangladesh's aspiration to become a climate-resilient nation. Ecosystem resilience in the face of climate change is core to achieving this aspiration, recognizing that ecosystems may be adversely impacted both

by Anthropogenic impacts and by climate change. Promoting sustainable nature-based solutions that balance economic growth and environmental sustainability has been sought as a means of ecosystem-based adaptation (EbA).

Vision of NAP

Building a climate-resilient nation through effective adaptation strategies to foster a robust society and ecosystems and stimulate sustainable economic growth.

The NAP sets goals to achieve its vision while considering diverse issues in different thematic sectors to address climate change adaptation. The goals were validated through rigorous stakeholder consultation processes.



The following six goals have been set to achieve the vision.

Goal 1: Ensure protection against climate change variability and induced natural disasters

Bangladesh is highly susceptible to climate anomalies and extreme and slow onset events, including temperature rise, rainfall variability, sea-level rise, frequent cyclones, river floods, flash floods, urban floods, heat stress, cold snaps, lightning, droughts, storm surges and salinity intrusions, etc. Diurnal variations in temperature, extreme heat waves, the disappearance of the prominence of autumn and late autumn, erratic and uneven rainfall, gradual fading of perennial wetlands, increased sea surface temperature and ocean acidification, etc. are becoming prominent concerns. The risks and vulnerabilities of poor, marginal and disadvantaged communities are increasing with subsequent losses and damages.

The first goal of the NAP aims at enhancing overall climate resilience through effective adaptation measures that minimize losses and damages and support natural resources management, strong economic growth, resilient ecosystems and sustainable livelihoods. This must be achieved by CCA in water resources management, and by strengthening disaster risk preparedness through innovative technology, response efforts and recovery across sectors, notably at the local and community levels, to reduce the loss of life and damages to infrastructure and properties.

Goal 2: Develop climate-resilient agriculture for food, nutrition and livelihood security

Agriculture's contribution to GDP is 14 percent. It employs over 40 percent of the workforce (GED,

2020a). Changing climate and its adverse effects pose significant challenges to agriculture, food security and livelihoods. Agriculture is one of the most vulnerable sectors to climate variability, such as changes in temperature, rainfall patterns, and increases in floods and droughts. Changes in crop calendar, crop phenology and pollination; crop damage during floods; pest infestation and diseases; abnormal growth and breeding for fisheries; deoxygenation and pH imbalances; and deaths of livestock and poultry under extreme heat occur recurrently. This creates a crisis for food and nutrition security and agriculture-dependent livelihoods. As projected by IPCC in its Sixth Assessment Report, future scenarios will likely be worse.

This goal aims to reduce the risks and vulnerabilities of climate change in agriculture by incorporating climate-resilient and smart agriculture (CRSA) in efforts to protect food, nutrition and livelihood security. This will be achieved through developing climate-smart agriculture, fisheries, aquaculture and livestock, and managing a sustainable value chain for agro-inputs in climate-vulnerable regions. Research and innovation for climate-resilient crops and smart agricultural practices can be strengthened.

Goal 3: Develop climate-smart cities for improved urban environment and well-being

Cities are the economic hub of the country. The per capita GDP, at $1,500, is almost four times as high as in rural areas (GED, 2020a). If extreme climate risks hit this large economy, the pace of national economic growth will slow, necessitating measures to develop urban resilience against climate change. Climate-resilient infrastructure and smart city development can significantly increase adaptation capabilities, especially in vulnerable communities, by preventing and managing the aftermaths of climate-induced disasters, such as urban waterlogging, tidal inundation and severe storm surge impacts. Adaptation can also improve the reliability of service provision, increase asset life and protect asset returns.

Through this goal, the NAP aims to develop climate-smart cities reinforced with robust urban drainage networks and water management infrastructure; expand green infrastructure, effective solid waste and renewable energy mechanisms; improve human health and WASH, and so on. A combination of management and eco-engineering structural measures would build climate resilience. Additionally, mainstreaming eco-engineering and nature-based infrastructure may provide viable alternatives or complement more conventional structural approaches to reduce risks and enhance climate resilience while conserving the urban environment.

Goal 4: Promote nature-based solutions for conservation of forestry, biodiversity, and well-being of communities

The NAP implementation will apply nature-based solutions (NbS) as a means of ecosystems-based adaptation (EbA) to protect, sustainably manage and restore natural or modified ecosystems. This process will address climate challenges effectively and adaptively, simultaneously providing human well-being and biodiversity benefits.

The application of EbA via nature-based solutions will reduce the vulnerability of human communities and improve the resilience of ecosystems to climate impacts through ecosystem conservation or restoration. Developing climate-resilient forestry, wetland, biodiversity and ecosystem services, community-based afforestation and reforestation measures; and pursuing research and capacity development for promoting EbA at the community level will facilitate this process.

Goal 5: Impart good governance through integration of adaptation into the planning process

The NAP aims to integrate inclusive climate change adaptation into planning through appropriate institutional arrangements to ensure robust governance, and to create an enabling environment for implementing adaptation actions. Achieving this goal will enhance the governance and institutional capacity of ministries,

departments, financial institutes, private sector firms and NGOs to mobilize and use climate finance with greater accountability, responsiveness and transparency, towards safeguarding vulnerable communities, sectors and ecosystems. Constraining factors for adaptation, including institutional weaknesses, a lack of coordination, conflicting objectives, etc. must be effectively overcome through robust governance.

Goal 6: Ensure transformative capacity-building and innovation for climate change adaptation

The NAP implementation process will instigate transformative capacity development at the individual, institutional and system levels to equip relevant stakeholders with better abilities, skills and understanding to address climate issues in a holistic, inclusive, feasible and sustainable way. This will include awareness-raising, training and individual skill development; collaborative research; knowledge management and communication of CCA.

This goal also addresses capacity gaps and needs in applying innovation in climate change-related research and knowledge generation by building the necessary capability and human resources to carry out research, data and knowledge management, and to share information to support the NAP implementation. Research and innovation to advance planned adaptation in all sectors will help achieve this goal.

1.5 Devising Sectoral Boundaries

The initial conceptualization of the NAP emphasized water resources; agriculture, food and livelihood security; coastal & drought zones; and urban areas as the priority sectors for adaptation. The NAP thus focuses on these four sectors and their subsectors, along with other critical cross-cutting issues, such as women and gender equality, youth, persons with disabilities, the private sector, infrastructure, WASH and health—to identify appropriate strategies considering the IPPC SSP1-2.6 and SSP5-8.5 in alignment with national aspirations. These sectors & subsectors have been further streamlined, cross-matched and blended to arrive at eight (8) distinct sectors and thematic issues. These 8 sectors are: 1) Water resources; 2) Disaster, social safety and security; 3) Agriculture; 4) Fisheries, aquaculture and livestock; 5) Urban areas; 6) Ecosystems, wetlands and biodiversity; 7) Policies and institutions; and 8) Capacity development, research and innovation.

First six sectors involve the physical implementation of CCA, whereas remaining two sectors i.e., Policies and institutions; Capacity development, research and innovations can catalyze an enabling environment to advance the NAP's smooth implementation. Infrastructure related to water and disaster management, agriculture, aquaculture, livestock, ecosystem restoration, urban WASH, health, drainage and heat management is considered part of the first six development sectors. The protection of transport, communications, rural WASH and health infrastructure are considered as cross-cutting issues. Women and people with diverse gender identities, youth, elderly people, persons with disabilities, ethnic communities, socially disadvantaged groups and the private sector are integral considerations in all eight sectors to ensure inclusive and participatory NAP implementation.

Thematic issues covered under the eight sectors are elaborated below.

Water resources

Water resources sector covers ensuring surface and groundwater availability; management of hydro-met slow-onset and sudden disasters; freshwater management for salinity reduction; river and estuaries management through dredging, maintaining connectivity, improvement of drainage and flood regulation, management of sediment, etc.; adaptation of water-related infrastructure; an early warning system for hydro-met disasters; protection of critical infrastructure and livelihoods; protection of water-related infrastructure; transboundary cooperation; and basin wide, integrated and participatory water resources management for climate adaptation.

Sectors of NAP

Disaster, social safety and security

This sector address reducing losses and damages and managing climate migration. Landslides, thunderstorms and lightning risk management are considered in addition to hydro-met and other disasters covered under the water resources sector. Disaster management focuses on creating an enabling environment and strengthening disaster preparedness and infrastructure, such as cyclone shelters, flood shelters and early warning systems for lightning and landslides. Other areas of emphasis include building climate-resilient housing facilities; managing disruptions of livelihoods due to disasters, such as occupational changes and shifts in work hours; expanding social safety nets and security; reducing early marriage, domestic violence and abuse; improving the disaster resilience of child education facilities; improving rural WASH infrastructure; ensuring social inclusion in disaster management; and establishing risk and recovery mechanisms for climate vulnerable people and migrants.

Agriculture

The agriculture sector focuses on rice and non-rice crop production; irrigation management; stress-tolerant seed and varietal development; development and extension of agricultural infrastructure (major and minor irrigation infrastructure, mechanization, crop management infrastructure like harvesters, etc.); urban farming and its irrigation; overall technological advancement and its extension; agriculture value chains; livelihood improvements for farmers; and food and nutrition security amid the adverse impacts of climate change.

Fisheries, aquaculture and livestock

This sector prioritizes the production of fisheries, aquaculture and livestock; breeding of stress-tolerant species and fodder; management

infrastructure such as *Mujib Killa*[3], resilient farms, etc.; technological advancement and its extension; resilient market systems for fisheries, aquaculture and livestock; exploring the blue economy; livelihoods improvement; and the achievement of food and nutrition security.

Urban areas

This sector covers the management of urban drainage and heat islands; the management of the urban environment; the development and expansion of urban green and blue infrastructure; and the improvement of health and WASH facilities and services for city dwellers. This spatially bound sector covers 43 major cities (each having over 100,000 people) and their peri-urban areas, including 12 city corporations identified in Bangladesh's Perspective Plan 2041.

Ecosystems, wetlands and biodiversity

Giving importance to ecosystem resilience amid climate change, this sector emphasizes the sustainable management of forestry, land, *haor*[4] and wetlands, and biodiversity; the maintenance of e-flow, soil and ecosystem health; the conservation of agroecosystems; the invention of stress-tolerant plant species; the conservation and restoration of ecosystems; the co-management of watersheds and wetlands; reinstating the connectivity of wetlands and waterbodies; improvement of the Chattogram Hill Tracts ecosystem; the management of marine and ocean ecosystems for unlocking the of blue economy; improving forest-dependent livelihoods; and promoting ecosystem-based adaptation.

Policies and institutions

This sector supports the development of enabling policies, governance and regulatory frameworks for NAP advancement and the reduction of losses and damages. It supports improved citizenship; integration of climate change into the development planning process; harnessing climate finance; monitoring, evaluation and learning based on the theory of change; and the empowerment of local governments for supporting locally led action.

Capacity development, research and innovation

Transformative capacity development at the planning, institutional and individual levels is a prime consideration for this sector, drawing on action research, innovation, field-level demonstrations, piloting and technology transfers. Climate change knowledge management and dissemination up to the local level are other key elements.

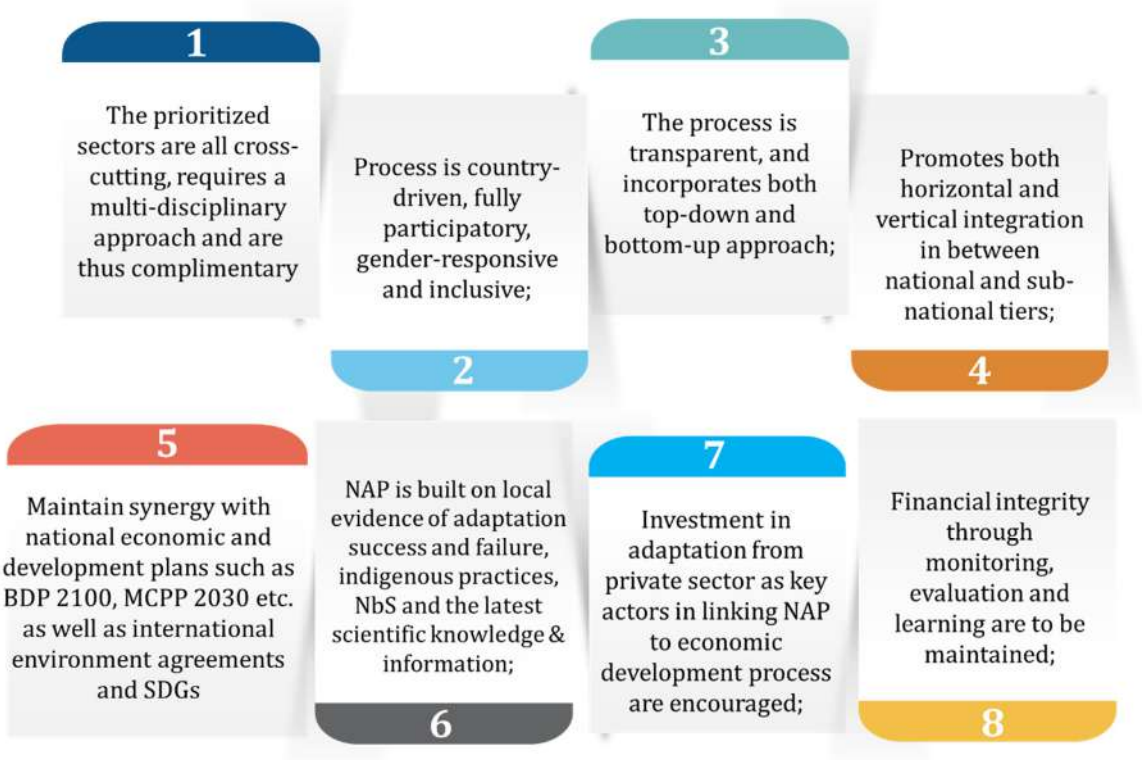
---

[3] *Built up higher grounds (popularly known as 'Mujib Killa') in flood plains to protect people and their livestock at that time*

[4] *A marshy wetland ecosystem in the northeastern part of Bangladesh, physically a bowl- or saucer-shaped depression that looks like inland seas during the monsoon floods*

1.6 Principles and Approach

Formulation and advancement of the NAP adhere to eight principles that ensure both distributive and procedural climate justice and recognition of diverse cultures and perspectives (IPCC AR6 WGII, 2022). These guiding principles align synergistically with the national development vision, the Bangladesh Delta Plan, the SDGs, the Cancun Adaptation Framework (Article II.1) and international commitments.



Principles of NAP

The principles include: priority sectors are cross-cutting, with a multidisciplinary and complementary nature; ensuring that the NAP process is country driven, participatory, gender responsive and sensitive to disability; being transparent and inclusive, and following bottom-up and top-down approaches; promoting horizontal and vertical integration; maintaining synergies with national and international development agendas and commitments; building on local evidence, indigenous practices, nature-based solutions and the latest scientific knowledge; promoting nature based solutions, private sector engagement; and financial integrity through effective monitoring, evaluation and learning.

The NAP has been developed based on national and international guidelines.[5] These helped frame the overall structure and define adaptation

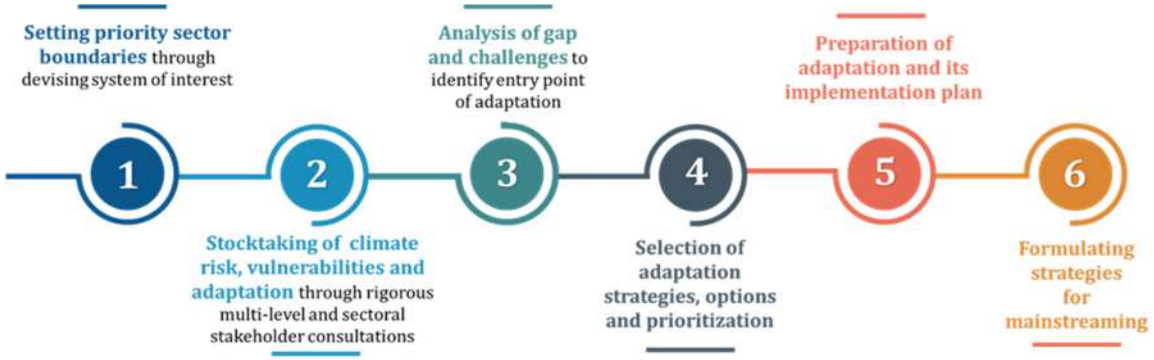
5 Roadmap of Bangladesh NAP (MoEFCC, 2015), Technical Guidelines of NAP by Least Developed Countries Expert Group of UNFCCC, PROVIA (The Program of Research on Climate Change Vulnerability, Impacts, and Adaptation) Guidelines, Gender Mainstreaming Guidelines, Private Sector Engagement Toolkit, Guidelines of EbA for NAP by UNFCCC, Guidelines for Nature-based Solutions by IUCN, Guidelines for Integrating Agriculture and Fisheries into NAP by FAO, MRV toolkit for climate change adaptation, Guidelines for Climate Resilient Health Care Facilities by WHO and several others.

programmes and actions. They shaped a comprehensive approach to participatory stocktaking, development of science-based future scenarios, sector-wise impact analysis, adaptation needs assessments, cost-benefit assessments and prioritization. Assessing vulnerability, impacts and subsequent conceptualizations of adaptation drew on standardized concepts of the IPCC; these will facilitate further risk and vulnerability assessment. Incorporating ecosystems functions and services entailed successfully integrating EbA and NbS concepts.

Six steps for compiling and communicating the NAP ranged from initiating its formulation to setting priority sector boundaries to devising a system of interests and other activities.

district and national levels from January 2021 to June 2022. The selection of locations for stakeholder consultations was based on spatially variable climate change risks and vulnerabilities, emphasizing the inclusion of women and people with diverse gender identities, ethnic and marginal groups, elderly people, persons with disabilities, youth and students, CSOs, community-based organizations, NGOs and private sector firms.

Thorough consultations with relevant ministries, departments and agencies from the public sector, private sector firms, civil society groups and other sectoral value chain actors identified and validated adaptation needs as part of devising short-, medium- and long-term adaptation strategies for the 2030s, 2040s, and 2050s respectively. In



Steps of NAP Formulation

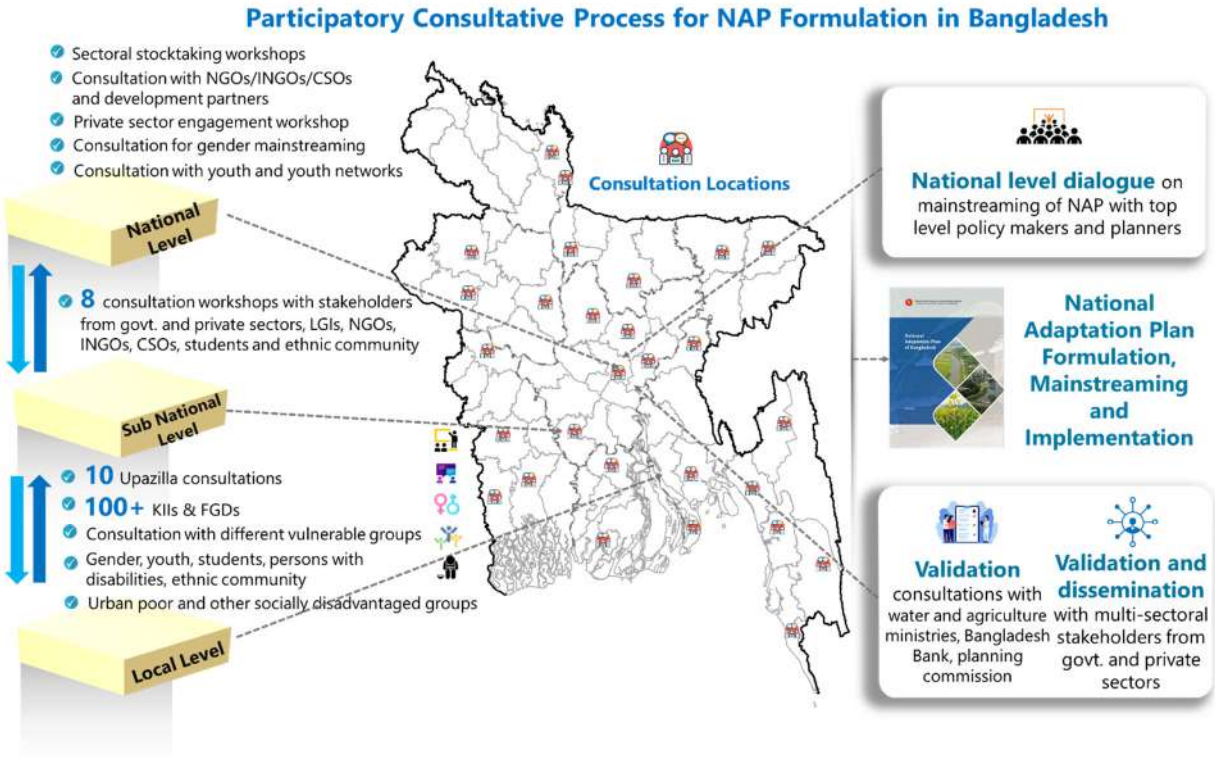
The NAP aims to identify potential adaptation needs and prioritize boundaries for the eight thematic sectors by devising a system of interests and subsequently developing adaptation strategies through policy analyses and a stocktaking of adaptation practices and barriers.

The stocktaking process, involving multi-sectoral stakeholder participation, blended bottom-up and top-down approaches. Indigenous knowledge was assembled from several local consultations with vulnerable and marginal communities, considering gender dimensions; the priorities of youth and students, the elderly, persons with disabilities and ethnic communities; and social inclusion principles. More than 35 stakeholder consultations and over 100 key informant interviews and focus group discussions consulted with approximately 5,000 people across the country at the local,

devising planning horizons, NAP formulation built on the latest available scientific data, assessed existing gaps and challenges in risks and vulnerabilities and referred to identified impact chains from local consultations. System dynamics analysis performed for multiple future scenarios identified adaptation entry points through assessing climate change risks and vulnerabilities.

Consultative processes engaging public and private stakeholders in priority sectors also identified, prioritized and validated adaptation strategies and options to address adaptation needs and reduce risks. Prioritized options and measures were translated into interventions for implementation. An assessment of the economics of adaptation options estimated the costs and benefits to support prioritization.

The NAP process envisions setting up strong institutional arrangements and effective coordination mechanisms with horizontal and vertical linkages through a stocktaking of institutional capacities, barriers and gaps; assessing the need for implementation and coordination; considering existing institutional arrangements and governance; devising proper resource mobilization strategies; and developing an effective result-based M&E framework. Bringing adaptation into national planning and programming processes will entail mapping mainstreaming opportunities, prioritizing CCA, conducting sectoral dialogues and integrating adaptation into macro-plans and development processes.



Climate Risks and Vulnerabilities

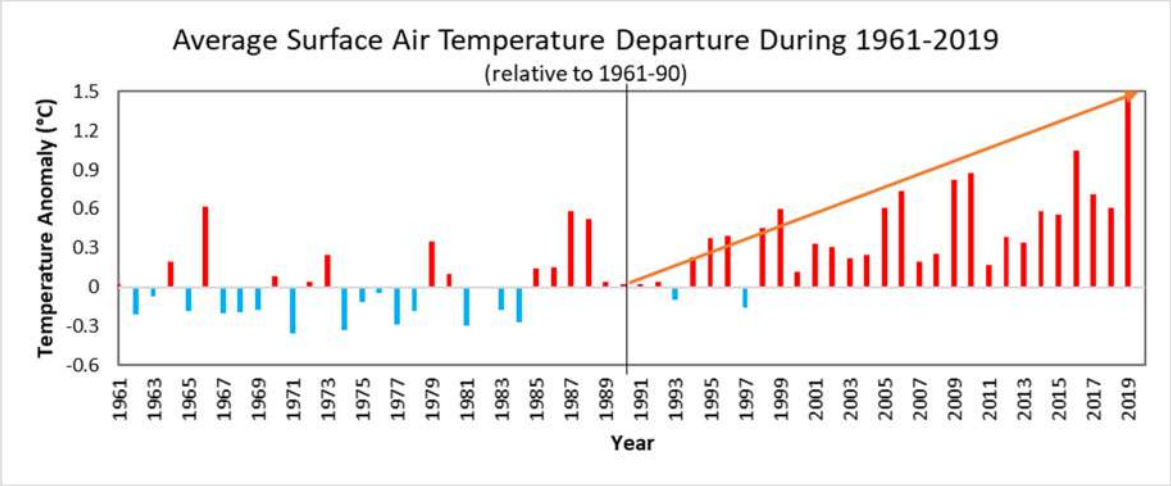
2. Climate Risks and Vulnerabilities

Bangladesh is a subtropical country in South Asia with a warm and humid climate. The average temperature ranges between 15°C and 34°C around the year. Mean annual rainfall is about 2,400 mm; about 70 percent of rainfall occurs during monsoon (June to September). Rainfall varies significantly across the country, with the arid western regions receiving as little as 1,400 mm and the north-eastern region and eastern hills receiving over 4,300 mm. Bangladesh has been experiencing higher temperatures, erratic rainfall and extreme rainfall events in recent decades due to climate change. It also is highly vulnerable to climate change impacts due to its low-lying terrain (13 percent of its territory lies within two meters above the mean sea level), high population density, and location at the confluence of the Ganges, Brahmaputra and Meghna River basins. Observed climate trends, hazards, future projections, ensuing stresses and resultant risks will be elaborated further based different regions of the country that reflect hydrological and topographical variations.

2.1 Historical Climate Trends

2.1.1 Temperature rise

The average temperature in Bangladesh is rising sharply in the last three decades compared to previous three decades. The plot below illustrates the stark differences in temperature distributions between two consecutive periods. Whereas temperature variations were minimal (0.0067°C per year) during 1961-1990, the variations rose sharply (to 0.03°C per year) from 1991 to 2019 (CEGIS, 2022).



Departure of average annual temperature in Bangladesh relative to climate normal of 1960-1990

Source: CEGIS analysis based on BMD data.

In recent decades, the mean temperature has been rising very rapidly. From 1991 to 2000, the mean temperature increased by 0.39°C, which further increased by 0.53°C during 2001-2010 and 1.06°C during 2011-2019 (CEGIS, 2022). The minimum temperature has risen by 0.45°C and 0.52°C for the winter and monsoon, respectively. As such, winters are becoming warmer with minimum temperature increase of 0.02°C per year. Even hotter summers during the pre-monsoon and monsoon have seen a maximum temperature increase of 0.022°C per year and 0.035°C per year, respectively, and minimum temperature rises of 0.024°C per year and 0.043°C per year, respectively (CEGIS, 2022).

2.1.2 Rainfall variability

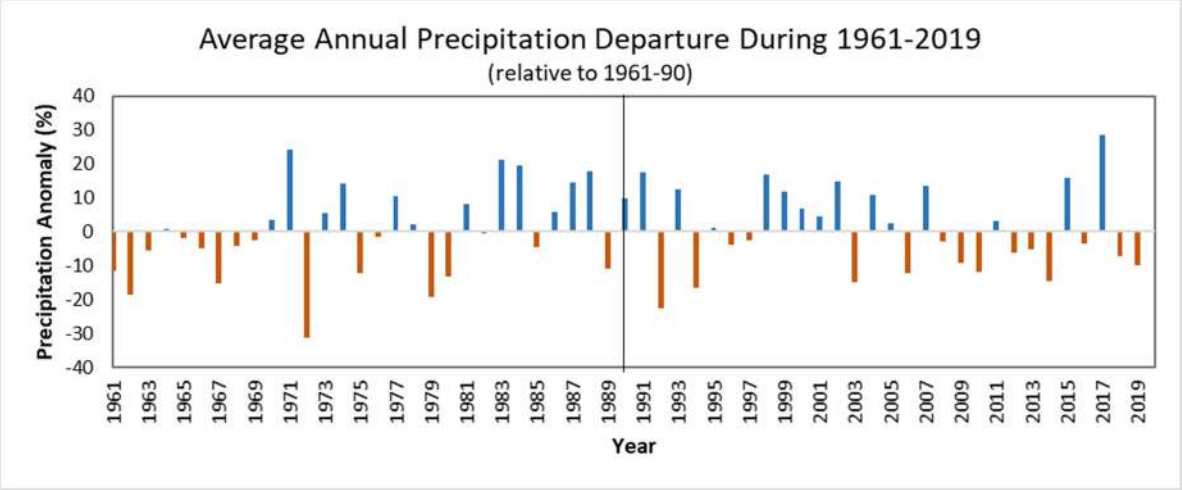
Rainfall varies significantly across the different hydrological regions of the country, with lower rainfall ranging from 791-2,241 mm in the dry north-western *barind* region to high rainfall (2,586-5,944 mm) in the north-eastern region. Rainfall increases nationwide are 8.4 mm per year (Roy et al., 2017). There is also temporal variation as average yearly rainfall distribution exhibits a skewed pattern. Rainfall is decreasing in the winter (December-February) and pre-monsoon (March-May) at 1.3 mm per year and 0.5 mm per year, respectively, while it is increasing for both the post-monsoon (October-November) and monsoon (June-September) at 0.05 mm per year and 4.5 mm per year, respectively. This indicates that winters are becoming dryer and monsoons are becoming wetter. Spatial variations in temporal rainfall distribution are erratic throughout the country, however (Rahman et al., 2015). The departure plot does not display increases as significant as those of temperature but it does illustrate the slightly increasing nature of rainfall in recent decades.

In recent years, the country has experienced several extreme rainfall events, e.g., 341 mm of rainfall occurred in 24 hours in Dhaka in 2004, 408 mm in 24 hours in Chattogram in 2007, 333 mm in 12 hours in Dhaka in 2009 and 433 mm of rainfall in 24 hours in Rangpur in 2020. The Rangpur rainfall was a record high in the last 60 years. Analysis of extreme rainfall indicates that consecutive dry days (CDD) is a significant increasing trend all over the country (Ezaz et al., 2021 and Islam et al., 2014). The simple daily intensity index (SDII) shows a decreasing trend in northern and central areas, while the coastal areas have an increasing trend (Ezaz et al., 2021). In addition, the difference in rainfall amount among regular and extreme events is increasing.

2.1.3 Sea-level rise and ocean warming

Sea levels have risen adjacent to the Bangladesh coast due to both the geographic location and nature of the delta. Between 1901 and 2010, sea level rose at 1.7 mm per year, and from 1993 to 2010, it rose 2.8±0.8 mm per year. Satellite altimetry data analysis also support this, showing a rising rate of 3.2±0.4 mm per year.

The Bay of Bengal is experiencing increasing sea surface temperature and subsequent changes in pH. A significant decreasing trend in pH is



Departure of average annual precipitation in Bangladesh relative to the climate normal of 1961-1990
Source: CEGIS analysis based on BMD data.

observed near the Bangladesh coast during the winter and fall seasons, indicating acidification of sea water (Sridevi and Sarma, 2021).

2.2 Future Climate Scenarios

The Sixth Assessment Report of the IPCC (IPCC, 2021) updated future climate projections with new shared socio-economic pathway (SSP) scenarios based on five narratives describing broad socioeconomic trends. These unfold the range of plausible future scenarios. According to the IPCC, SSP1-2.6 represents low future greenhouse gas emissions (GHG), while SSP5-8.5 is the very high emissions scenario. To capture the complete variation of future climate as presented in the IPCC Sixth Assessment Report (AR6), these two scenarios have been considered for Bangladesh. The SSP1 and SSP5 scenarios envision relatively optimistic trends for human development in the future. SSP5 assumes this will be driven by an energy-intensive, fossil fuel-based economy, while in SSP1, there is an increasing shift towards sustainable practices.

2.2.1 Temperature

IPCC AR6 (2021) projects a global temperature increase of 1.5°C to 1.6°C in the near term (2030s), 1.7°C to 2.4°C in the mid-term (2050s) and 1.8°C to 4.4°C in the long term (end of the century). Climate projections for Bangladesh based on a downscaled multi-model ensemble (following the IPCC AR6) for Bangladesh indicate a warming of 0.44°C to 0.69°C in the near term (2030s) and 1.3°C to 2°C in the mid-term (2050s) for the SSP1-2.6 and SSP5-8.5 scenarios, covering the potential range of future temperature rise. Interestingly, in the near term, SSP1-2.6 has a slightly higher temperature rise (0.69°C) than SSP5-8.5 (0.44°C) across Bangladesh. This changes in the mid-term with higher amounts of warming expected under SSP5-8.5.

Future Projected Annual Average Temperature (°C)

Climate Stress Area	Base (1981-2010)	SSP1-2.6		SSP5-8.5	
		2030s (2016-2045)	2050s (2036-2065)	2030s (2016-2045)	2050s (2036-2065)
SWM	25.8	26.5	27.1	26.2	27.7
SEE	25.6	26.2	26.8	26.1	27.5
CHT	25.3	26.1	26.7	25.9	27.4
FPE	24.9	25.7	26.4	25.4	27.0
HFF	24.5	25.3	26.0	25.1	26.8
DBA	25.5	26.2	26.9	25.8	27.5
NNW	24.9	25.6	26.3	25.2	26.9
CBL	25.3	26.0	26.8	25.7	27.4
CHI	25.2	25.9	26.6	25.7	27.3
URB	25.3	26.0	26.7	25.8	27.3
BD	25.5	26.1	26.8	25.9	27.4
BoB*	28.1	28.7	29.0	28.7	29.4

°C: 24.5 25.5 26.5 27.5 28.5 29.5

Future Projected Annual Average Rainfall (mm)

Climate Stress Area	Base (1981-2010)	SSP1-2.6		SSP5-8.5	
		2030s (2016-2045)	2050s (2036-2065)	2030s (2016-2045)	2050s (2036-2065)
SWM	2129	2138	2210	2185	2215
SEE	3266	3300	3411	3374	3431
CHT	2912	2943	3040	3010	3069
FPE	2558	2579	2598	2647	2667
HFF	3653	3652	3683	3712	3783
DBA	1560	1588	1631	1638	1643
NNW	2157	2193	2191	2281	2255
CBL	1663	1692	1724	1745	1741
CHI	2686	2699	2750	2769	2800
URB	2759	2785	2840	2839	2882
BD	2579	2582	2640	2615	2669
BoB	1560	1353	1393	1628	1707

mm: 1300 1800 2300 2800 3300 3800

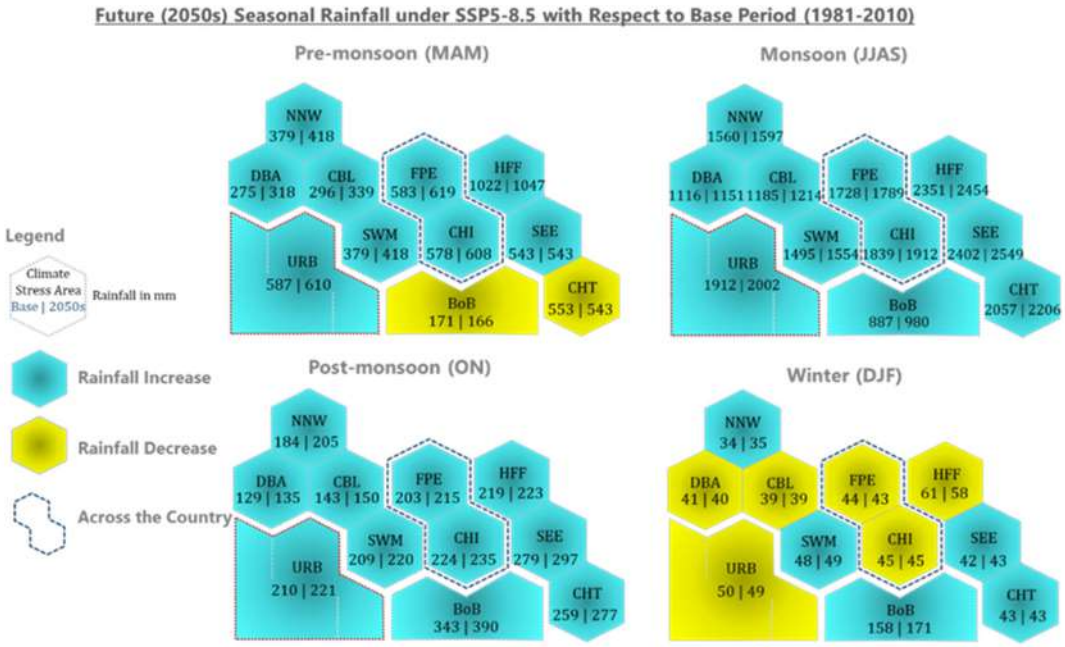
Future projections of temperature and rainfall for Bangladesh and different climate stress areas based on downscaled climate data

(Source: CEGIS analysis from the IPCC Sixth Assessment Report multi-model ensemble)

Note:

**Sea surface temperature is used for future projections.*

***Climate stress areas: SWM: south-western coastal area and Sundarbans; SEE: south-east and eastern coastal area; CHT: Chattogram Hill Tracts; FPE: river, floodplain and erosion-prone area; HFF: haor and flash flood area; DBA: drought-prone and Barind area; NNW: northern and north-western region; CBL: Chalan Beel and low-lying area of the north-west region; CHI: Char and islands; BoB: Bay of Bengal and ocean and URB: urban areas.*

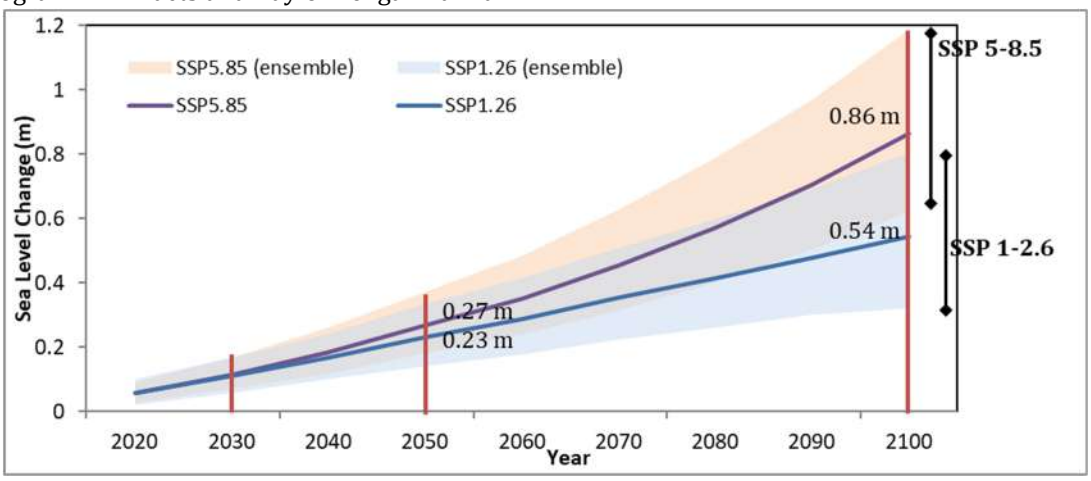


2.2.2 Rainfall

Rainfall variation due to future climate change for Bangladesh ranges between 0.1-1.4 percent in the 2030s and 2.4-3.5 percent in 2050s. The north-eastern and eastern hills regions will receive higher rainfall, while the western part will see lower levels. Future annual rainfall will be slightly higher or similar in the 2030s across the country. In the 2050s, rainfall will increase all over the country. A higher amount of change is expected in coastal areas and the Chattogram Hill Tracts. Future projections indicate that winter rainfall is decreasing for most of the country except in the coastal and Chattogram Hill Tracts regions. In contrast, pre-monsoon rainfall will decrease in the Chattogram Hill Tracts and Bay of Bengal. Rainfall in the rest of the country will increase during this season. Monsoon and post-monsoon rainfall all over the country will increase. The frequency of heavy rainfall events is projected to rise while that of light rainfall events will fall, inferring a shift towards a lower number of wet days with an increase in the intensity of rainfall on days with rain, entailing an increased risk of flash floods (Caesar and Janes, 2018).

2.2.3 Sea-level rise

Global warming is causing sea-level rise and increasing the vulnerability of low-lying coastal areas of Bangladesh. Future sea-level rise is projected to be between 0.11-0.12 m in the near term, 0.23-0.27 m in the mid-term and 0.54-0.86



Sea-level rise projections near the Bangladesh coast in the Bay of Bengal

Note: The lines and shaded region represent the ensemble average of sea-level rise and the spread of ensemble results from the IPCC CMIP6 models, respectively. (Source: Fox Kemper et al., 2021.)

metres in the long term (IPCC, 2021). There is, however, substantial uncertainty in the long-term projections near the Bangladesh coast, according to the IPCC. Some global models estimate an increase of up to 1.75 m.

2.3 Increased Extremities of Hazards

Due to climate change, most climate-related hazards will increase in frequency and/or intensity. The most critical climate change-induced hazards in Bangladesh are rainfall variability, river floods, flash floods, urban floods, sea-level rise, salinity, cyclonic storm surges, droughts, extreme heat waves, extreme cold, riverbank erosion, lightning, landslides, higher sea surface temperature and ocean acidification.

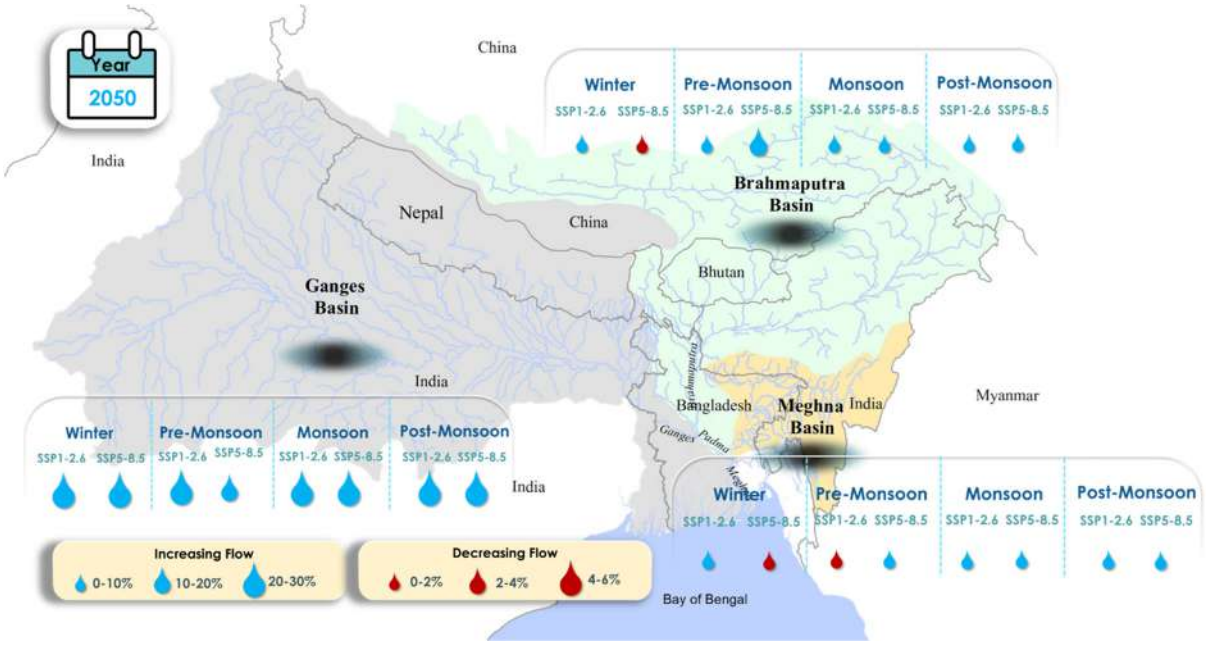
2.3.1 River flood

River flooding is a recurrent phenomenon in Bangladesh, occurring almost every other year. It generally takes place during the monsoon and inundates low-lying floodplain areas.

Major floods happened in 1987, 1988, 1998, 2004, 2007 and 2017. The area inundated during the 1987, 1988, 1998 and 2007 floods comprised 39 percent, 61 percent, 69 percent and 42 percent of the country, respectively. During the 1988 floods, embankments of 1,990 km (17.5 percent of the total), irrigation canals/drainage channels of 283 km (5.3 percent of the total), 1,465 structures (10 percent of the total) and protection works of 265 km (24.8 percent of the total) of the Bangladesh Water Development Board (BWDB) were partially or fully damaged. The 1998 flood caused the death of 1,100 people and damaged 4,500 km of embankments and 575,000 hectares of crop. During the 2004 floods, embankments of 3,158 km (27.7 percent of the total) and protection works of 178 km (16.6 percent of the total) were partially or fully damaged. The 2007 flood caused 405 deaths. The flood of 2020 was an alarming event. Around 5 million people were affected; 41 people lost their lives.

Estimated damages due to the flood events of 1988, 1998, 2004, 2007 and 2017 were $1.2 billion, $2.8 billion, $6.6 billion, $1 billion and $900 million, respectively. While flood-related fatalities are decreasing, economic losses have been increasing over the years. The Government has been developing and implementing various measures to reduce flood risks.

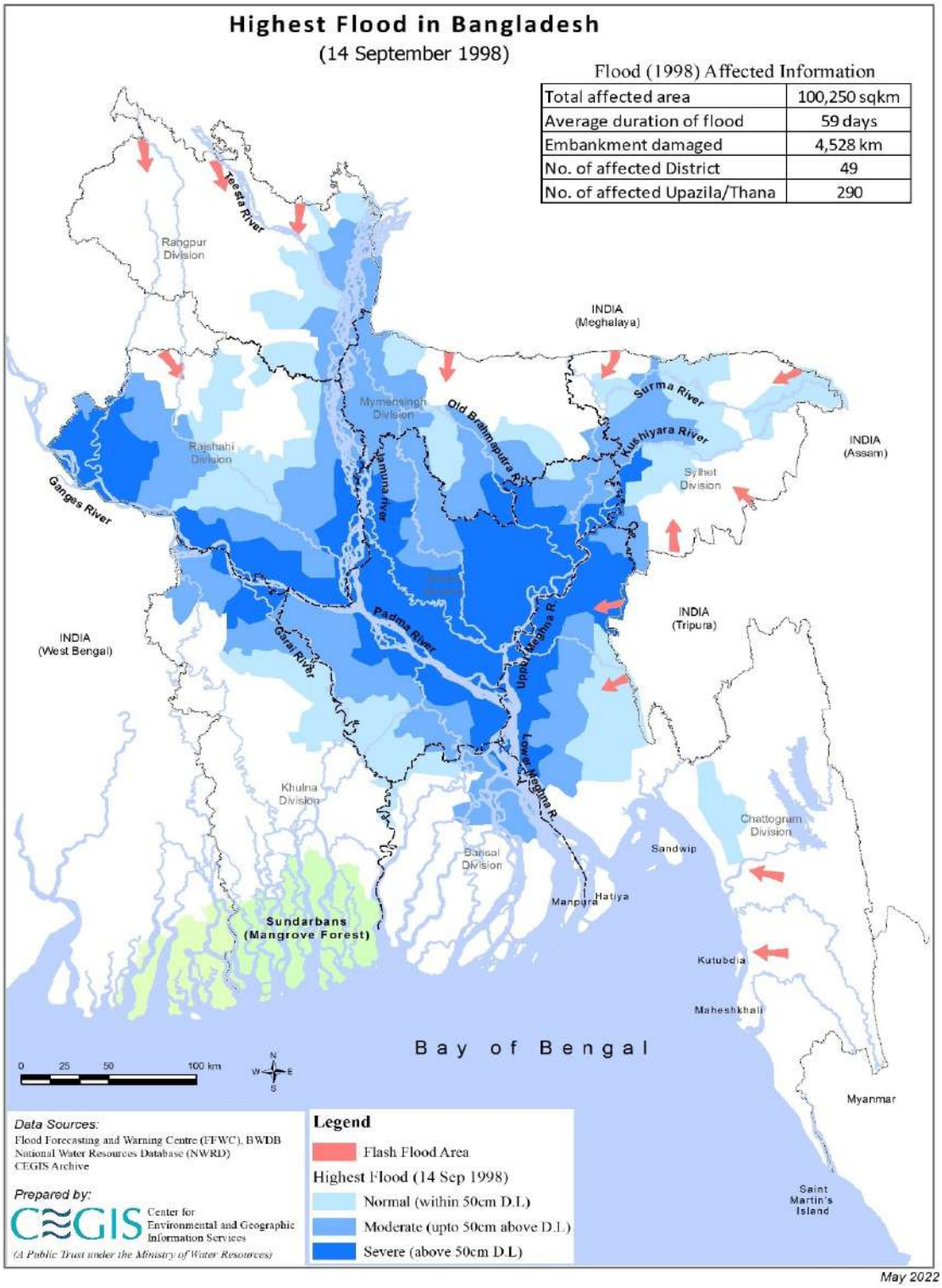
Due to climate change, the mean annual flow of the Ganges, Brahmaputra and Meghna river basins will increase by 17-28 percent, 2-5 percent and 1-4



Future seasonal flow variation in the Ganges, Bhramaputra and Meghna basins

Source: CEGIS GBM Model (2021)

percent, respectively, under the SSP5-8.5 scenario in the 2050s (CEGIS, 2021). The seasonal flow distribution in the 2050s will also increase substantially during the pre-monsoon in all three basins. The flow will increase significantly (18-30 percent) in the Ganges basin, while a smaller increase might occur in the Brahmaputra and Meghna basins. The higher increase in the Ganges basin is most probably attributed to additional flow from melting Himalayan glaciers. This will increase the flooding probability in the country. Winter flows will decrease in the Brahmaputra and Meghna basins under SSP5-8.5.



2.3.2 Drought

The dry regions of Bangladesh located along the western border are most vulnerable to meteorological droughts in pre- and post-monsoon periods. The mean annual rainfall in the dry zone is around 1,250-1,750 mm, mainly from May-June to September-October (Ahmed and Suphachalasai, 2014). Due to the combined effect of soils with low moisture-holding capacity (<200 mm available moisture), an increasing number of dry days (precipitation <0.5 Potential Evapo-Transpiration) and extreme summer temperatures of more than 40°C, the drought situation in the dry areas become extremely severe during April and May. Nineteen droughts occurred in Bangladesh between 1960 and 1991. The average occurrence is once in 2.5 years. Bangladesh experienced severe droughts in 1951, 1957, 1961, 1972, 1976, 1979, 1989 and 1997. On average, 2.32 million ha per year (Kharif seasons) and 1.2 mha per year (Rabi season) of agricultural lands are damaged during a typical drought event (CEGIS, 2013).

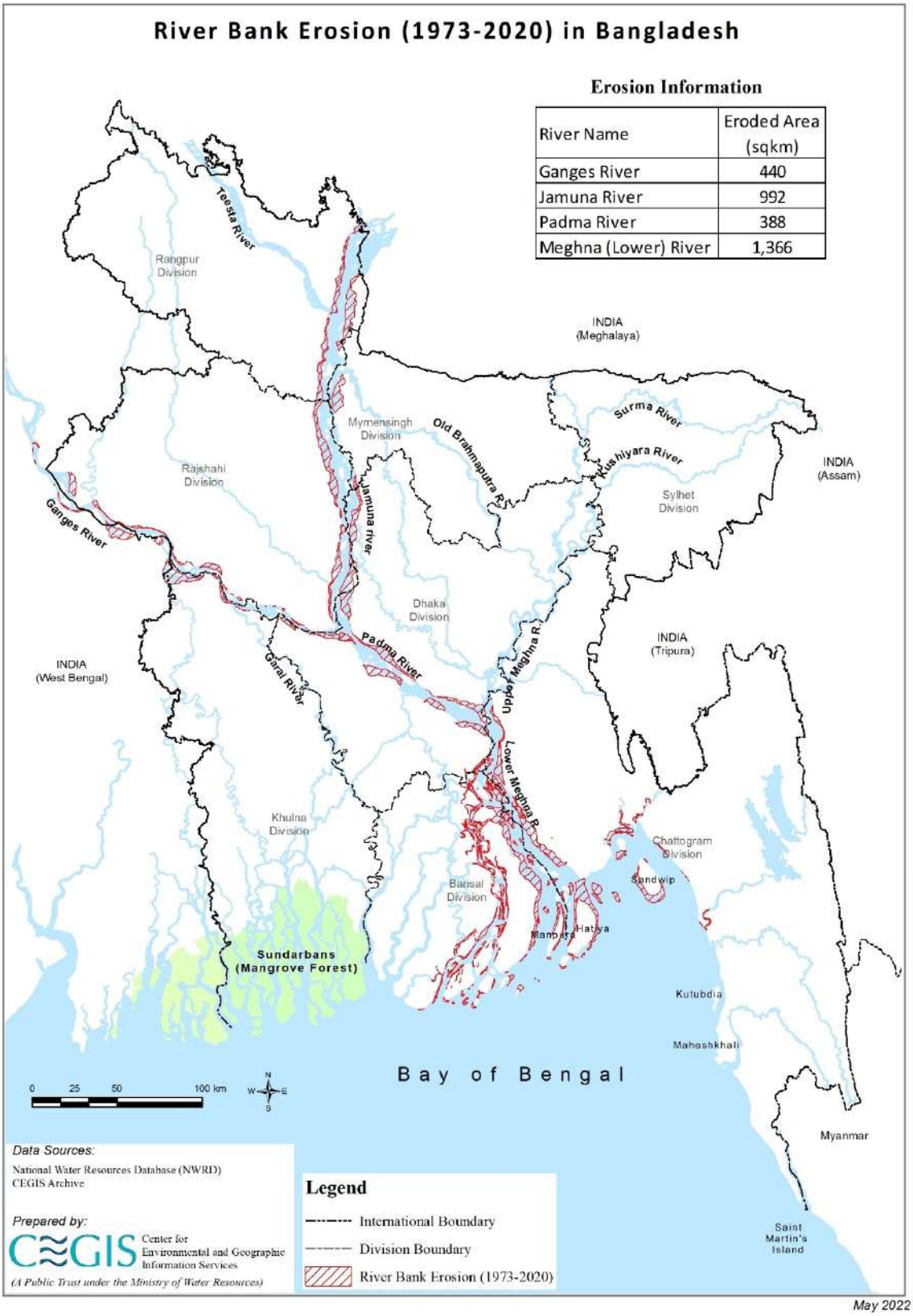
Future climate change projections outline an increase in daily temperature with more hotter days during the pre-monsoon and fewer rainy days. According to BDP2100 studies, Aus production would decline by 27 percent under a moderate climate change scenario while wheat production would fall to 61 percent. Under a severe climate change scenario (with 60 percent moisture stress), the yield of dry season or Boro rice might decrease by 55-62 percent. Moisture stress might force farmers to reduce Boro cultivation.

2.3.3 Riverbank erosion

Every year in Bangladesh, rivers erode around 10,000 hectares of land (NWMP, 2001). According to CEGIS estimates, between 1973 and 2021, erosion along the Jamuna River was 93,965 ha and accretion was 14,545 ha. During this period, erosion along the Ganges River was 30,300 ha while accretion was 29,100 ha. Along the Padma River, erosion was 33,585 ha and accretion was 5,485 ha.

In 2020, 725 ha eroded along the Jamuna, 460 ha along the Ganges and 780 ha along the Padma. Currently, on average, total erosion in Bangladesh is 3,000 ha per year, displacing approximately 25,000 people annually.

Changes in river flow and sediment transport due to the multifaceted impacts of climate change are expected to increase the dynamics of these rivers even more. Due to climate change, erosion might escalate further in the near term as high-intensity rainfall and peak flow in the major rivers will increase and carry more sediment from upstream catchments (CEGIS, 2010).


River Bank Erosion (1973-2020) in Bangladesh
Erosion Information
River Name | Eroded Area (sqkm)
Ganges River | 440
Jamuna River | 992
Padma River | 388
Meghna (Lower) River | 1,366
Teesta River
Rangpur Division
INDIA (Meghalaya)
Mymensingh Division
Old Brahmaputra R.
Surma River
Kushiyara River
INDIA (Assam)
Rajshahi Division
Ganges River
Jamuna river
Sylhet Division
Dhaka Division
Padma River
Upper Meghna R.
INDIA (Tripura)
INDIA (West Bengal)
Garai River
Lower Meghna R.
Khulna Division
Chattogram Division
Sandwip
Barisal Division
Manpura
Hatiya
Sundarbans (Mangrove Forest)
Kutubdia
Maheshkhali
Bay of Bengal
0 25 50 100 km
N W E S
Myanmar
Saint Martin's Island
Data Sources:
National Water Resources Database (NWRD)
CEGIS Archive
Prepared by:
CEGIS Center for Environmental and Geographic Information Services
(A Public Trust under the Ministry of Water Resources)
Legend
International Boundary
Division Boundary
River Bank Erosion (1973-2020)
May 2022

2.3.4 Flash floods

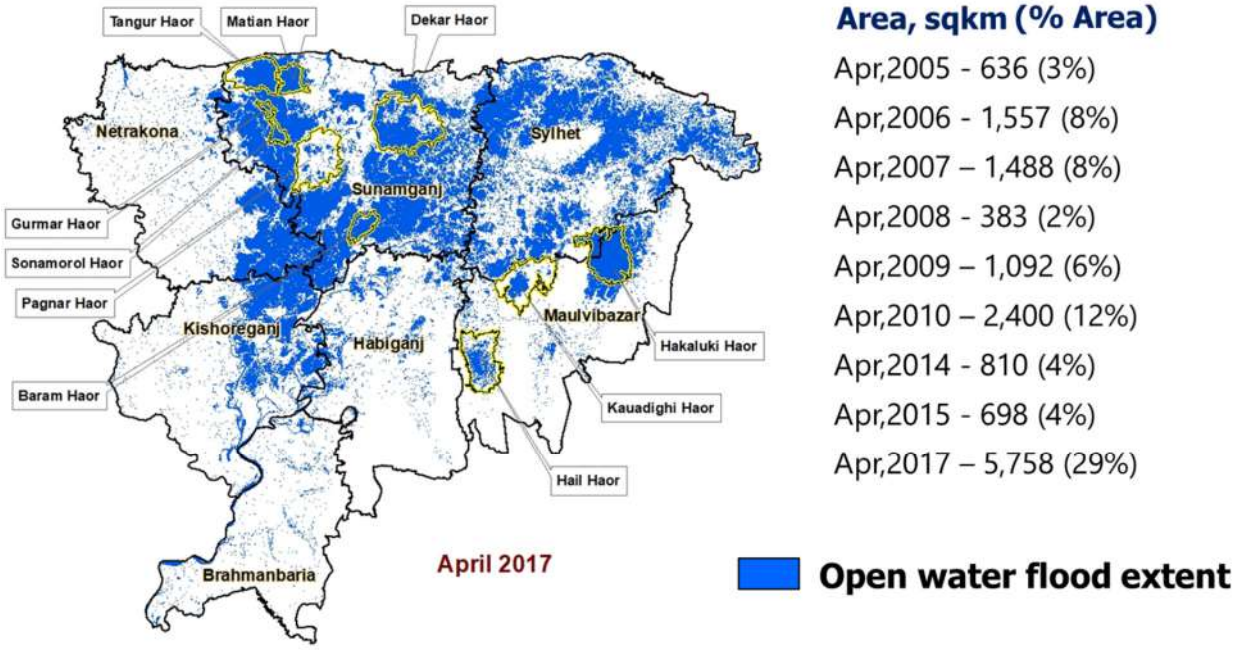
Flash floods are caused by heavy or excessive rainfall or upstream flooding in a short period of time. Flash floods are most common from April to July and from September to October (WMO, 2003). The north-eastern areas of Bangladesh are more prone to flash flooding than other parts of the country.

Boro rice is the only major crop in the north-eastern areas. Almost 80 per cent of the area is covered by dry season rice from January to May (pre-monsoon), producing 18 percent of Bangladesh's total rice production (BHWDB, 2012). Flash floods suddenly inundate crops near the harvesting time, damage infrastructure and often cause losses of lives and properties.

The flash flood event of 2017 was the most devastating early flash flood, disturbing roads and embankments and damaging pre-mature dry season crops worth $1.49 billion, which posed a threat to the overall food security of the country.

The flash flood of 2022 severely affected 7.2 million people in nine north-eastern districts, damaging 1,133 sq. km of croplands, 44,254 water ponds and 49,885 sanitation facilities. Livestock losses reached $27.84 million. Around 3,600 schools suspended activities, and 480,000 people were displaced (UN RC Bangladesh, 2022).

The Eastern hill regions are also very prone to flash floods. During 1985 to 2015, 12 flash flood events occurred in the region. These events have caused substantial damages to the local population and economy. The torrential rain event of 23rd June 2015 triggered a flash flood that affected approximately 1.8 million people in Chattogram,



Flash flood-affected areas in north-eastern Bangladesh
Source: CEGIS analysis based on satellite images.

Bandarban, and Cox's bazar districts (Adnan, 2019). Future climate change will likely increase rainfall in the pre-monsoon and monsoon seasons in the north-eastern areas, resulting in more chances of flash floods.

2.3.5 Urban floods

Urban floods in Bangladesh have recently become an environmental and economic concern. In the last two decades, Bangladesh has experienced several significant urban floods (as elaborated in 2.1.2). In 2004, Dhaka saw record high daily rainfall causing widespread flooding. The event affected more than 80 percent of the city and over 5 million people. Combined with underdeveloped

drainage infrastructure and the reduction of water bodies, these short-duration but high-intensity rains exert extreme stress on urban drainage management. With growing urbanization, more cities are prone to urban floods as many are located in low lying floodplains, and rainfall extremes are increasing. Climate change projections indicate an increasing trend of short-term heavy rainfall in urban catchments, which will intensify the risk of urban flooding and waterlogging.

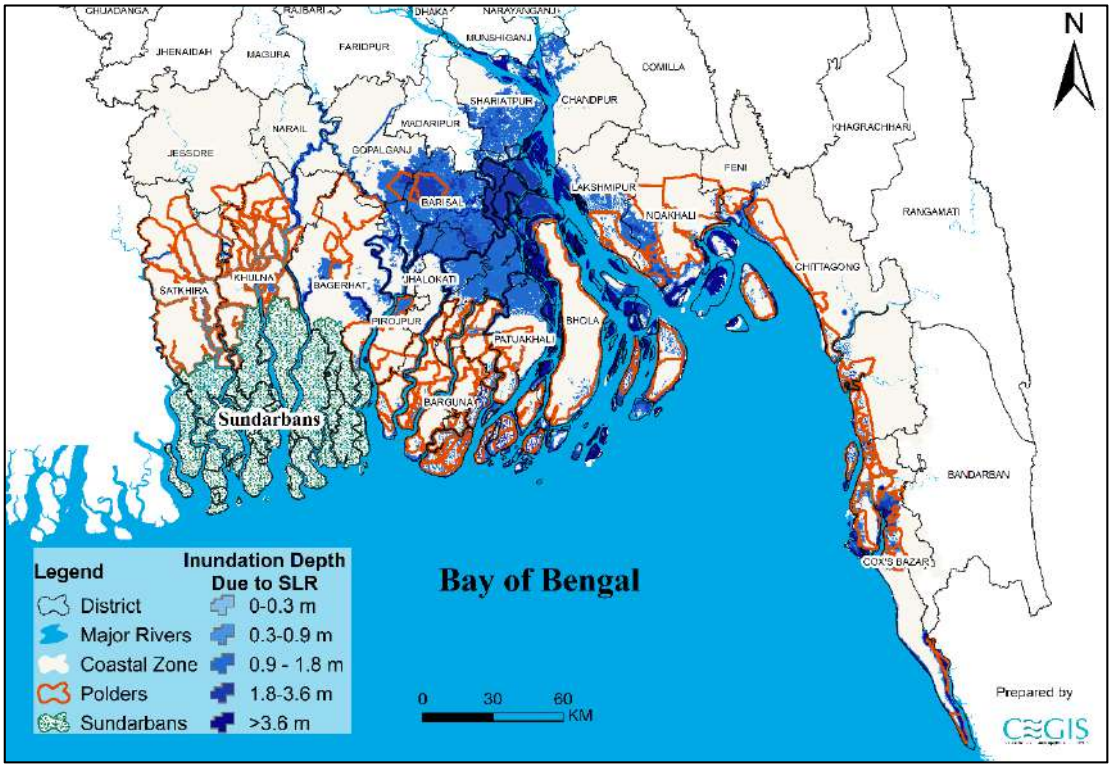
2.3.6 Sea-level rise

Climate change will further aggravate historical sea-level rise and projections for the coastal areas. This will substantially affect coastal communities, infrastructure and livelihoods. Potential coastal inundation estimated by CEGIS (2021) for variable sea-level rise, incorporating the existing coastal polder set-up, shows that by the mid-term, around 18 percent of the coastal area might be inundated due to sea-level rise projections, based on the SSP5-8.5 scenario. The inundated areas are mostly behind the coastal polders in the south-central region and are low-lying. Some existing polders have flooded due to lower polder height caused by previous damage. In case of a breach or damage to the polder, which was not considered in the simulation, the inundated area will be much greater. This will impact the coastal population and livelihoods, exacerbate salinity intrusion, and damage crops and fisheries.

2.3.7 Cyclone, tornado and storm surges

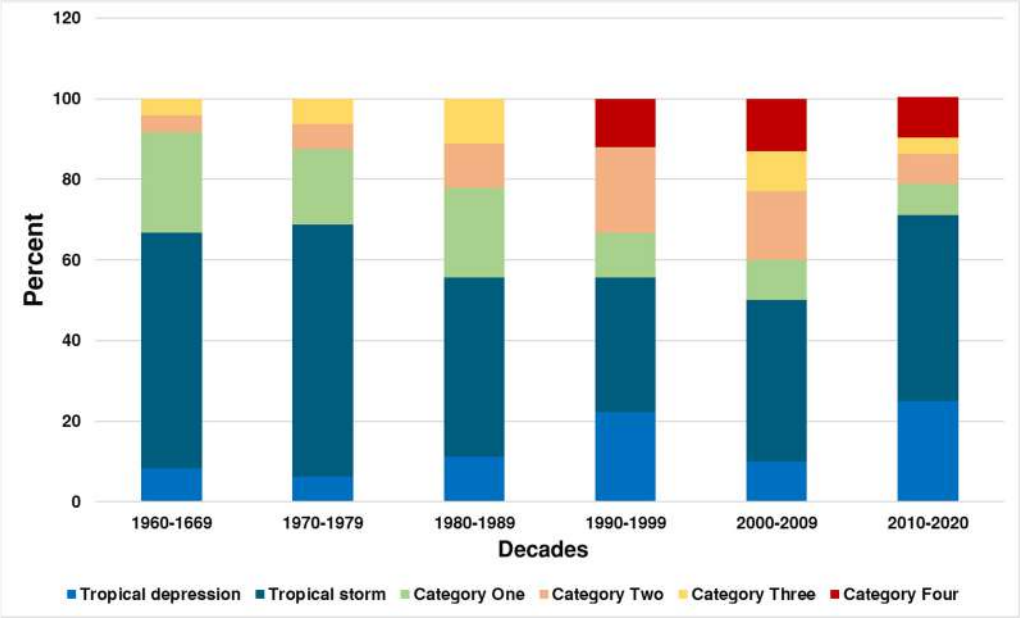
Twenty-one severe cyclones (winds between 87 to 117 km/hour) and severe cyclonic storm with hurricane intensity (winds >117 km/hour) struck the Bangladesh coast between 1960 and 2010 (MoEFCC, 2018b). Among them, 33 percent happened pre-monsoon and 67 percent post-monsoon. In the three decades since 1990, Bangladesh has experienced category four cyclones with wind speeds of 209-251 km per hour.

Besides cyclones, Southern and central Bangladesh is very prone to tornados. Tornados in Bangladesh generally form during April and cause damage to lives and properties (Finch and Dewan, 2003). In 25 Mar 2013, a deadly tornado happened in Brahmanbaria, causing death of 31 persons and injury of 388 persons (DMIC, 2013).



Potential inundation due to sea-level rise and cyclone storm surges in the coastal areas by the 2050s

(Source: CEGIS Bay of Bengal Model, 2021)

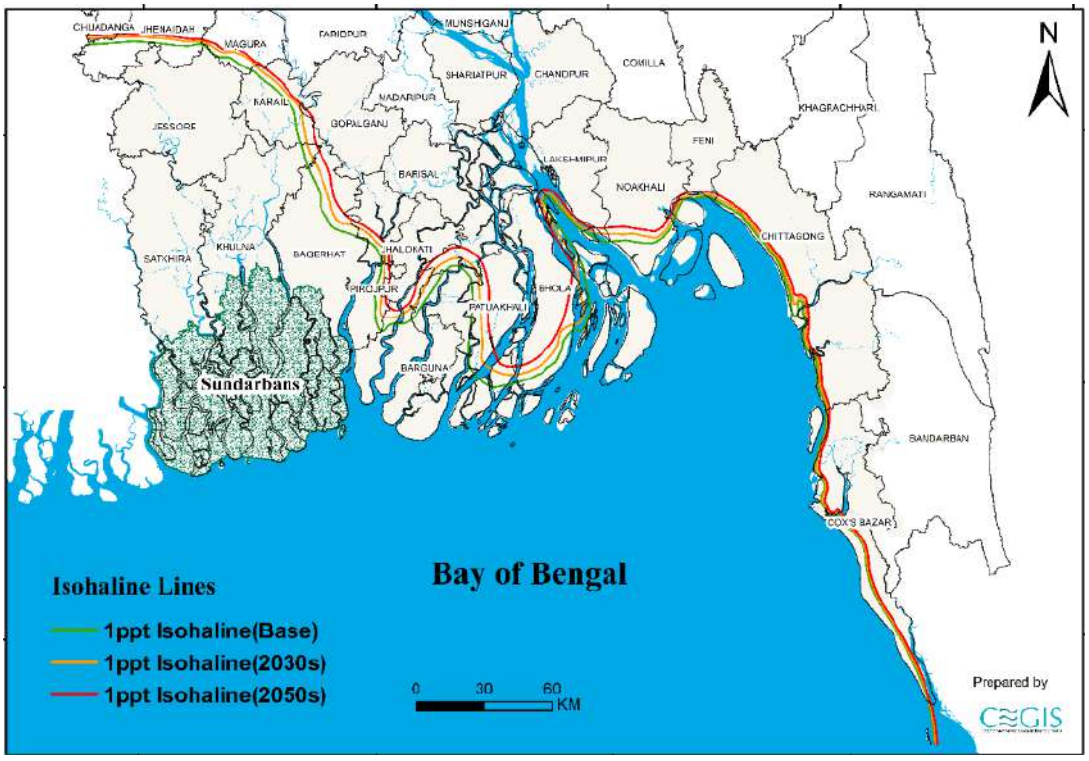


Distribution of different categories of cyclones, 1960-2020

(Source: CEGIS analysis based on BMD data)

Storm surge is a common phenomenon during and after a cyclone. The surges have devastating impacts on the local population and resources. Combined with sea-level rise, this will cause more devastation in low-lying coastal areas (DoE, 2020).

Numerous catastrophic cyclone events have taken place, especially in the last two decades. In 2020, Cyclone Amphan affected more than a million people in 26 districts and caused 26 deaths. It damaged 55,667 houses, 149,000 ha of agricultural



Surface water salinity distribution in coastal Bangladesh due to climate change

(Source: CEGIS Bay of Bengal Model)

lands, 1,80,500 hatcheries, 150 km of embankments, 200 bridges and culverts, and 100 km of roads, causing a total loss of BDT 11 billion (IFRC, 2021). Future 50 cm sea-level rise combined with a SIDR equivalent cyclonic storm surge could potentially inundate large parts (11%-12%) of the coastal area of Bangladesh (DoE, 2020).

2.3.8 Salinity

The coastal zone of Bangladesh covers about 20 percent of the country and more than 30 percent of cultivable land. The salinity level (surface water, ground water or soil) generally increases almost linearly from October to late May with the gradual reduction of upstream freshwater flows. Historic salinity data illustrate an increase of salinity in Khulna from 0.7 ppt to 16.8 ppt in the Rupsa River from 1962 to 2011. Low salinity (0-2 ppt) in the south-central zone, i.e., in much of the Barisal area for the whole year, results from the significant volume of freshwater flow from the Padma River and the Lower Meghna River. Salinity intrusion in the south-west region reduces the freshwater-supported area, resulting in decreased agricultural production in many parts of the coastal zone, especially the Khulna and Patuakhali regions and small areas in Noakhali and Chattogram. Climate change-induced sea-level rise will significantly increase river salinity during the dry season which is further aggravated due to less water availability in the major rivers.

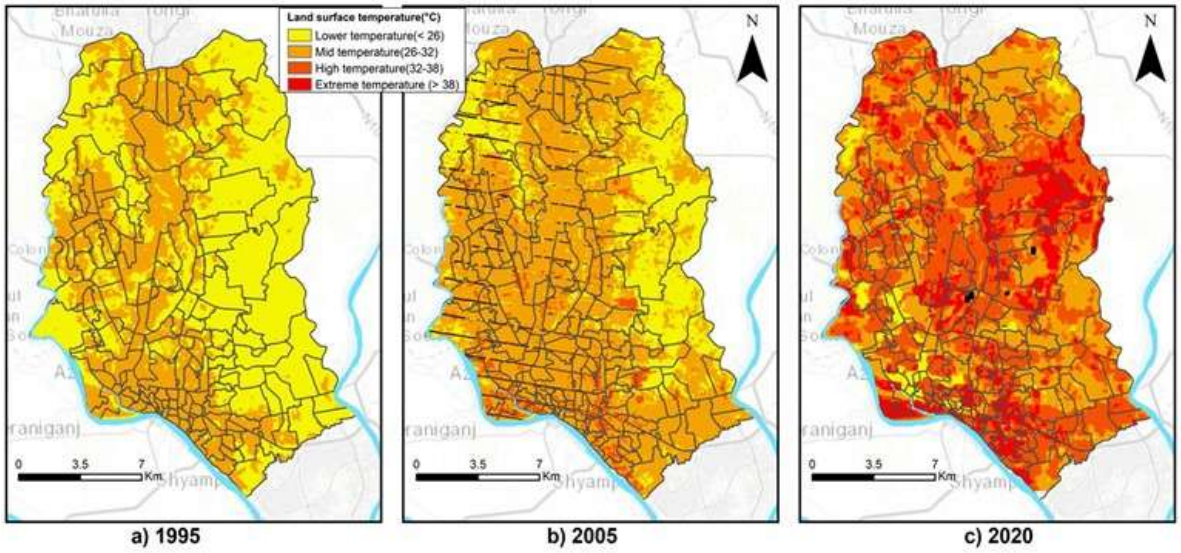
Of 2.86 million ha of coastal and offshore lands, about 1.056 million ha are affected by different degrees of soil salinity. From 1973 to 2009, land affected by salinity in Bangladesh grew by about 26.7 percent, amounting to approximately 0.223 million hectares. Salinity increased in around 35,440 hectares of new land between 2000 and 2009 alone (SRDI, 2010).

Future sea-level rise will push salinity further inwards in the near and mid-term (CEGIS, 2021). The 1 ppt salinity-affected areas will increase by 7.5 percent in the 2050s while the 5 ppt areas will increase by 9 percent under SSP5-8.5. The situation will be worse on the western coast.

2.3.9 Extreme heat waves

The seasonal trends in surface urban heat island intensity (SUHII) (◦C per year) from 2003 to 2019 in major Bangladesh cities exhibit significant increases during the pre-monsoon and winter seasons in most cities. Winter nights show a strongly increasing trend in central (Dhaka) and western cities. There is a significantly decreasing trend in north-east (Sylhet) and south-west (Khulna) cities.

Other urban areas of Bangladesh will face similar impacts in the future due to climate change



Land surface temperature changes in Dhaka

(Source: CEGIS analysis based on satellite imagery)

extremes. Trends in land surface temperatures in recent years in Dhaka reinforce already evident surface heating over past decades. A similar situation is visible in other major urban concentrations in Bangladesh.

Extreme heat events impact people and animals in various ways. The productivity of labourers declines, disease outbreaks occur and heatstroke increases. Cattle, poultry and fish suffer heavily from extreme heat and their mortality increases. Crop production is very susceptible to extreme heat. As plants maintain all physiological processes within temperature thresholds, sudden temperature changes hamper important activities like flowering, germination, etc.

2.3.10 Extreme cold

Extreme cold is expressed as the days with temperatures below 10°C. During the winter, northern Bangladesh experiences cold waves regularly. Extreme cold occurred in 2001, 2003, 2011, 2013, 2017 and 2018, with extreme temperatures below 6°C in 2003, 2013 and 2018. The annual frequency of days with a minimum temperature of less than 10°C is increasing (0.035 more days per year) in Rajshahi and decreasing in Rangpur (0.123 fewer days per year) and Dinajpur (0.119 fewer days per year) (Karmakar, 2019). Such extreme weather events often have severe impacts, hindering the livelihoods of the most vulnerable people. For example, fog and winter rain can reduce cash crop yields and thus income. Cold waves can also have significant health impacts, contributing to acute respiratory infections (ARI), fever, pneumonia, asthma, coughs and skin diseases, especially among the elderly and children. Overall, future climate change is expected to increase the impact of extreme cold in Bangladesh.

2.3.11 Lightning

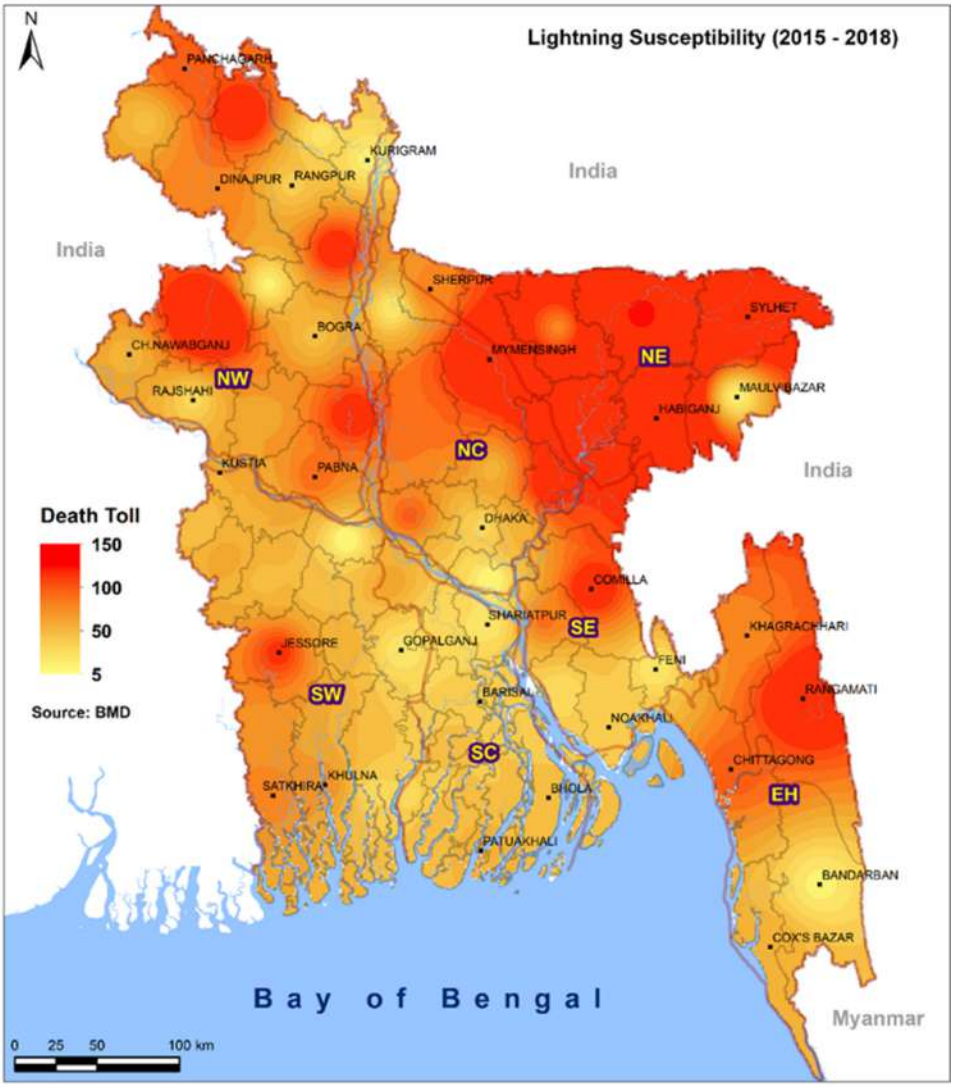
In recent decades, lightning has become a devastating hazard due to changing weather patterns and declining tree cover. Lightning generally occurs from March to October-November (Mazumder et al., 2021). From 1990 to mid-2016, 3,086 fatalities and 2,382 injuries occurred, with annual averages of 114 fatalities and 89 injuries (Dewan et al., 2017). Over this period, 93 percent of lightning strikes took place in rural areas. The majority of deaths were among males, with farming the major activity (Dewan et al., 2017, Holle et al., 2019). The death rate due to lightning in the last six years has been 368 persons per year (BBS, 2022a).

The largest numbers of casualties have taken place during the pre-monsoon season. Deaths have been more common in the north-eastern and eastern hilly regions along with some small areas in the north-western part of the country (Dewan et al., 2017, Holle et al., 2019).

Climate change has a significant link to increasing lightning events globally. As temperatures rise and rainfall grows, lightning events will also increase in the future.

2.3.12 Landslides

Since 1990, Bangladesh has experienced more than 30 landslide events in the hilly regions, with a death toll of approximately 200 people and massive economic and property losses. The causes of landslides are topography, weakening slopes through saturation by water, steeper slopes due to erosion, soil properties (sandy soil), torrential rain and high-velocity surface run-off. According to the geological timescale, the hilly area of Bangladesh developed in the tertiary age and is mainly composed of unconsolidated sedimentary rocks such as sandstone, siltstone, shale and conglomerate (Rashid, 1991). The areas are underlain by tertiary and quaternary sediments that have been folded, faulted and uplifted, and then deeply dissected by rivers and streams (Brammer, 1996). Future climate change is expected to increase the monsoon and post-monsoon rainfall in the hilly regions by 5-10 percent. This might further aggravate the landslide risk for vulnerable areas.

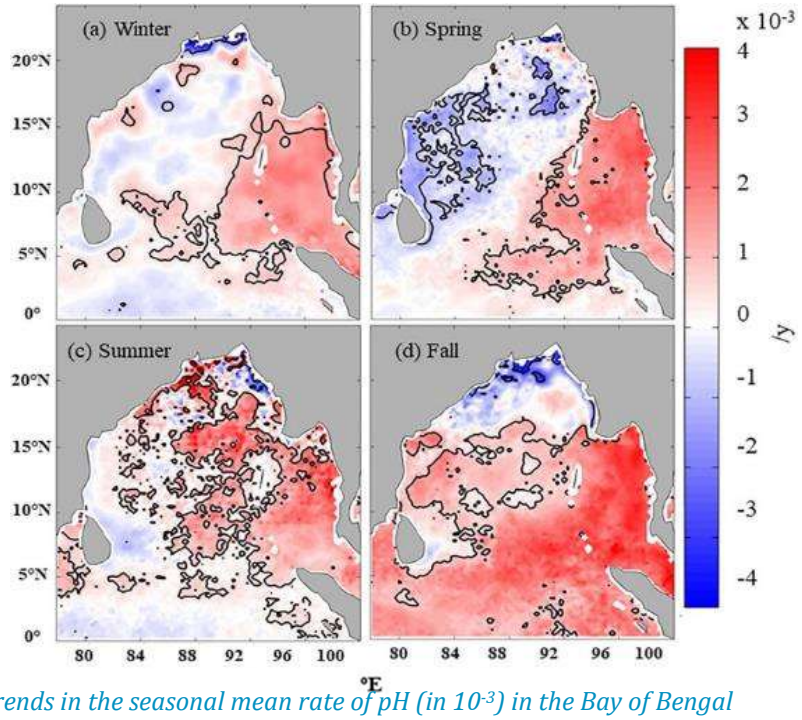


Spatial distribution of lightning susceptibility in Bangladesh (Source: CEGIS analysis based on BMD data)

2.3.13 Sea surface temperature (SST) and ocean acidification

The historical record of SST in the Bay of Bengal demonstrates an increasing trend. The region near the Bangladesh coast shows a rising trend of 0.01°C and 0.058°C per year during the pre-monsoon and monsoon, respectively, while decreasing at a rate of 0.004°C and 0.021°C per year during the winter and post-monsoon, respectively (Sridevi and Sarma, 2021). Sea surface temperatures in the future are expected to increase by 0.6°C in the near term and 1°C to 1.4°C in the mid-term in the Bay of Bengal. The pH level trend mostly decreases at a rate between 0.0002-0.0025 per year during most seasons (Sridevi and Sarma, 2021). Only the monsoon pH rises at a rate of 0.0014 per year.

Increasing SST and acidity have harmful consequences, such as depressing metabolic rates in jumbo squid, depressing the immune responses of blue mussels and coral bleaching. This will impact the sea ecosystem and create low oxygen conditions for fish species. Along with future climate change-induced rises in sea surface temperature, ocean acidification will likely intensify in the Bay of Bengal.



Trends in the seasonal mean rate of pH (in 10^{-3}) in the Bay of Bengal
Source: Sridevi and Sarma, 2021.

2.4 Future Climate Risks and Vulnerabilities

2.4.1 Climate stress areas

A multi-hazards risk map for Bangladesh illustrates the spatial distribution across the country (CEGIS, 2021). The risk map includes all described hazards and segregates the country into 11 climate stress areas defined as follows.

Table 2.1: Climate stress area coverage and related hazards

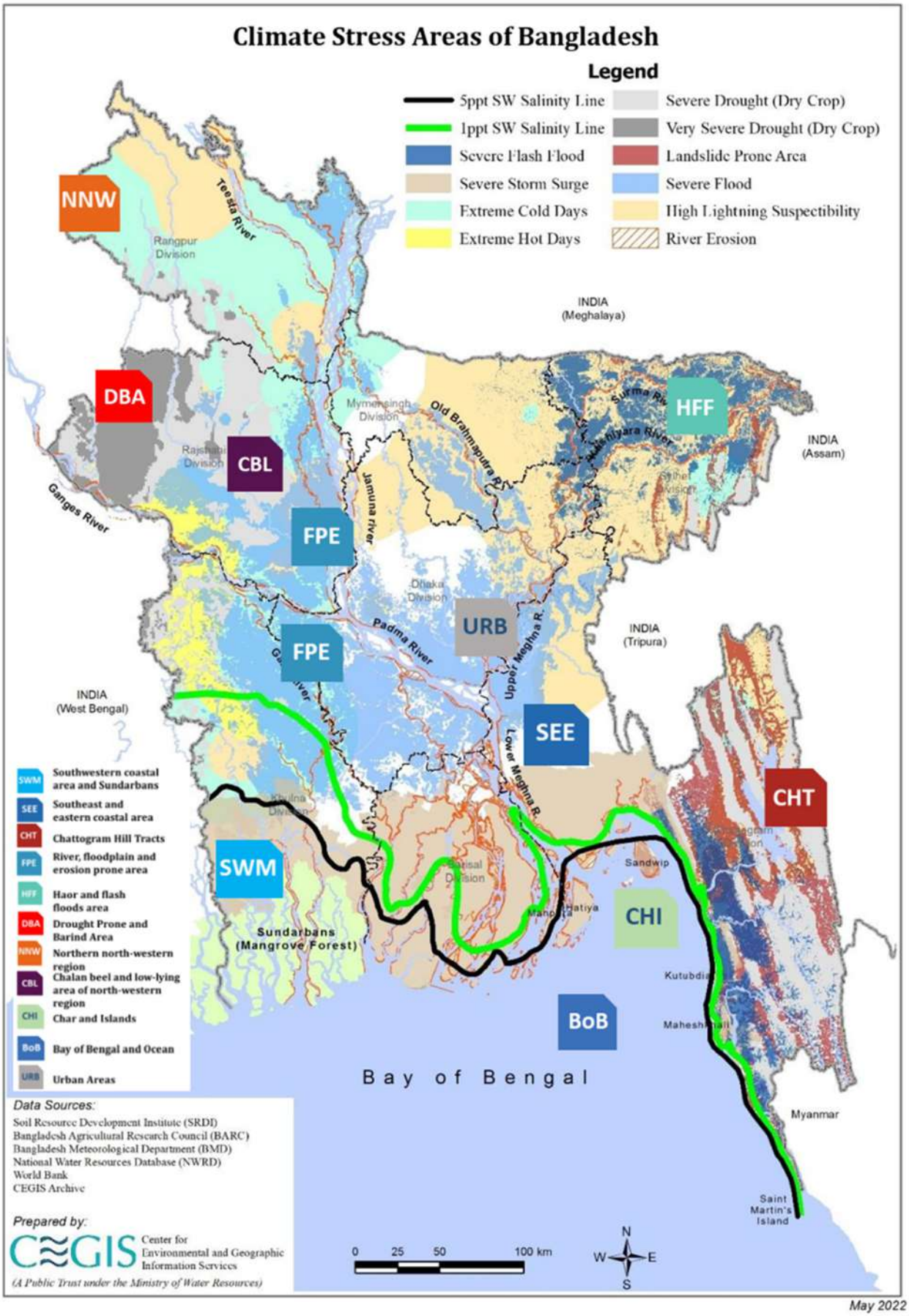
Climate stress area	Districts	Area (sq. km)	Vulnerable population, 2020 (millions)	Prominence of climate hazards
South-western coastal area and Sundarbans (SWM)	Satkhira, Khulna, Bagherhat, Pirojpur, Barguna, Barisal, Patuakhali, Jhalokhathi, Bhola, Shariatpur, Gopalganj, Jashore, Sundarbans	30,646	13.57	Rainfall variability, river floods, sea-level rise, salinity, tropical cyclone, storm surges, drought, extreme heat waves, extreme cold, riverbank erosion and lightning
South-east and eastern coastal area (SEE)	Noakhali, Feni, Lakshmipur, Chattogram, Cox's Bazar, Chandpur	13,891	10.93	Rainfall variability, river floods, sea-level rise, salinity, tropical cyclone, storm surges, drought, extreme heat waves, extreme cold, riverbank erosion, lightning and landslides
Chattogram Hill Tracts (CHT)	Rangamati, Khagrachari, Bandarban	13,294	1.33	Rainfall variability, flash floods, tropical cyclone, storm surges, drought,

Climate stress area	Districts	Area (sq. km)	Vulnerable population, 2020 (millions)	Prominence of climate hazards
				extreme heat waves, extreme cold, lightning and landslides
Rivers, floodplains, and erosion-prone areas (FPE)	Nilphamari, Kurigram, Lalmonirhat, Gaibandha, Rangpur, Bogura, Sirajganj, Pabna, Rajshahi, Jamalpur, Tangail, Manikganj, Dhaka, Munshiganj, Mymensingh, Sunamganj, Netrokona, Habiganj, Kishorganj, Sylhet, Brahmanbaria, Narsingdi, Narayanganj, Rajbari, Faridpur, Madaripur, Gopalganj, Narail, Sariatpur, Barisal, Patuakhali, Bhola, Jhalokathi, Khulna, Chandpur, Cumilla, Noakhali, Lakshmipur, Cox's Bazar	58,010	12.72	Rainfall variability, river floods, tropical cyclones, tornado, extreme heat waves, extreme cold, riverbank erosion and lightning
Haor and flash floods areas (HFF)	Sunamganj, Netrokona, Habiganj, Kishorganj, Sylhet, Maulvibazar, Brahmanbaria	19,662	4.02	Rainfall variability, flash floods, tropical cyclone, tornado, extreme heat waves, intense cold, riverbank erosion, lightning and landslides
Drought-prone and ***barind*** areas (DBA)	Naogaon, Chapai Nawabganj, Rajshahi, Bogura, Joypurhat, Rangpur, Dinajpur, Meherpur, Chudanga, Kushtia, Jashore, Magura, Jhenaidah	21,512	3.85	Rainfall variability, tropical cyclone, tornado drought, extreme heat waves, extreme cold and lightning
Northern, north-western region (NNW)	Panchagarh, Thakurgaon, Nilphamari, Lalmonirhat, Rangpur, Kurigram, Dinajpur	9,917	6.32	Rainfall variability, river floods, flash floods, tropical cyclone, tornado, drought, extreme heat waves, extreme cold, riverbank erosion, lightning and landslides
Chalan beel and low-lying area of the north-western region (CBL)	Pabna, Natore, Sirajganj, Rajshahi, Naogaon	5,027	5.70	Rainfall variability, river floods, , tropical cyclone, tornado,, extreme heat waves, extreme cold, riverbank erosion and lightning
Char and islands (CHI)	Nilphamari, Lalmonirhat, Kurigram, Gaibandha, Sirajganj, Jamalpur, Mymensingh, Manikganj, Munshiganj, Shariatpur, Chandpur, Bhola, Patuakhali, Feni, Noakhali,	3,976	8.51	Rainfall variability, river floods, sea-level rise, salinity, , tropical cyclone, tornado, storm surges, extreme heat waves, extreme cold, river bank erosion, lightning, higher sea surface temperature and ocean acidification

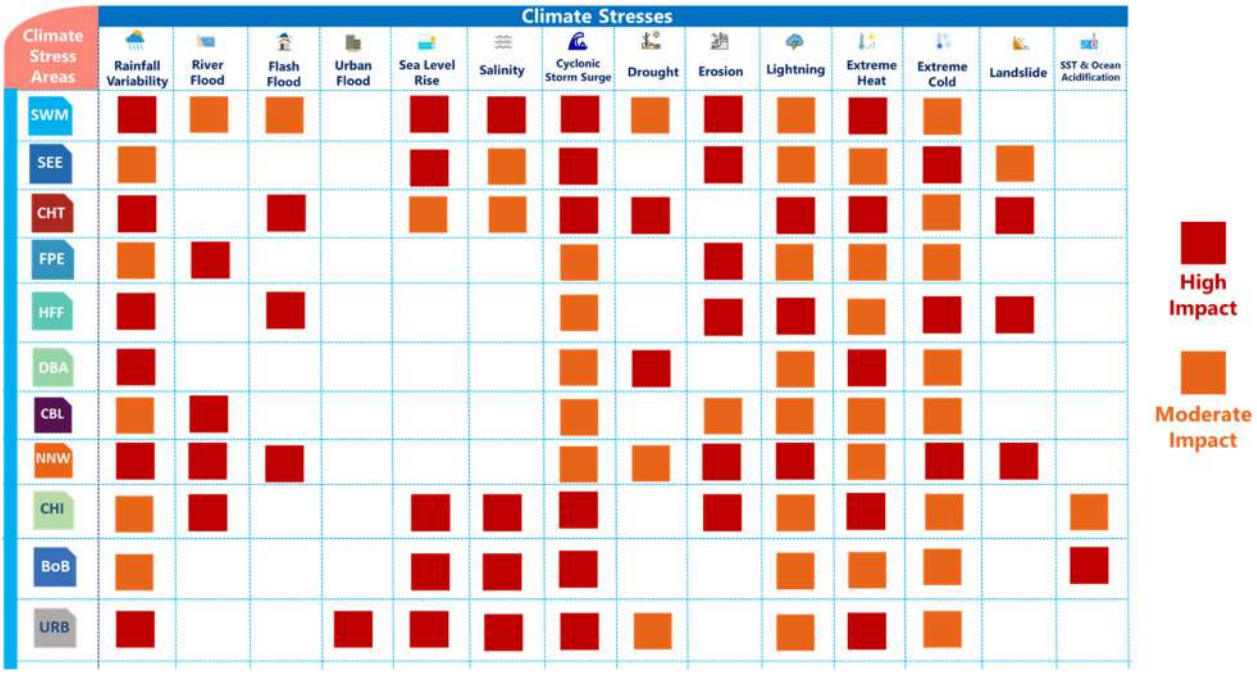
Climate stress area	Districts	Area (sq. km)	Vulnerable population, 2020 (millions)	Prominence of climate hazards
	Lakshmipur, Chattogram, Cox's Bazar			
Bay of Bengal and ocean (BoB)	Bay of Bengal (maritime boundary)	118,813	1.26	Rainfall variability, sea-level rise, tropical cyclone, tornado, storm surges, extreme heat waves, lightning, higher sea surface temperature, hypoxy and ocean acidification
Urban areas (URB)	43 cities	10,600	32.41	Rainfall variability, urban floods, sea-level rise, salinity, tropical cyclone, storm surges, drought, extreme urban heat waves, extreme cold and lightning

** The area and population are tentative estimates based on hazard information, climate stress areas and BBS data (BBS, 2022b).*

***Appendix I presents the alignment of climate stress areas with BDP2100 hotspot areas and hydrologic regions.*


Climate Stress Areas of Bangladesh
Legend
5ppt SW Salinity Line
1ppt SW Salinity Line
Severe Flash Flood
Severe Storm Surge
Extreme Cold Days
Extreme Hot Days
Severe Drought (Dry Crop)
Very Severe Drought (Dry Crop)
Landslide Prone Area
Severe Flood
High Lightning Suspectibility
River Erosion
NNW
DBA
CBL
FPE
FPE
URB
HFF
SEE
CHT
SWM
CHI
BoB
Teesta River
Rangpur Division
INDIA (Meghalaya)
Mymensingh Division
Old Brahmaputra R.
Surma Riv
Kushiyara River
INDIA (Assam)
Sylhet Division
Rajshahi Division
Ganges River
Jamuna river
Dhaka Division
Padma River
Upper Meghna R.
INDIA (Tripura)
INDIA (West Bengal)
Lower Meghna R.
Khulna Division
Barisal Division
Sandwip
Hatiya
Sundarbans (Mangrove Forest)
Kutubdia
Bay of Bengal
Myanmar
Saint Martin's Island
Southwestern coastal area and Sundarbans
Southeast and eastern coastal area
Chattogram Hill Tracts
River, floodplain and erosion prone area
Haor and flash floods area
Drought Prone and Barind Area
Northern north-western region
Chalan beel and low-lying area of north-western region
Char and Islands
Bay of Bengal and Ocean
Urban Areas
Data Sources:
Soil Resource Development Institute (SRDI)
Bangladesh Agricultural Research Council (BARC)
Bangladesh Meteorological Department (BMD)
National Water Resources Database (NWRD)
World Bank
CEGIS Archive
Prepared by:
CEGIS
Center for Environmental and Geographic Information Services
(A Public Trust under the Ministry of Water Resources)
0 25 50 100 km
N
W
E
S

May 2022



The map and table describe the geographic coverage of the hazards and potentially vulnerable populations across the climate stress areas. Most areas face five or more disasters. With all disasters intensifying or becoming more frequent due to climate change, the climate stress areas face larger risks in the future.

2.4.2 *Risks and vulnerabilities of different sectors*

Climate change impacts in Bangladesh mainly affect climatic patterns and disasters. These ultimately increase vulnerabilities and risks in major sectors like water resources, crop production, fisheries and aquaculture, livestock, ecosystems, biodiversity, etc. The NAP has identified the risks and vulnerabilities of major resources through the stocktaking and consultation process, which involved local sessions with different vulnerable communities dependent on various sectors. This information was combined with future climate change-induced vulnerability and risk information to summarize the potential risk levels of major sectors under different climate change scenarios. Tables 2.2-2.8 present the risk levels under two future climate scenarios (SSP 1-2.6 and SSP 5-8.5), expressed as low (+), medium (++) and high (+++). The estimation entailed aggregating all stakeholder consultation outcomes and finalizing them based on expert knowledge of risk. The following sections briefly discuss the sector-specific vulnerabilities and risks for different regions of Bangladesh.

Water resources

Being a lower riparian country, Bangladesh largely depends on freshwater availability from the country's transboundary rivers. Recent research on global freshwater storage depicts the area in and around Bangladesh as having a water deficit (Rodell et al., 2018). It is characterized by water depletion and less water reaching the groundwater layer.

Due to climate change, the average annual flow of the Ganges, Brahmaputra and Meghna River basins will increase, resulting in more frequent river floods. Additionally, flash floods might occur early and become more frequent, droughts during the dry season might become more severe and water scarcity will be aggravated. Due to sea-level rise and increased salinity, more coastal areas will face freshwater shortages and damage to agriculture, while extreme heat might cause a reduction in water bodies. The potential impacts and risks for water resources are presented in the following table for the two scenarios.

Table 2.2: Potential impacts and risks for water resources

Climate signals and hazards	Potential impacts	Risk level	
		SSP1-2.6	SSP5-8.5
Excessive rainfall	• Waterlogging and drainage problems • Frequent erosion	++	+++
Extreme heat	• Decreases in perennial water bodies and wetlands	+	++
Frequent river floods	• Sediment problems • Prolonged waterlogging	+	+++
Early or frequent flash floods	• Drainage problems in drainage structures • Sediment problems • Navigation problems • Water management infrastructure becomes dysfunctional/damaged • Submersible embankment breaches	++	+++
Severe drought/water scarcity	• Lower water availability • Hampered water security • Dependency on groundwater increases and groundwater depletion	++	++
Increased salinity	• Less freshwater availability • Unfavorable water quality	+	++
Frequent tropical cyclones/ tornado and storm surges	• Polder or coastal embankment breaches • Water quality deteriorates • Salt water ingress	++	+++
Sea-level rise	• Salinity increases • Inundated land area increases with potential land loss	+	++

**Risk level: low (+), medium (++) and high (+++).*

Agriculture, fisheries and livestock

A major part of the food production system is at risk due to climate signals and hazards. Phenological changes appear due to increasing temperatures, including at night. Rising temperatures and uncertain rainfall may create phenological changes in plants that result in lower yields (Baker et al., 1990). Higher temperatures beyond certain thresholds have several effects on plants and their outputs, such as spikelet sterility in rice, reversal of vernalization (cooling of the seed during germination) in wheat, the reduced formation of tubers in potatoes and the loss of pollen viability in maize. Yields can be severely affected if temperatures exceed critical limits for periods as short as one hour during flowering. Increased temperatures can also speed up phenological development, reducing the crop's grain-filling period and lowering yield.

Infestations of pests and diseases may also intensify with rising temperatures. Recent research has found that leaf folder infestation in rice fields might increase by 80-136 percent in different regions of Bangladesh by 2050. This concern will be more prominent in the north-west, north central and north-east regions. Similar damage is also possible for other major crops and vegetables, causing substantial production losses (Salam et al., 2019).

Due to sea-level rise and cyclonic storm surges, coastal flooding may cause rice crop production losses of 7.4 percent and 10.1 percent, based on sea-level rises of 0.62 metres and 0.92 metres, respectively, under the RCP8.5 scenario (DoE, 2020). The potential impacts and risks on crop production are presented in the following table.

Table 2.3: Potential impacts and risk for crops

Climate signals and hazards	Potential impacts	Risk level	
		SSP1-2.6	SSP5-8.5
Excessive rainfall	• Crop damage • Cultivation becomes less suitable due to waterlogged conditions • Loss of cultivable lands • Changed cropping patterns	++	+++
Extreme heat	• Crop yield change/reduction • Pest infestations and disease outbreaks • Changes in flowering patterns and phenological changes	++	+++
Cold spells	• Crop damages • Phenological changes • Pest and diseases	+++	+++
Frequent river floods	• Crop damages • Loss of fisheries and livestock production • Loss of livelihoods	+	++
Early or frequent flash floods	• Dry season (Boro) crop damages • Harvesting and storage problems • Changed cropping patterns • Seasonal migration • Shifting occupations	++	+++
Severe droughts/water scarcity	• Irrigation water crisis • Less yield • Food crisis • Pest and diseases	++	++
Frequent lightning	• Death of farmers	++	++
Increased salinity	• Crop damages among traditional varieties • Low yields • Less suitable irrigation water • Cropping pattern change • Limited scope for agricultural production • Loss of livelihoods • Internal displacement	++	+++
Frequent cyclone/ tornado and storm surges	• Crop damages • Loss of livelihoods • Human death • Food and medicine crisis	+++	+++
Sea-level rise	• Less availability of cultivable lands • Low crop yields • Hampered food security	++	+++

**Risk level: low (+), medium (++) and high (+++).*

Fisheries play a vital role in the economy of Bangladesh, accounting for 3.52 percent of GDP (26.37 percent of agricultural GDP), 1.39 percent of export earnings and more than 60 percent of the animal protein supply in people's diets (DoF, 2021). Fish are also an important source of different minerals, micronutrients and vitamins essential for the human body. Fishing provides direct or indirect employment to 12 percent of the total population. More than 50 percent of fish

production is from aquaculture, which is highly sensitive to climatic signals and hazards. Research suggests pond water quality can degrade when the temperature exceeds 25°C. Temperatures above 22°C can cause less feed intake by fish, while more than 32°C can cause slow growth and mortality. Extreme temperatures and erratic rainfall directly impact fish physiology, growth, mortality, reproductive systems, feeding behaviour, production and migration in inland and marine waters. The sensitivity of certain species to high temperatures and other climatic conditions is an important concern (Hossain et al., 2021). Recent studies indicate a potential decrease in the marine fish catch due to climate change impacts (Fernandes et al, 2015). Based on the stakeholder consultations, Table 2.4 summarizes key potential impacts on fisheries and aquaculture due to climate change.

Table 2.4: Potential impacts and risks for fisheries and aquaculture

Climate signal and hazards	Potential impacts	Risk level	
		SSP1-2.6	SSP5-8.5
Excessive rainfall	• Increased natural mortality due to lower pH • Decreased fish catchability • Problems in dry fish processing • Breaching of shrimp farm/fishpond dikes • Overtopping of cultured fish from shrimp farms/fishponds	+	++
Extreme heat	• Increased natural mortality due to thermal shock, depletion of dissolved oxygen (DO), and bacterial decomposition • Decreased pond water availability period due to high evaporative loss • Decrease in productivity	+	++
Cold spells	• Abnormal behavior in spawners • Less food intake	+	+
Frequent river floods	• Overtopping of ponds or shrimp/prawn farms with fish escaping • Breaching of shrimp/prawn/fish farm dikes • Disruption to fish harvesting, storage and processing	++	+++
Early or frequent flash floods	• Wash out and/or overflow of fishponds causing with fish escaping • Degradation of habitat quality	++	+++
Severe droughts/water scarcity	• Declining water area and loss of connectivity • Increase in fish mortality and loss of fish diversity and composition • Reduction of pond water availability period and extended days of levels under thresholds • Disease outbreaks and loss of fish production	+	++
Frequent lightning	• Risk of life to fishing people	+	+
Increased salinity	• Unfavorable habitat conditions for freshwater fish • The appearance of marine fish in the intersaline convergent zone, threatening freshwater fish	++	+++
Frequent cyclone/ tornado and storm surges	• Overtopping of ponds or shrimp/prawn farms with fish escaping • Degradation of the aquatic conditions of fishponds/shrimp farms • The decline of fishing days and reduction of fish caught	++	+++
Sea-level rise	• Prevalence of marine fisheries in places with freshwater fisheries	++	+++

**Risk level: low (+), medium (++) and high (+++).*

Livestock is a significant and affordable source of protein in Bangladesh. The major climate change impacts on livestock include heatstroke; disease outbreaks; regenerative changes; reduced milk, meat and egg production; a water availability crisis; livestock deaths dues to disasters; a fodder crisis; reduced protein intake and malnutrition. Based on the stakeholder consultation, Table 2.5 summarizes critical potential impacts on livestock due to climate change.

Table 2.5: Potential impacts and risks for livestock

Climate signal and hazards	Potential impacts	Risk level	
		SSP1-2.6	SSP5-8.5
Excessive rainfall	• Chance of disease increases	+	+
Extreme heat	• Heatstroke and mass deaths • Outbreaks of diseases • Regenerative changes • Changes in meat and egg production • Loss of livelihoods	++	+++
Cold spells	• Disease outbreaks • Less food intake	++	++
Frequent river floods	• Livestock-rearing problems in low-lying areas	+	++
Early or frequent flash floods	• Livestock-rearing problems in low-lying areas • Livestock deaths due to flooding • Less milk and meat production	++	+++
Severe droughts/water scarcity	• Drinking water crisis • Bathing water crisis • Fodder crisis due to lower grass cultivation • Regenerative changes • Less milk and meat production	++	+++
Frequent lightning	• Death of cattle	+	++
Frequent landslides	• Death of cattle	+	++
Increased salinity	• Very low livestock production due to unfavorable drinking water quality and less fodder availability • Less milk production • Loss of livelihoods • Internal displacement	++	+++
Frequent cyclones/ tornado and storm surges	• Livestock deaths • Loss of livelihoods • Disease outbreaks	++	+++
Sea-level rise	• Loss of cultivable area for fodder • Less production • Hampered protein intake and malnutrition	++	+++

**Risk level: low (+), medium (++) and high (+++).*

Ecosystems, wetlands and biodiversity

Ecosystems are rapidly altering in response to climate change, including through shifts in rainfall, atmospheric carbon dioxide concentrations, water balance, ocean chemistry, the frequency and intensity of extreme events and other variables. Given complex interactions among organisms, and disturbances and other stresses, ecosystems differ in their sensitivity and responsiveness to climate change.

Changes in natural ecosystems threaten biodiversity worldwide; Bangladesh is no exception. Based on system characteristics, the interrelationship of components and spatial connotations, its ecosystems are classified mainly as the riverine and floodplains ecosystem, terrestrial ecosystem, mangrove ecosystem, wetland ecosystem, coastal-marine ecosystem, *barind* ecosystem, forest ecosystem and urban ecosystem (Ullah et al., 2015).

Due to climate change, for example, mangrove forest areas will be vulnerable to increasing sea levels and salinity. Major tree species, such as *sundari* and *gewa*, are both susceptible to increasing salinity. In the Sundarbans, the tiger population and suitable habitats are at significant risk (Mukul et al., 2019).

Similar threats to other ecosystems and biodiversity are imminent due to climate change. These ecosystems support a diverse range of resident and migratory waterfowl and endangered and commercially important species of national and international significance (Nishat, 1993; Islam and Gnauck, 2009). Furthermore, it supports a diverse range of flora and fauna. It contributes significantly to the financial well-being of millions of people in rural Bangladesh by providing jobs, food and nutrition, fuel, fodder, transportation and irrigation (Nishat, 1993).

The effects of climate change on wetlands may include the loss of carbon stored in the soil, changes in soil structure, more frequent drying out or flooding, changes in plant or animal communities, saltwater intrusion in freshwater coastal wetlands, changes in the timing and amount of water availability for wetlands due to erratic rainfall, and subsequent upstream flow variations. Table 2.6 elaborates the potential impacts on ecosystems and biodiversity and associated risk levels.

Table 2.6: Potential impacts and risk for ecosystems, wetlands and biodiversity

Climate signal and hazards	Potential impacts	Risk level	
		SSP1-2.6	SSP5-8.5
Excessive rainfall	• Soil erosion • Loss of habitat area	+	++
Extreme heat	• Loss of native flora and fauna • Disappearance of biodiversity • Loss of permanent wetlands and beels • Less favorable habitat conditions • Changes in the growth, composition and density of specific flora and fauna like *sundari, gewa, goran*, etc. • Loss of water from the canopy and less soil moisture in the CHT	++	+++
Cold spells	• Dryland increase	+	++
Frequent river floods	• Habitat conditions disrupted • The quality of water deteriorates due to mixing with agro-chemicals	++	+++
Early or frequent flash floods	• The quality of water deteriorates due to mixing with agro-chemicals • Habitat condition disrupted	++	+++
Severe droughts/water scarcity	• Loss of aquatic habitats • Desertification of hills and forests due to less soil moisture • Less soil moisture and groundwater recharge	+	++
Frequent lightning	• Shocks for flora and fauna • Death of animals	+	++

Climate signal and hazards	Potential impacts	Risk level	
		SSP1-2.6	SSP5-8.5
	• Breeding patterns change		
Frequent landslides	• Soil erosion • Hill landscape degradation • Loss of vegetation coverage and hill forests	++	+++
Increased salinity	• Tiger habitat shifting towards localities for fresh water with increased risk of human death • Changes in mangrove species diversity and composition • Land degradation • Changes in biodiversity habitat	++	+++
Frequent cyclones/ tornado and storm surges	• Ecosystem degradation • Biodiversity extinction • Forest damages • Habitat damages	++	+++
Sea-level rise	• Degraded freshwater ecosystems and dependent biodiversity • Loss of habitable lands	++	+++

**Risk level: low (+), medium (++) and high (+++).*

Private sector

Bangladesh is enormously dependent on a vibrant private sector to drive economic and social development. But it now faces climate change risks with limited awareness and different capacities and motivations to invest in developing new approaches, markets or tools that support climate change adaptation. The private sector includes trade and business; industries; financial institutions; CMSMEs; tourism industries and growing service sectors, which are reportedly disproportionately impacted by climate variability and extreme events, like prolonged floods and waterlogging, heat stress, devastating cyclones and tidal surges, salinity in coastal regions, cities and growth centres. Many autonomous adaptation practices through disaster preparedness initiatives by large industries or companies are increasingly evident in different parts of the country. Disproportionately impacted CMSMEs and informal sector stakeholders, however, lag in actions to protect their enterprises from the recurrent shocks of climate hazards, often due to limited financial and/or adaptive capacity. Many are unaware of the need for autonomous and planned adaptation to climate disasters. Following table shows level of risks of the private sector and sub-sectors by types of industries and enterprises.

Table 2.7: Level of risk by type of private sector actor

Types of enterprises, industries and other private sector actors	Level of risk based on exposure, sensitivity and adaptive capacity
Informal and formal MSMEs such as small shopkeepers, street vendors, light engineering firms, information and communication technology (ICT) services and agribusiness	**Highly vulnerable** to climate extremes because of their high level of exposure and sensitivity (often located in fringe areas) and poor adaptive capacity: lack of awareness, interest, financial capacity and skills for planned adaptation and technical know-how for implementation of CCA and DRR.

Types of enterprises, industries and other private sector actors	Level of risk based on exposure, sensitivity and adaptive capacity
Cottage industries like potteries and hand looms	**Highly vulnerable** because of a high level of exposure and sensitivity to climate extremes with poor adaptive capacity: lack of capacity and interest in planned adaptation and technical know-how for integration and implementation of CCA.
Large industries like textiles, RMGs and pharmaceuticals	**Low to moderately vulnerable**: Industries and infrastructure sometimes develop protections from floods and storms; they can maintain operations and basic functions even during a small climate disaster, and have good linkages with government, political processes and financial institutions for accessing finance, technical support and services to avoid risks and vulnerabilities.
Tourism, food and beverage industries	**Highly vulnerable:** High level of exposure and sensitivity to climate extremes because of the location of enterprises near riverbanks, coast lines and hills facing frequent cyclones, storms and heavy rain-induced landslides and waterlogging every year; lack of awareness and capacity for disaster preparedness and integration of CCA & DRR.
Bank, insurance and financial institutions	**Moderately vulnerable:** They are not affected physically and directly but their investments are sometime at risk; very often they cannot recover their investments.
Others: port cities, urban facilities and infrastructure	**Highly vulnerable:** Limited interest in climate change issues by city authorities and no contingency plan for CCA; informal traders and businesses are highly vulnerable to climate change impacts in large cities.

Sources: Stakeholder consultation and focus group discussions (FGDs), 2021.

2.4.3 Risks and vulnerabilities in stress areas

South-western coastal area and the Sundarbans (SWM)

The southwestern coastal area and Sundarbans have an area of 30,646 sq. km and 13.57 million vulnerable people. The Sundarbans is the largest mangrove forest in Bangladesh. The area faces most climate-related hazards, as summarized in Table 2.1. A large percentage of households have experienced damage due to cyclones (53.3 percent), salinity (6.53 percent) and lightning (7.5 percent) in recent years (BBS, 2022a). Average damages and losses from disasters totaled BDT 30.2 billion during 2016-2021, mainly driven by climatic stresses (BBS, 2022a).

Future climate change will intensify these stresses. While the Sundarbans is an essential part of the natural ecosystem and biodiversity of Bangladesh, it is now under threat due to sea-level rise.

South-east and eastern coastal area (SEE)

The south-east and eastern coastal area (SEE) has an area of 13,891 sq. km and 10.93 million vulnerable people. The region faces hazards similar to those in the south western coast. It includes the major industrial areas, ports and some forests. A large percentage of households have faced damages due to cyclones (29 percent), salinity (2.5 percent) and lightning (7.2 percent) in recent years (BBS, 2022a). Average losses and damages due to disasters were BDT 17.2 billion during 2016-2021, mainly driven by climatic stresses (BBS, 2022a). Future climate change will intensify these stresses.

Chattogram Hill Tracts (CHT)

The Chattogram Hill Tracts (CHTs) region in the eastern hills area is a distinct part of Bangladesh with topographically different settings. It is inhabited by ethnic communities. The region has an area of 13,294 sq. km (about 10 percent of the country), with elevations ranging from 60 m to more than 1,000 m. A large part of the region is forest with a unique ecosystem. The region is underdeveloped and harder to reach than other areas, and the local population (around 1.9 million) mainly depends on hill resources and agriculture for livelihoods. As a result, people are

highly vulnerable to climate change impacts and associated disasters. Households have faced damages due to landslides (2.4 percent), droughts (3 percent), and lightning (7.2 percent) in recent years (BBS, 2022a). Average losses and damages due to disasters were BDT 11.5 billion during 2016-2021, mainly driven by climatic stresses (BBS, 2022a). Future climate change is expected to reduce pre-monsoon rainfall in the region and raise the annual average temperature by 1.3 to 2°C. The rise in temperature will be more for daily maximum temperature.

For ethnic communities, climate change is not simply a physical environmental change. It is also a threat to livelihoods and resources, and to their social life, traditional knowledge and culture. Climate change will continue to cause substantial damage to the CHT region by increased drought, water scarcity, landslides, desertification, flash floods, soil erosion and health issues due to water pollution. These will negatively affect the population, their hill and spring watershed dependent livelihoods and their unique ecosystems.

River, floodplain and erosion-prone area (FPE)

A large part of Bangladesh (58,010 sq. km) falls in the river, floodplain and erosion-prone area, which spreads across different regions. With the Bangladesh delta formed due to sediment deposits from three major rivers and their tributaries, this area is most fertile for agriculture but experiences floods, erosion and related hazards. It is home to about 12.72 million vulnerable people. They have faced damages due to floods (50 percent), droughts (3 percent), and lightning (5-9 percent) in recent years (BBS, 2022a). Average losses and damages due to disasters were more than BDT 100 billion during 2016-2021, mainly driven by climatic stresses (BBS, 2022a). Managing water resources and associated hazards are major tasks to reduce vulnerability in this area.

Haor and flash floods area (HFF)

The north-eastern *haor* area has unique geographic features and is home to various ecosystems, flora and fauna. This area covers 19,662 sq. km with a vulnerable population of 4 million. Households have faced significant damage due to flash floods (56.5 percent), lightning (14.8 percent), droughts (7.2 percent) and landslides (0.2 percent) in recent years (BBS, 2022a). Average losses and damages due to disasters were BDT 26.8 billion during 2016-2021, mainly driven by climatic stresses (BBS, 2022a).

Drought-prone and Barind area (DBA)

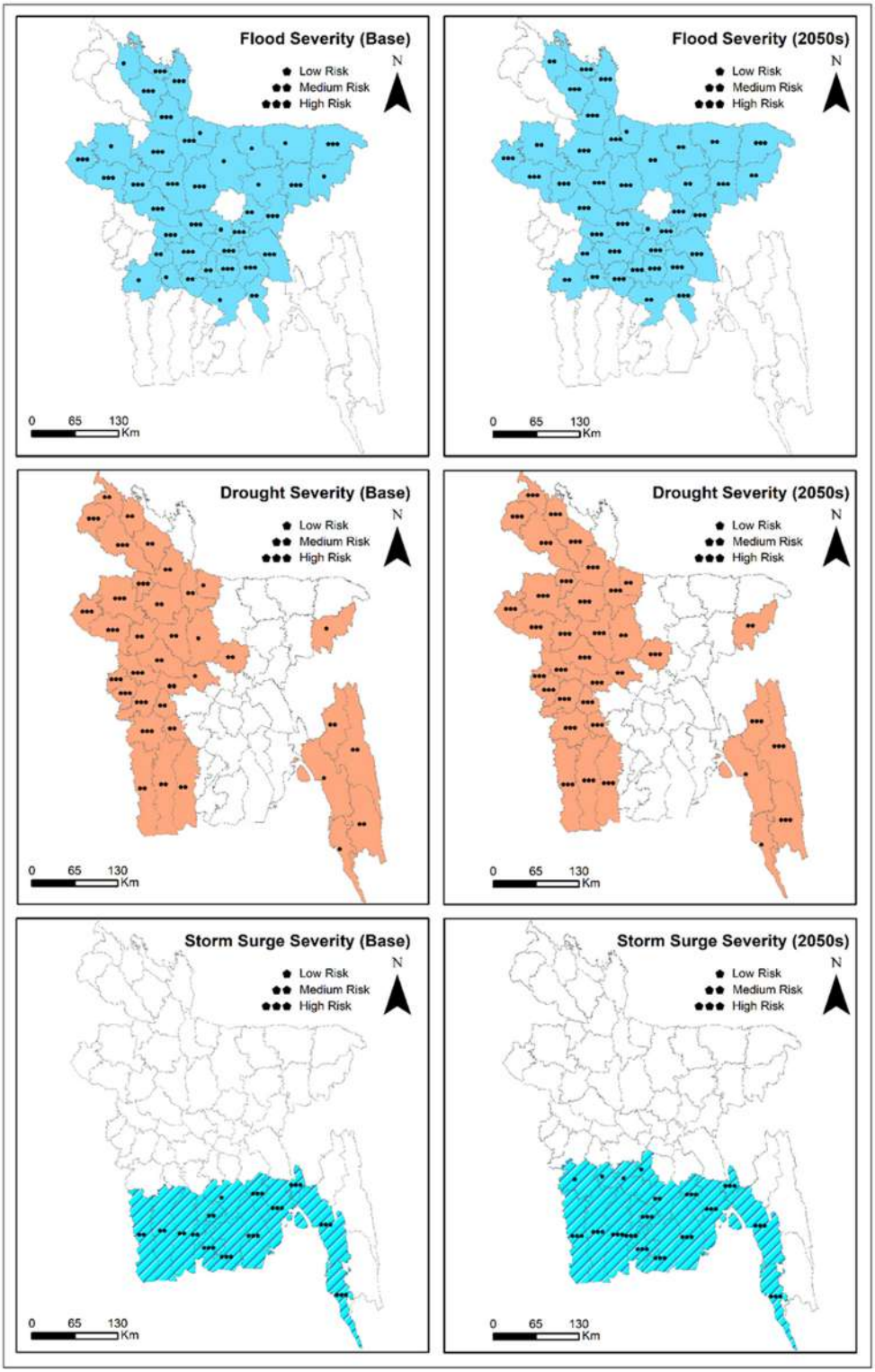
The north-western *barind* area is in the highlands with soils that have low moisture-holding capacity. The area experiences higher temperatures and low rainfall. It covers 21,512 sq. km. with a vulnerable population of 3.85 million. It is highly productive for various crops, including rice. The population faces damages due to droughts, floods, lightning and extreme heat. Average losses and damages due to disasters were BDT 1.7 billion during 2016-2021, mainly driven by climatic stresses (BBS, 2022a).

Northern and north-western region (NNW)

The northern and north-western region spans 9,917 sq. km with a vulnerable population of 6.32 million. It faces damages due to floods and flash floods (52 percent), droughts (1.7 percent), lightning (9.3 percent) and extreme heat and cold waves. Average losses and damages due to disasters were BDT 33.3 billion during 2016-2021, mainly driven by climatic stresses (BBS, 2022a).

Chalan beel and the low-lying area of the north-western region (CBL)

The *chalan beel* and low-lying north-western area cover 5,027 sq. km. This area is very low-lying and faces damages due to floods and flash floods (34 percent), droughts (3 percent), lightning (17 percent) and extreme heat and cold waves. The area has a vulnerable population of 5.7 million. Average losses and damages due to disasters were BDT 16.7 billion during 2016-2021, mainly driven by climatic stresses (BBS, 2022a).



Flood, drought and storm surge severity in Bangladesh due to climate change

Source: CEGIS, 2021

Char and islands area (CHI)

The char and islands area covers different parts of the country totaling a significant 3,976 sq. km. As major rivers intersect, they host large chars or islands that are continuously flooded and eroded each year. About 8.51 million vulnerable people experience these hazards, forcing them to live in a loop of poverty. Agriculture and livestock rearing are major livelihood activities in the chars and islands. The coastal islands confront almost all climate-induced disasters common to sea-facing locations.

Bay of Bengal (BoB)

The Bay of Bengal is part of the Indian Ocean, covering a large area. Bangladesh's extended economic zone is 118,813 sq. km. It is used for fishing and other economic activities by 1.26 million vulnerable coastal residents. An expansion in economic activities through blue economy initiatives is occurring as the ocean faces increasing SST and gradual acidification. This primarily damages the sea ecosystem and fish species and will affect coastal people.

Urban areas (URB)

The urban areas include 43 cities, with 2 (Dhaka and Chattogram) holding more than 1 million people, 6 (Rajshahi, Sylhet, Khulna, Gazipur, Narayanganj and Bogura) with between 0.5 million and 1 million people, 10 (Savar, Mymensingh, Barisal, Rangpur, Cumilla, Kushtia, Jashore, Cox's Bazar, Feni and Manikganj) with between 200,000 and 500,000 people, and 25 that comprise mostly the greater districts, district towns and *upazilla*-level towns (such as Chowmuhuni, Bhairab, Sreepur, Saidpur, etc.) with between 100,000 to 200,000 people. The estimated total population of urban areas is 61.8 million.

Climate change and associated urban risks substantially impact the overall economy. Major cities are at high risk of urban flooding due to changing rainfall patterns and have reported recurrent urban drainage problems (CEGIS 2022a). Different city corporations and municipalities have also experienced these issues in unplanned urban developments that are intended to meet increased population demand but often take place without ensuring adequate drainage capacity.

Heat waves will affect human health adversely. As human bodies are not habituated to adjust to a sudden temperature rise, more heatstroke will occur. Vector-borne diseases will spread as well. Adverse impacts of climate change in rural areas may increase internal migration to urban areas. People migrating into urban areas as a result of climate induced disasters are the most vulnerable in the society. Table 2.7 summarizes potential impacts and associated risks in urban areas.

Table 2.7: Potential impacts and risks for urban areas

Climate signal and hazards	Potential impacts	Risk level	
		SSP1-2.6	SSP5-8.5
Excessive rainfall	• Urban drainage problem resulting in prolonged water logging • Work hours reduced • Education hampered • Vector-borne diseases due to waterlogged conditions • Road damages and disrupted communications • Recurrent investment losses • Sanitation problems • Waste washouts that pollute the environment • Loss of infrastructure	++	+++
Extreme heat	• Heatstroke and increased deaths • Drinking water crisis • Work hours reduced for the marginal people • Drops in water levels and quality	++	+++

Climate signal and hazards	Potential impacts	Risk level	
		SSP1-2.6	SSP5-8.5
	• Declines in dissolved oxygen and poor habitats for aquatic species • Roads and flexible pavement cracking and damaged • Vector and water-borne disease outbreaks • The heat island effect intensified		
Cold spells	• Distress and suffering for homeless and marginalized people	++	+++
Frequent river floods	• Houses, roads and other infrastructure inundated and damaged • Communications problems • Investment losses • Outbreaks of diseases • Severe water and sanitation problems • Education hampered • Poverty increases • Loss of crops, poultry, fish and livestock • The agriculture supply chain disrupted due to poor communications	++	+++
Early or frequent flash floods	• Houses, roads and other infrastructure inundated and damaged • Communication problems • Investment losses • Outbreaks of diseases • Severe water and sanitation problems • Education hampered • Poverty increases • The agriculture supply chain disrupted due to poor communications	++	+++
Severe droughts/water scarcity	• A drinking water crisis in urban areas • Disease outbreaks in slum areas • WASH problems • Less spring water in the hills • Increased workload for women	+	++
Frequent lightning	• Accidental deaths • Hearing problems • Electrocution and fire hazards	+	++
Frequent landslides	• Damage to settlements • Human deaths • Communication problems • Road and infrastructure damages	++	+++
Increased salinity	• Severe drinking water crisis • Sanitation problems • Corrosion of road and bridge materials due to salt • Need for recurrent investment • Human health issues like premature childbirth or death, stroke, high blood pressure, etc.	++	+++
Frequent cyclones and storm surges	• Losses of houses and damages to properties • Losses of livelihoods • WASH problems	++	+++
Sea-level rise	• Infrastructure damages • Recurrent loss of investment • Increased drinking water crisis due to salinity intrusion	++	+++

**Risk level: low (+), medium (++) and high (+++).*

2.4.4 *Risks and vulnerabilities for communities and livelihoods*

Both rapid- and slow-onset climatic hazards and disasters cause serious havoc to the socioeconomic fabric. With different climatic events likely to be more frequent and severe in the future, increasingly adverse impacts will jeopardize livelihoods, especially those of the poor, who are mostly dependent on natural resources. They also threaten Bangladesh's significant socioeconomic achievements in reducing poverty and improving living standards (MoEFCC, 2018b).

The impact of climate change on livelihoods may propel approximately 19.9 million internal climate migrants by the 2050s, half the projected climate migrants of the entire South Asia region (Clement, Rigaud, de Sherbinin, et al., 2021). From 2009 to 2014, households suffered estimated damages close to BDT 18,425 crore (or nearly $2.3 billion) (BBS, 2016). The damages could be much higher if all economic activities are considered. An estimated 7 million and 13 million people will be at risk in coastal zones alone by 2025 and 2050, respectively (Karim and Mimura, 2008). On estimate finds that damages and losses stand at $4.6 billion from cyclones and storm surges over a 10-year return period; this will increase to $9.16 billion due to climate change impacts. The costs of tropical cyclones and storm surges, which now touch 0.3 percent of GDP, would rise to 0.6 percent in 2050 due to climate change impacts (World Bank, 2010b). Table 2.8 presents the potential impacts and associated risks of future climate change for communities and livelihoods.

Table 2.8: Potential impacts and risks for communities and livelihoods

Climate signal and hazards	Potential impacts	Risk level	
		SSP1-2.6	SSP5-8.5
Excessive rainfall	• Hampered water and food security • Malnutrition and health problems • Loss of livelihoods; increased poverty • Economic losses • Disrupted urban economy • Ecosystem degradation • Gender and domestic violence • Social inequality • Internal displacements • Hampered sustainable development	++	+++
Extreme heat		++	+++
Cold spells		++	+++
Frequent river floods		++	+++
Early or frequent flash floods		++	+++
Severe droughts/water scarcity		++	+++
Frequent lightning		++	+++
Frequent landslides		++	+++
Increased salinity		++	+++
Frequent cyclones and storm surges		++	+++
Sea-level rise		++	+++

**Risk level: low (+), medium (++) and high (+++).*

2.4.5 Risks and vulnerabilities among women, the elderly, children and youth

Women's vulnerability to climate change differs from that of men due to gender inequalities, including reduced access to and control over resources (GED, 2014), limited opportunities for decent work, lower social status (Mitchell et al. 2007), and dependency on men for information (Saroar and Routray, 2012). Bangladesh has a Gender Inequality Index value of 0.537, according to the 2019 index, and ranks 133 out of 162 countries.

Adverse health consequences due to climate change are quite prominent among women. Climate effects can compound nutritional problems during pregnancy or menstruation, for example, such as when floods result in a shortage of foods. Female-headed households are particularly vulnerable, including to economic disruptions. Salinity in the coastal areas also causes women's health problems. Pre-eclampsia and gestational hypertension rise during the dry season when salinity goes up (Khan et al., 2014). Since salinity intrusion is pervasive and will likely increase, women may face growing reproductive health risks in coastal areas. Generally, a sharp increase in water-borne diseases and maternal health-care problems occurs during a disaster. In coastal areas, increasing salinity is causing various health issues that include more births of children with disabilities. Increased use and intake of saline water are also linked to skin diseases and diarrhea.

The lower participation of women in decision-making due to socio-cultural factors renders them more vulnerable to risks despite their demonstrated capability to act on and adapt to climate stresses.

Climate change-induced heat stress heavily affects children and youth and the elderly. For the former, school-going can become a major problem, which may lead to intergenerational transmission of vulnerability and impaired chances for future earnings. For elderly people, coping with emergencies and securing a safe haven can be serious challenges. Additionally, extreme heat, cold and increased salinity impact their physical and mental health through recurrent sickness and increased comorbidity.

Youth are the future of any nation but climate change-induced disasters may limit their prospects. They face difficulties in maintaining basic needs such as food, clothing and education, while disasters can also hamper social and mental development. Many youth are forced to engage in labour due to disaster-impelled migration from coastal areas, a pattern evident in other forms of fallout due to climate change. Since many disasters heavily impact Bangladesh, the challenges and risks for youth are only growing.

2.4.6 Risks and vulnerabilities among persons with disabilities

Persons with disabilities face neglect and various health, mobility and other problems in day-to-day life, making them more vulnerable to hazards or disasters. While persons with disabilities experience the same impacts as other people, they may be less equipped to cope given limited participation in climate action, which often overlooks their specific needs. Certain groups of people with disabilities are disproportionately at risk from climate change-related hazards, including people with pre-existing mental health conditions. Dependence on natural resources and a lack of skills, knowledge and limited alternative livelihood opportunities all affect food security and nutrition.

Additionally, the health of persons with disabilities is also adversely impacted. Experiencing extreme weather events causes significant stress and distress and contributes to more serious mental health issues for persons with disabilities.

2.4.7 Risks and vulnerabilities for national economy

Bangladesh had a per capita gross national income of $1,610 in FY2016-2017 (BBS, 2017). Economic losses due to climate change over the past 40 years

have been an estimated $12 billion, suppressing GDP annually by 0.5-1 percent. An average temperature rise of 2°C will cause an annual GDP loss of around 2 percent by 2050 (Ahmed et al., 2014). There is a 10 percent chance that losses will be over 4 percent. In the long term, if no action is taken to adapt to or mitigate global climate change, average annual total economic losses are projected to be 9.4 percent by 2100, excluding damages due to extreme events (MoEFCC, 2018b).

On average, 1.32 percent of annual GDP loss from 2016-2021 occurred due to climate change-induced disasters (BBS, 2022a).

Nationally, climate change is hindering overall economic growth by impacting all aspects of the economy. It puts national goals for food security, poverty reduction and sustainable development at risk. As impacts on different regions of the country intensify, the associated vulnerabilities and risk to assets, people, livelihoods, primary production systems and the economy are mounting. Future climate change projections indicate a strong need to take an integrated, efficient approach to adaptive practices and actions to limit negative consequences.

Adaptation Priorities for Combating Adversities of Climate Change

3. Adaptation Priorities for Combating Adversities of Climate Change

As a global pioneer in climate adaptation, Bangladesh has advanced substantially in building adaptive capacity and resilience for coping with various climate change impacts across sectors and levels. As underscored in the NAP, the frequency, intensity and dominance of multiple hazards, abrupt shifts in climate trends and their disproportionate effects, the significant uncertainties of future risks spread across the country, and various challenges in implementing coping mechanisms and adaptation all call for a systematic and planned approach to prioritizing and implementing climate change adaptation actions.

This chapter elaborates the nucleus of the NAP as a meticulous framework for reinforcing country-driven and locally led and planned adaptation, with priorities for the medium and long term. The overall aim is to combat climate change adversities and overcome all implementation barriers and challenges in line with the NAP's guiding principles.

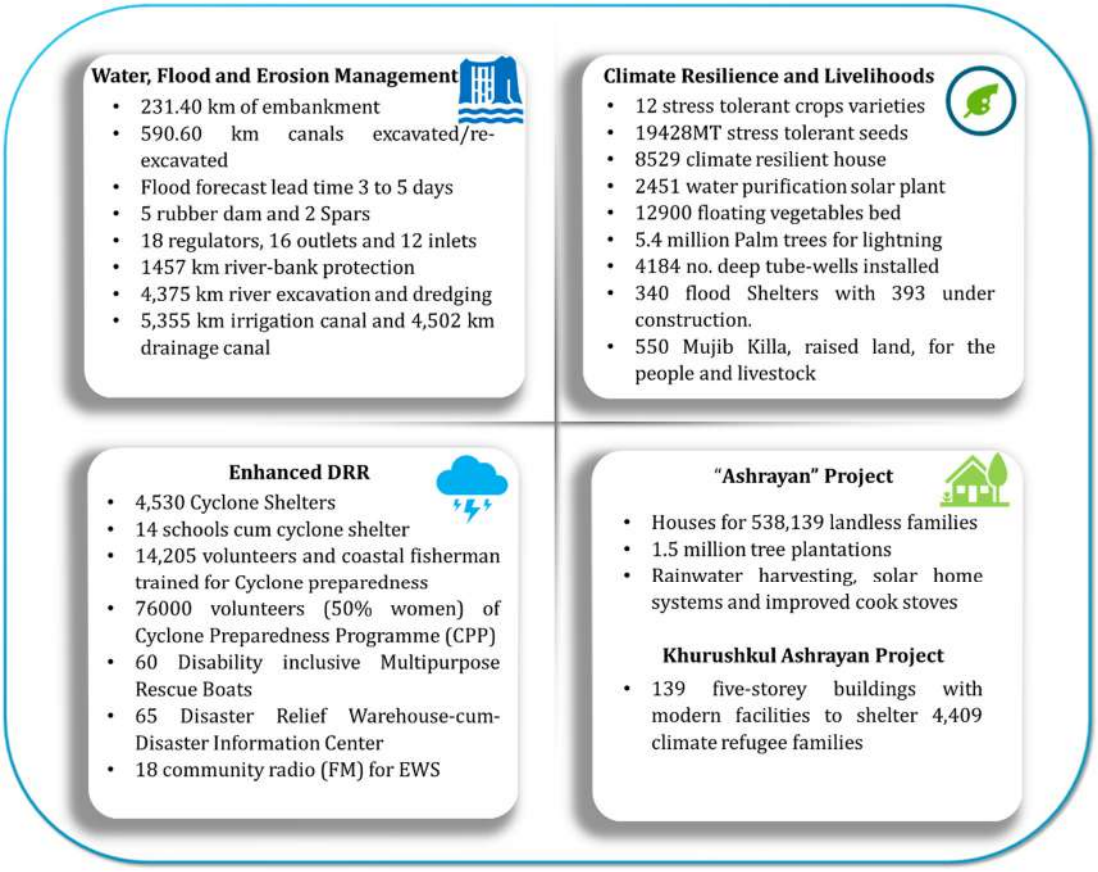
3.1 Lessons Learned from Past Initiatives

Bangladesh has made significant advances in climate adaptation through incremental initiatives supported by a broad policy regime. A streamlined and strategic institutional setting is oriented towards realizing the aspiration of climate-resilient sustainable development through creating required policies and regulatory frameworks.

The NAPA (2005) and BCCSAP (2009) ushered in a journey that continues to date. Noteworthy points along the way include the Bangladesh Climate Change Trust Act (2010) and the formation of the Bangladesh Climate Change Trust Fund (BCCTF) to support implementation of strategic adaptation actions under the six key pillars of BCCSAP, focusing on adaptation, mitigation, research and capacity-building; formation of the Bangladesh Climate Change Resilience Fund (BCCRF) as a multi-donor trust fund (although this was later stopped); Climate Change Gender Action Plan (2013) for mainstreaming gender into planning; the Climate Public Expenditure and Institutional Review (CPEIR) in 2014 and the Climate Fiscal Framework (2014) for supporting prioritized climate actions through providing incentives based on practical and efficiently managed public finance; and the Bangladesh Country Investment Plan for Environment, Forestry and Climate Change (2017) with a strategic framework enabling coordinated investment across the environment, forestry and climate change (EFCC) sectors and enhancing sector contributions to poverty reduction, sustainable development and improved climate resilience. Bangladesh submitted its first, second and third National Communications to the UNFCCC in 2002, 2012 and 2018. It appointed the Economic Relations

Division (ERD) as the nationally designated authority (NDA) for the Green Climate Fund (GCF) to provide broad strategic oversight of related activities and to facilitate readiness and initial support funding in the country. Climate change adaptation has been explicitly mainstreamed into the 7th and 8th Five-Year Plans and the Second Perspective Plan (2021-2041). In recent years, the 100-year strategic delta plan (BDP2100) has been formulated around adaptive water management towards ensuring a climate-resilient and prosperous delta upholding long-term water and food security, economic growth and environmental sustainability. The plan proposed 52 climate change adaptation projects among 80 projects to support the aspirations of the nation. The Sector Action Plan on Environment and Climate Change has been prepared to translate strategies of the 8th Five-Year Plan into an immediate action plan for the Annual Development Programme (ADP). The National Disaster Management Plan and Standing Order on Disasters (SOD) has been updated for accelerated disaster risk reduction. The Mujib Climate Prosperity Plan (2030) has been drafted to enhance resilience, promote nature-based infrastructure, grow the economy, create jobs and expand opportunities, using climate change action as the catalyst. An updated Nationally Determined Contribution (NDC) submitted in 2021 that supports global efforts to limit the global temperature rise to 2°C or preferably 1.5°C above pre-industrial levels.

Divergent structural/physical interventions (as presented in the infographics below) have facilitated national adaptation and advancement parallel to policy interventions. The BCCT has undertaken about 800 projects with an investment of around $480 million to implement strategic adaptation and mitigation actions. Over the last seven years, the climate-relevant budgetary allocation has doubled, increasing from $1.44 billion in FY2015-2016 to $2.96 billion in FY2021-



Noteworthy adaptation initiatives

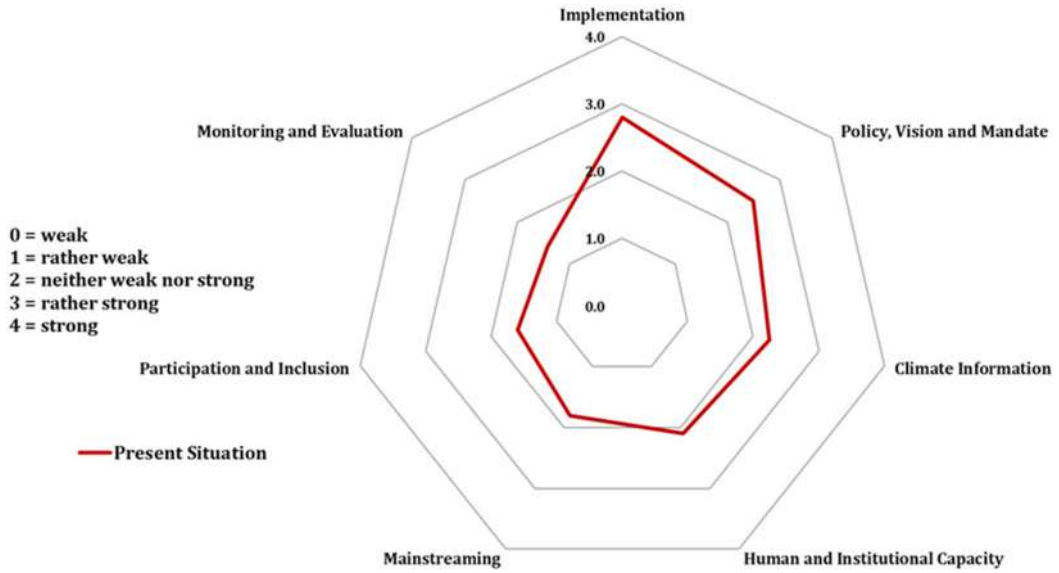
(Source: MoEFCC, 2021, Country Paper for COP26 and Sectoral Ministries)

2022, which is 0.73 percent of GDP for FY2021-2022 (MoF, 2021). Through the GCF country programme, the NDA identified 48 priority projects after a review and analysis, based on multiple criteria, of over 230 initially submitted projects. It accessed $368.6 million for six projects and disbursed $4.1 million for seven readiness support activities. Other funds came from the Adaptation Fund, Least Development Country Fund, Climate Investment Fund, different multilateral and bilateral channels and the BCCTF to facilitate adaptation implementation. Nonetheless, the Government is still contributing 75 percent of total climate investment from its resources. Flows of international finance are inadequate considering funding requirements.

Stocktaking during the NAP formulation process (SNAP) revealed substantial gaps in adaptation M&E (as shown in the infographics below). Effective M&E framework for tracking adaptation is in dire need. Required technical knowledge, analytical capacity and negotiation skills among stakeholders and institutions are needed to support the M&E process. Furthermore, M&E is weak in tracking stakeholder engagement in adaptation, most importantly, tracking the inclusion of women, people with diverse gender identities, youth, the elderly, persons with disabilities and ethnic communities. The supply of climate information has reached a moderate level but climate-downscaled data are not consistently stored, processed or updated at the national and subnational levels. Communications barriers, difficulties in accessing climate information among stakeholders at different levels and limited research are other concerns.

Major implementation challenges include accessing international financial support as promised; following standardized project prioritization criteria with mainstreamed climate change issues; participation and inclusion of stakeholders such as women, people with diverse gender identities, the elderly, youth, persons with disabilities and ethnic communities up to desired level; building required institutional capacity and manage knowledge; maintaining coordination among multisector and multilevel stakeholders; decentralization of climate change adaptation management through local government institutions (LGIs); reducing gap in research, including on field outcomes; and in terms of finance.

Bangladesh has several policies and plans related to CCA, where there is room for update and improvement. Institutional arrangement will need to be further strengthened to facilitate the outcome based M&E. Integrating climate change into the development planning process should be



SNAP Outcome

(Source: NAP consultations, previous stocktaking for national adaptation planning and expert feedback)

accelerated. For instance, the Climate Change Gender Action Plan (ccGAP) was appropriately mainstreamed into the National Women's Development Policy but not in other gender-related policies. Private sector engagement in CCA is still in the initial stages of mainstreaming and inclusion. Climate change-related risk screening or climate risk assessment as part of feasibility or pre-feasibility studies needs to be operational. The NAP treats these gaps, challenges and barriers as priority institutional aspects that need to be addressed as entry points.

3.2 Entry Points for Adaptation

Understanding adaptation needs stemming from observed climate stresses and future risks is key to identifying entry points for adaptation, prioritizing adaptation strategies and supporting the adjustment to actual or expected climate effects with structural, physical, social and institutional interventions (IPCC, 2014). In conjunction with rigorous analysis of climate change risks and vulnerabilities, the NAP identifies potential adaptation needs or entry points by analyzing the current policy and legislative landscape. It also refers to the stocktaking of adaptation practices, barriers and challenges based on consultation with stakeholders and communities and at multiple levels. The NAP emphasizes performing system dynamics analysis, and considering critical elements of priority and cross-cutting sectors to devise medium- and long-term adaptation strategies and options.

Priority areas for structural adaptation emphasized by stakeholders at multiple levels include construction, repair and rehabilitation of polders and cyclone shelters protecting the lives and livelihoods of people in coastal communities; water, flood and erosion risk management; river dredging, reservoirs and re-excavation of drainage canals; climate proofing of infrastructures; agricultural research and extension support for stress-tolerant varieties or breeds to ensure desired food production under climate risks such as salinity, floods, drought, heat, etc.; flood forecasting, early warning systems, cyclone preparedness, emergency responses and disaster risk reduction; expanding solar-based renewable energy; livelihood improvement and enhancement of climate resilience; promotion of climate-resilient rural and urban WASH infrastructure; building the capacity of communities and service providers in terms of WASH, coastal reforestation, afforestation and green belt development; housing and incentivizing climate refugees for reducing risks; massive plantation and ecosystem conservation; research and knowledge management; and capacity-building of institutions and communities.

System dynamics analysis of priority and cross-cutting sectors finds several entry points for structural and social categories of adaptation. This type of analysis comprises understanding the impact chain through a causal loop diagram that exerts climate risks on climate exposure and sensitive elements. Realizing the priority sector as a system includes all interconnected elements to generate subsequent impacts from one to another triggered by climate signals and hazards. This analysis for adaptation entry points considers a vast chain of impacts developed by bio-physical climate-sensitive elements to generate climate risks on the socioeconomic system.

The climate signals (such as temperature rise, rainfall variability, sea surface temperature rise, etc.) and their immediate impacts are called climate hazards (floods, droughts, sea-level rise, salinity intrusion, cyclonic storm surges, river bank erosion, lightning or landslides, etc.). Reducing adverse impacts of these climate stresses are always considered high-priority entry points for adaptation, although they are primarily external factors beyond the control of human interventions.

Being impacted immediately by climate signals & hazards, building resilience of the different natural resources through sustainable management are envisaged as high-priority entry points for adaptation. If the resilience of these natural resources is built at the desired level, the impact of

external climate factors or hazards will be adjusted by next layer of the systems, which consists of resources based production and food system, human and socio-economic system.

Subsequent layers of system elements are then analyzed for different causal loop factors to identify anticipated and observed impacts (described in the previous chapter) and their flow and variability (high, medium or low severity).

Prioritization and implementation of effective adaptation measures at the first entry points may substantially reduce adaptation costs and efforts related to secondary or tertiary layers of elements based on the socioeconomic system. The analysis enables cross-cutting and multidisciplinary sectors to prepare adaptation plans holistically, considering priority and other complementary sectors. For instance, agriculture, livestock and fisheries system analysis includes water and infrastructure elements.

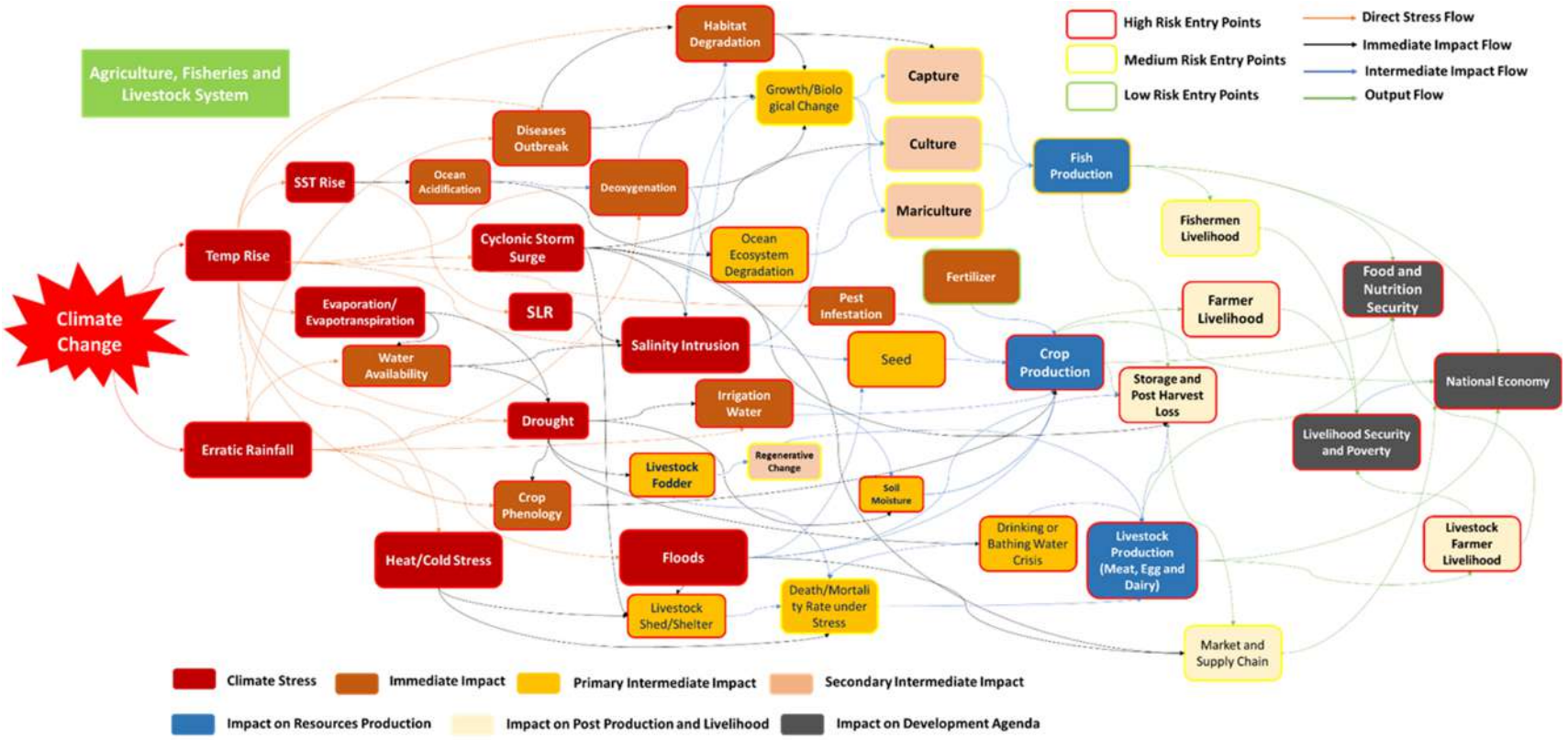
The key entry points for the agriculture, fisheries, aquaculture and livestock sector are irrigation water availability during the dry season and under drought conditions, conservation of soil moisture, freshwater availability for salinity-prone regions, quality seeds and understanding of crop flowering patterns and phenology changes, and managing pest infestations. The NAP also refers to the livestock fodder crisis because of floods, salinity or droughts, and the drinking or bathing water crisis due to floods or salinity intrusion.

For fisheries and aquaculture, managing habitat conditions; water temperature and pH; dissolved oxygen; disease outbreaks; freshwater, marine and ocean ecosystems; deoxygenation; ocean acidification, etc. are priority entry points. All of these anticipate higher production losses, post-harvest losses, and unstable market and supply chains. Potential food and nutrition insecurities and livelihood instabilities leading to losses and damages to the national economy are anticipated as outcome-based adaptation entry points under the future uncertainties of climate change. The livelihoods of farmers and fishers are at stake, with the potential for increased poverty. The system dynamics diagram for this sector is illustrated.

Critical entry points for the water resources sector are managing land, water and sediment; water-related disaster management such as for floods and flash floods, erosion, droughts, salinity intrusion, storm surge inundation, etc.; freshwater flow availability and wetlands ecosystem conservation; desalinization for drinking water purposes; management and restoration; early warning and dissemination.

For urban areas, priority entry points include solving urban drainage problems; the resilience of urban communities, especially the poor and slum dwellers; urban environmental conservation; youth-led urban wetlands management and improvement in human well-being; unplanned urbanization and deforestation; urban heat island effects; the sustainable management of stormwater; urban greens and blue infrastructures; boosting the urban economy; climate-resilient rural and urban infrastructures and communication facilities; climate-stress-resistant construction materials; the adequate opening of cross drainage; innovative research on construction materials; setting adaptation standards for critical infrastructure and mainstreaming these into relevant guidelines or policies; stress-tolerant housing, eco-engineering or bioengineering interventions, etc..

As a cross-cutting priority sector, climate-resilient WASH technologies and health-care facilities for urban, slum and hard-to-reach areas, the Chattogram Hill Tracts, and coastal and drought-prone areas are prioritized as key entry points. Alongside climate change-induced vector or water-borne diseases, research on climate sensitivity of diseases and boosting physical and mental health, well-being, etc., are adaptation entry points for the WASH and health sector.



Example of system dynamics and impact chain for climate change

The NAP includes ecosystem conservation, restoration and biodiversity conservation, nature-based solutions or ecosystem-based adaptation, wetlands and ocean ecosystem conservation, and hill forest and soil conservation as priority physical adaptation interventions. It also focuses on understanding the sensitivity of flora and fauna to climate change and on the conservation of native species, coastal afforestation, deforestation, land degradation, agroecosystem development, and youth-led nature conservation as high-priority entry points for physical adaptation interventions under the ecosystem, wetlands and biodiversity sector.

Reducing the immediate consequences of climate change and climate change-induced slow-onset and sudden extreme events on human, natural and economic resources are considered high-priority entry points. The inclusion of gender dimensions, youth and the elderly, persons with disabilities, ethnic communities and socially disadvantaged communities in all possible aspects are also core adaptation needs.

3.3 Adaptation Preferences

The NAP implementation will scale up and extend locally practiced adaptations to transform the adaptation process, building on existing socially acceptable and locally led practices for transformation, assuring few or no negative impacts on society and the surrounding physical environment, and optimizing resources. Some locally practiced or indigenous adaptations will require further investigation and research to establish the scientific basis for inputs, processes and desired outputs. For instance, NAP consultations found that people in the coastal district of Satkhira apply sugar to cropland to reduce salt. But the science behind this technique and the actual implications of it necessitate further investigation and research.

Examples of some preferred locally led or indigenous adaptation practices along with expert preferences based on consultations and stocktaking are described in the following subsections.

3.3.1 Water resources

Stakeholders reported that top preferences for adaptation related to water, land and sediment management are regular and timely rehabilitation of polders, internal drainage management of polders, ensuring the quality of polder construction, green belt development, creating co-management committees and making existing water management groups functional, coordination with disaster management committees, community-based rainwater harvesting or freshwater pond management, tidal river management to manage tidal floods and sediment, elevated houses for flood resilience, development of retaining walls around villages in the *haor* or vast wetlands to protect against wave action and land degradation, plantations inside wetlands or along embankment slopes, ecosystem-based adaptation and living with floods[6] in the *haor* and wetlands, construction of *Mujib killa,* strengthening existing early warning and dissemination system so they are easier to understand by multiple users, river dredging, excavation or re-excavation of *khals* or canals for increasing conveyance capacity, reservoirs or pond digging to harvest and segment surface water flow in drought-prone and coastal areas, increasing freshwater availability in coastal rivers,

[6]*Living with floods allow creating a safer community for themselves by their ability to anticipate and act to minimize the impact of floods. It also means adaptation of livelihood systems as a reaction to changing frequency and intensity of flooding. For instances, adoption of alternative livelihoods away from 3 rice crops instead of complete avoidance of flooding.*

Locally led adaptation: Solar water solutions in the Chittagong Hill Tracts

Local communities in Jurachhari Upazilla of Rangamati in the Chittagong Hill Tracts faced severe water crisis problems. They are mostly dependent on village common forests, which provide food and water flows into streams, and support agroforestry dependent livelihoods. Recently, droughts, landslides, and floods have reduced farm outputs and left most land uncultivated due to a lack of water resulting in food shortages every year. Locals believe this problem is becoming more frequent and intensifying due to climate change and acute water crisis. Women and girls fetch water by walking miles from home.


Photo credit: Zhantu Chakma

Community representatives formed a Climate Resilience Committee (CRC) under the Chittagong Hill Tracts Climate Resilience Project (CCRP) of SID-CHT, supported by the United Nations Development Programme (UNDP). The CRC took part in training on adaptation, resilience-building, project management, financial management, participatory monitoring and reporting, vulnerability assessments, local resilience planning and project formulation. They developed their own climate change vulnerability assessment and LRP for projects, considering high durability, environmental sustainability, community benefits, a community willingness to contribute and community cohesion. The communities designed and implemented a solar power-based safe water supply project at a cost of $15,000 to ensure safe drinking water for residents. They installed a tube well that runs by 12 solar panels and distributes into five neighborhoods. The committee monitors and maintains the project.

Water scarcity is the most devastating impact of climate change in the poverty-stricken CHT. The water crisis of Jurachari is now past because of an action led by a skilled, aware and climate-resilient community. Similar renewable energy-based, locally led solutions could be scaled up to ensure sustainable adaptation for other vulnerable communities.

volumetric pricing of water and improving water use efficiency, groundwater management through artificial recharge, eco-engineered flood and drainage management, sustainable river and costal erosion protection, etc.

Adaptation coordinated with the medium- and long-term strategies of the BDP2100 and its 52 climate adaptation projects would make a climate-resilient, prosperous delta. In terms of physical interventions, preferences are to introduce funds or allowances for vulnerable communities to reduce their poverty, build resilience, mitigate climate change-induced migration and losses and damages, and improve livelihoods. Gender-sensitive livelihood diversification and incentive mechanisms, youth-led watershed and disaster management, awareness-raising and capacity development are other demands. Transboundary river and basin-level cooperation, basin wide and participatory water resources management, climate-sensitive land zoning and planned resettlement to halt climate migration are considered potential policy initiatives.

Scaling up these preferred adaptation measures along with building low-cost, climate-resilient (flood, cyclonic surge, heat-tolerant) houses, communication infrastructures and education centers with co-beneficial facilities focused on enhancing resilience against floods are excellent options for local adaptation, disaster risk management and climate-resilient water resources management.

3.3.2 Disaster, social safety and security

The NAP aims to protect lives, livelihoods and infrastructure against geo-hazards and water-related disasters. Social safety net coverage should be increased through blending traditional initiatives such as KABIKHA (food for work), ad

Climate-resilient housing

Communities in southern Bangladesh have always had to brace themselves and their homes and livelihoods against catastrophic cyclones and storm surges. From the historic 1970 cyclone to the one in 1991 and most recently cyclones Sidr (2007) and Aila (2009), both the frequency and intensity of such disasters are increasing due to the adverse effect of climate change, causing catastrophic damage.

In 2013, WorldFish began a climate-resilient housing project, creating a prototype climate-smart house that is cyclone resilient and efficient in terms of water, food, energy and space. The house is in the Satkhira district, near the Sundarbans. It is built above the flood line on an elevated platform of wood or concrete. The home protects against cyclones and flooding while promoting water and energy use efficiency. Many of its features focus on enhancing food production, assisting families in becoming more self-sufficient and coping with extreme weather events. A rainwater harvesting system with filters, rainwater-fed multipurpose fish tanks, drip irrigation, a vertical agriculture system, a barrel composting system, an improved cook stove and a twin pit sanitary toilet are some of the house's unique features.

hoc cash transfers, funds for dry food and rehabilitation of houses, and emergency medication during and after a disaster. Innovative initiatives include government-subsidized insurance-based risk recovery mechanisms, the establishment of climate-resilient houses like those in the Ashrayan project, low-interest loans, etc. To ensure protection of transport and communication infrastructures, climate proofing of road and communication infrastructures preferred.

The NAP also looks at strengthening ICT-based early warning and dissemination systems and engaging communities with readily understandable warning advisory services in local languages to reduce losses and damages from sudden disasters, minimize disaster risks and achieve SDG targets. The NAP further suggests alternative livelihood generation and income-related opportunities, the provision of climate-resilience funds or subsidies to recover losses and damages, low-cost desalination tools and climate-smart livestock sheds, community-based adaptation in association with LGIs and NGOs, youth leadership programmes, special climate funds for local governments to spend for vulnerable communities, and similar options. These should be systematically developed and extended to improve livelihoods particularly for the vulnerable, especially women, people with diverse gender identities, persons with disabilities, youth and ethnic communities. Gender-responsive and inclusive budgeting, adaptation management committees, health care, and rural and urban WASH facilities are envisaged under the NAP.

3.3.3 Crops

Agricultural advancement amid climatic and non-climatic challenges is central to adaptation actions. Farmers can adopt various indigenous, locally led and climate-smart adaptation practices. Some key climate-smart adaptation techniques include the following.

Agricultural research institutes have developed different stress-tolerant (flood, drought, short duration, salinity, lodging tolerance, etc.) rice and non-rice crop varieties. These need further extension programmes (field and block

demonstration, etc.) to extend them across the country. Yield gaps between research and farmer fields currently make these varieties non-attractive to farmers. Integrated and holistic research coordinated with National Agricultural Research System (NARS) organizations (the Bangladesh Agricultural Research Institute [BARI], the Bangladesh Rice Research Institute [BRRI], the Bangladesh Institute of Nuclear Agriculture [BINA], the Soil Resource Development Institute [SRDI], etc.) could develop more productive and stress-tolerant cultivars to reduce yield gaps. Supporting extension services, market links and supply chains, expanding e-commerce, and integrated pest and diseases management are recommended. A comprehensive investigation also suggested developing new stress-tolerant rice and non-rice crop varieties considering emerging climate extremes like heat or cold.

Preferred indigenous adaptation practices in the floodplain, coastal areas and hill tracts are raised-bed and zero/minimum tillage for production of crops such as mustard, pulses, sesame, etc.; cultivating local rice varietys (*Ratna, Sylhety, Lambu, Shaheb, Chikon, Swarna, Ranjit, Ranisalut, Dud Kumar, Sadamota, lalmota, laxmibilash, Rajasail, Shitta, Brindamoni, Shitabhog, Kachra, Bashful, Benapol,* etc.); rainwater harvesting in coastal saline areas; mini-ponds for supplementary irrigation during drought spells; drip irrigation with mulch in raised beds; use of combine harvesters for early harvesting in *haor* areas to reduce the risk of flash floods; the Kuni method for minor-scale irrigation; the pyramid method for tide-affected lands and vegetables in Gher; floating cultivation and the Sorjan technology as widely practiced in the coastal water stagnant areas; nuts and coffee in the Chattogram Hill Tracts; diagonal *jhum* cultivation, etc..

The NAP implementation process will develop and scale up these adaptation practices and introduce four crop-based cropping patterns developed by BARI to increase cropping intensity from 192 to 400 percent. Other areas of focus are increasing water use efficiency through climate-smart agriculture techniques such as alternating, wetting and drying; buried pipes; mulching; smart metering; etc. Field-level demonstrations on stress-tolerant cultivars, mechanization, use of location-based agromet services and early warning systems will be developed on a mandatory basis to support greater agriculture production to ensure food and nutrition security. See also Table 3.1.

Sack gardens for subsistence farming

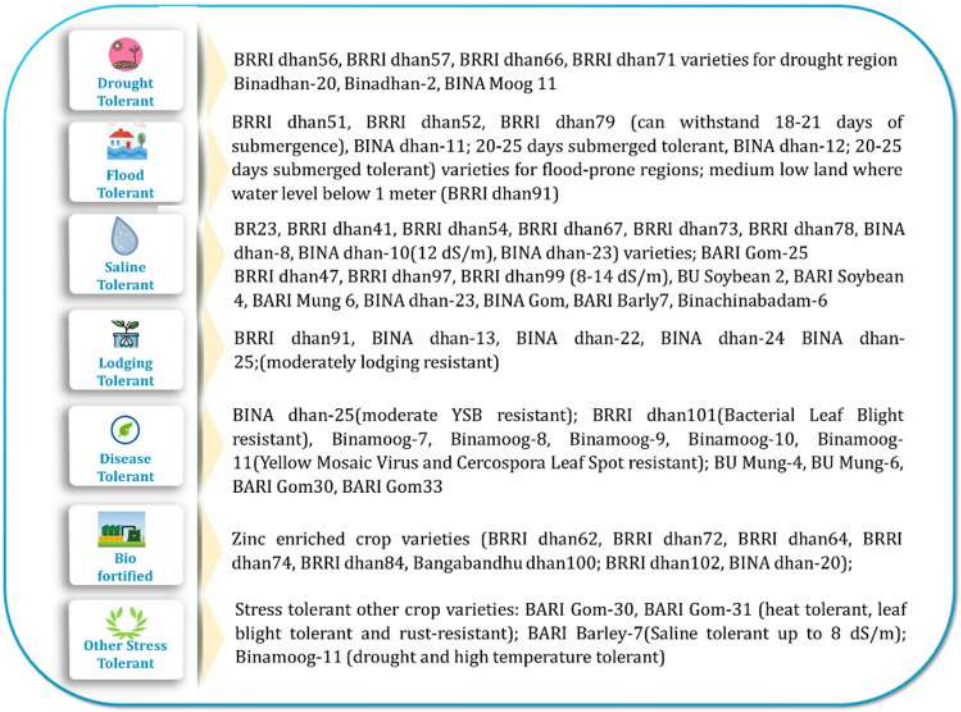
In Ohirkunji village, Barlekha Upazilla, Moulvibazar, Kunjolota Biswas, age 38, has become a successful farmer using the sack gardens method. She has practiced it for 1.5 years, backed by the "Suchana Programme" of the Center for Natural Resource Studies. This method can produce sufficient vegetables for herself, while she sells the rest for nominal profit.

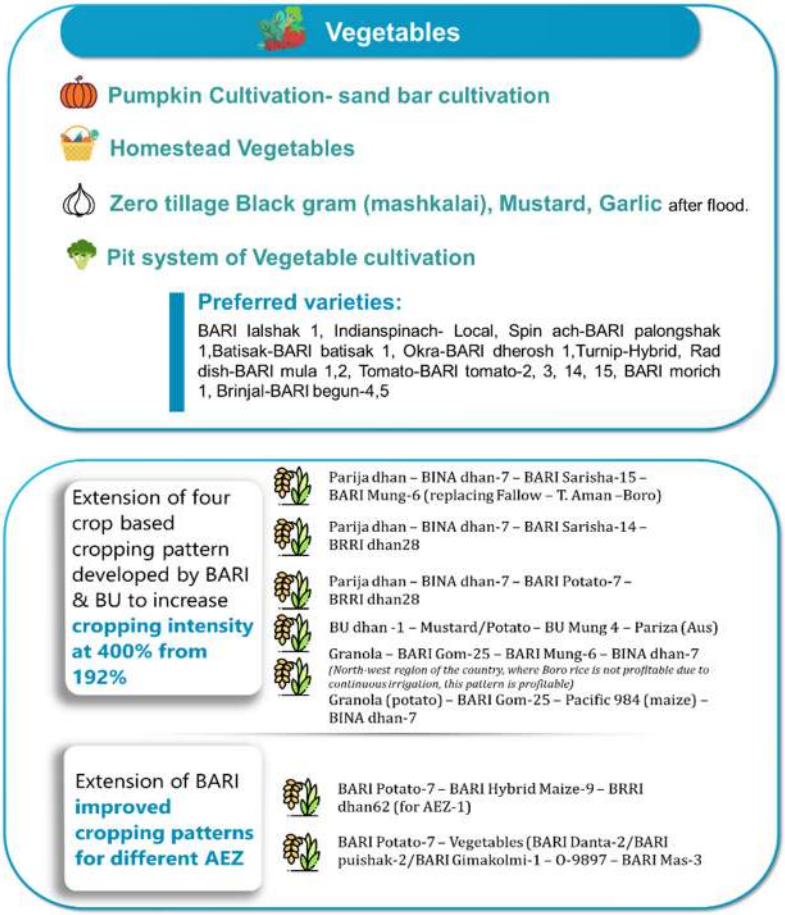
People living in the *haor* regions are compelled to use strategies such as sack farming to promote their living standards. The intensity of excessive rainfall causing floods has increased over the years, and climate-induced disasters have already impacted the livelihoods of the local community. Chemical fertilizers are not used in large quantities in sack cultivation, making cultivated vegetables much healthier.

Furthermore, cultivation has no adverse effects on the environment. It is essentially a safe food production method that can withstand floods. Although the technique is not widely used for commercial cultivation, it is a better option for subsistence farming.

Table 3.1: Preferred and available stress-tolerant crop varieties and techniques

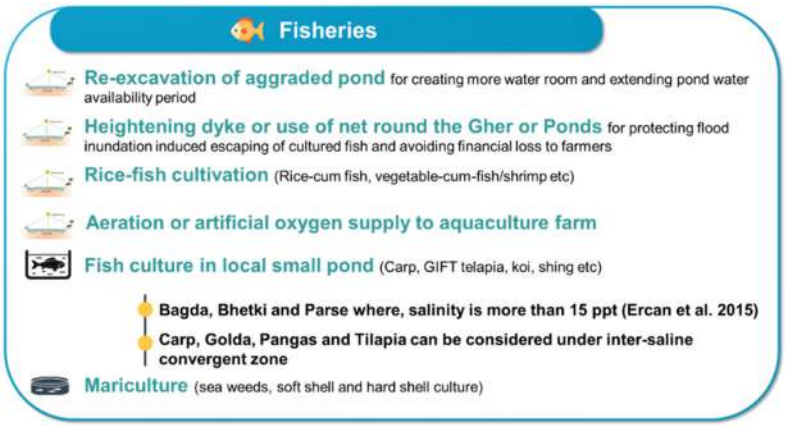
Rice crops			Non-rice crops
Aman	**Boro**	**Aus**	
– Use of submergence-resistant high-yielding variety (HYV) Aman – Use of short-duration HYV Aman – Floating seedbed – Supplementary irrigation	– Use of salinity-resistant HYV Boro rice – Short duration HYV – Alternating wetting and drying – Buried pipes – Solar-powered irrigation	– Direct transplanting (dibbling) – Use of stress-tolerant HYV varieties	– Salinity and drought-tolerant varieties – Floating bed cultivation waterbodies – Growing creeping vegetables on nets over ponds or hydroponic vegetable farming – Vegetable farming using sac or plastic/bag/pot/raised platform/macha, etc. – Vertical farming – Conservation agriculture – Reduced/zero tillage – Drip or sprinkler irrigation – Sorjan method in a region with high salinity – Intercropping/relay cropping with short-duration vegetables – Year-round homestead vegetable gardening (cucumbers, red spinach, chilies, seasonal leafy spinach, gourds, bitter gourds, ladies finger, etc.)





3.3.4 Fisheries and aquaculture

The fisheries and aquaculture sector plays an essential role in the national economy. It contributes 3.52 percent to total GDP and more than one fourth (26.37 percent) to agricultural GDP (DoF, 2020). The sector faces various climate-induced risks and vulnerabilities. Tackling these issues requires more applied research and investigations to understand the sensitivity of native fish species to climate change and variabilities and corresponding measures to address these; strengthening extension services; promotion of modern and proven aquaculture technologies such as cage culture; integrated farming; supplying quality feed including plant additives instead of antibiotics along with vitamin C and oxygen; managing disease outbreaks; raising



Seaweed culture's potential for the blue economy

Along the Reju Khal, a hill stream flows through the southern portion of Cox's Bazar district and into the Bay of Bengal, along vast lines of bamboo poles. The poles artificially cultivate seaweed that involves knotting two grams of seed onto a rope at 20 cm intervals. The rope is then linked between the poles and submerged in salty water where the seeds grow into 400-500-gram plants.

Since 2016, resident Mohammad Idris has been farming seaweed in this manner. Idris earns roughly BDT 15,000 per month by working with a team of about two dozen employees.

Like him, many people in coastal areas have begun cultivating seaweed, potentially boosting Bangladesh's blue economy. Around 300 households are involved in seaweed cultivation at Nuniarchara, Inany Beach and Reju Khal in Cox's Bazar, generating 390 tonnes in 2020 with potential applications in the food, cosmetic, feed and pharmaceuticals industries. The price of 390 tons of wet seaweed is BDT 23.4 million, whereas dried seaweed fluctuates depending on usage. If the crop's full potential is realized, it can grow enormously, creating one lakh jobs for people living in coastal areas like Cox's Bazar, Chattogram, Noakhali, Patuakhali and Satkhira.

the dikes of aquaculture farms (ponds and *ghers*); avoiding excessive use of chemicals;

supplementary irrigation in drought-prone areas; zoning suitable areas for shrimp cultivation; wetlands management and conservation of fish biodiversity; subsidies for poor fishers; capacity-building and hands-on training on aquaculture technologies; conservation of river and *beel* fisheries by establishing sanctuaries; restoration of connectivity of *khals/beels* and rivers; conservation of mother fisheries and promotion of mariculture (seaweed, soft shell and hard shell); encouraging women in small-scale aquaculture; dedicated EWS and climate information services, etc. Apart from open water fisheries, understanding ocean dynamics more broadly is crucial to unlocking the potential of the blue economy.

Some key adaptation priorities related to fisheries and aquaculture are:

- Provide supplementary aeration using Oxy-A, Oxy-Rane or Aerator, swimming by human during hypoxia conditions due to extreme heat or cold;
- Provide artificial oxygen supplies through oxygen cylinders and stop feed supplies during heavy rains and in oxygen-depleted conditions
- Balance pH by using or limited use of lime
- Use of disinfectant to cure epizootic ulcerative syndrome
- Raising the dikes of aquaculture farms (ponds or *ghers*) and using fencing to protect overtopping of fish during floods or storm surges
- Aggregation of water hyacinth for reducing heat stress, increasing water depth in drought-prone areas and maintaining desired habitat conditions
- Use of geotextile sheets on pond bottoms to restrict seepaging and percolation loss of pond water, mainly in arid areas
- Pre-matured or early harvesting of cultured fish before any extreme flood or storm surge based on early warning information
- Adaptive culture fisheries in flood-affected ponds considering a six-month culture duration and relatively large-size fry releases (more than 6 inches) after floods

- Less feed supply during afternoons and provision of Vitamin C-rich feed in the morning
- Avoid fingerling stocking during the afternoon or evening
- Cultivation of small indigenous species
- Apply horra pulling to remove toxic gases during heat stress
- Reduce fish stock density and partial harvesting during drought conditions or low pond water depth
- Conduct situation-based adjustments of stocking time and density
- Frequent monitoring of water quality and fish behaviour during high-stress conditions
- Grow more aquatic weeds in ponds for sheltering fish
- Integrated fish farming through planting fruit trees or vegetation on pond dikes or slopes

3.3.5 Livestock

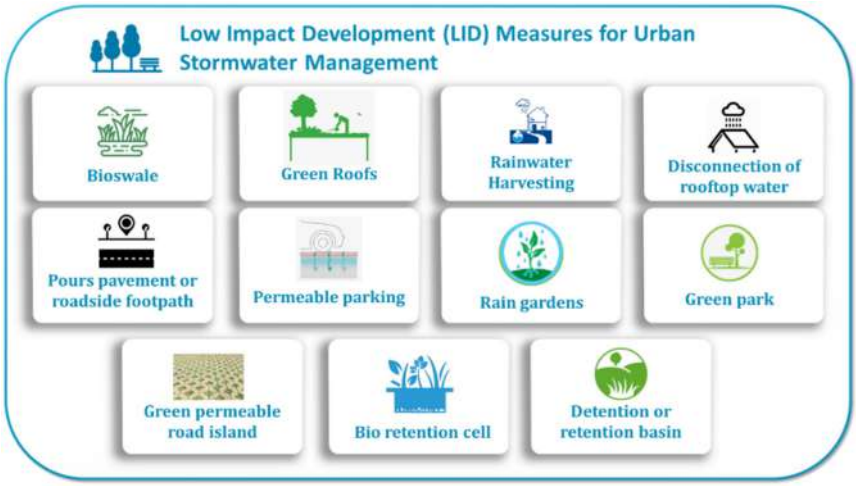
The gradual unfolding of climate risks and vulnerabilities poses severe threats to the livestock and poultry sectors, and are becoming key drivers of increasing food and nutrition insecurities. The livestock sector, including meat and dairy production, is highly vulnerable to heat stress, droughts, flooding, strong winds and extreme weather events. Such hazards can change the quality of meat and milk. For example, temperature and humidity impact milk production and fat content, and wind speed and the number of hours of sunshine per day affect protein content (Hill and Wall, 2014). Livestock are susceptible to changes in water availability for drinking or bathing, especially in drought-prone and coastal regions, disease outbreaks under extreme heat stress, and salinity. Some preferred adaptation practices to scale up are as follows.

- Ensure the availability of water for fodder cultivation, drinking and bathing through rainwater harvesting, re-excavation of canals or digging mini-ponds
- Invent stress-tolerant fodder
- Enhance the rearing of backyard poultry and the red Chattogram cattle breed
- Timely vaccination and deworming programmes to reduce the mortality rate due to climate stresses
- Alternate scheduling of vaccination programmes for stress management
- Building *Mujib killa* or raised land to ensure the shelter of livestock during floods or storm surges
- Expansion of local indigenous techniques for reducing the effects of heat and cold stress on livestock and poultry, such as trailing bottle gourds over the livestock or poultry shed, giving vitamins or saline, using a cooling fan or insulator shed during heat stress, taking care of calves by covering the shed with plastic during cold stress and using dried wheat as fodder during the dry season
- Using cow dung as fuelwood during the flooding season to reduce fuel problems
- Hydroponic grass cultivation to reduce pressure on inland cultivation
- Establishment of biogas plants at the farm level for livestock manure management and to support energy needs
- Compost and biogas plants
- Commercial livestock fattening
- Crossbreeding and artificial insemination
- Changed or stress-tolerant fodder crop varieties
- Aquaponics fodder cultivation
- Community-based rainwater harvesting

The NAP suggests combining indigenous livestock farming practices, climate-smart practices, research and strengthened extension services.

3.3.6 Urban areas

The NAP aims to ensure development of climate-resilient urban drainage infrastructure by implementing eco-engineering or bioengineering measures; providing enough cross drainage



considering extreme climate change; innovation of eco-friendly and climate-resistant construction materials; expanding green and blue infrastructures such as green buildings, urban green parks and playgrounds; conservation of urban wetlands and biodiversity; renewable energy-based utility facilities; implementation of low-impact development (LID) measures for reducing urban drainage problems and allowing infiltration, groundwater recharge and reduced attenuation of flood peaks; managing urban heat islands with planned urbanization and keeping green areas at 25 percent following 'other effective area-based conservation measures' (OECM) principles; and reforming detailed area (DAP) or structure plans to make them more green development-friendly and water-smart.

Integrated waste and urban drainage management can create a holistic solution for both issues, supported by standard guidelines, manuals and modelling. Implementation of NAP will help develop climate-smart, livable, pollution-free, clean and healthy cities through city climate action plans (City-CAP) up to municipality level and considering peri-urban areas, poor urban communities and the potential influx of climate migrants. Youth-led and community-based urban waste and nature management will be prioritized. Development and expansion of climate-, gender- and disability- responsive WASH, health and disease prevention facilities will give preference to urban slums and marginal communities, leading to smart and resilient city development.

3.3.7 Ecosystems, wetlands and biodiversity

The conservation of ecosystems, wetlands and biodiversity will be given the utmost attention in supporting sustainable development through adaptation. Nature-based solutions, (NbS), as an umbrella for ecosystem-based solutions, will be promoted to protect, sustainably manage and restore natural or modified ecosystems, and to address societal challenges effectively and adaptively. These solutions simultaneously provide human well-being and biodiversity benefits (IUCN, 2021).

Restoration and conservation of ecosystems will be practiced in various ways to protect forests, wetlands, land, mangroves, hills and marine ecosystems. Preferred adaptation options are: community-based coastal afforestation or reforestation; conservation of village common forests (VCFs) and co-management of watersheds in the Chattogram Hill Tracts; soil conservation in hill ecosystems; spring management; floating gardens; swamp forest restoration and conservation; coastal erosion protection with oyster reefs; expansion of social and urban forestry engaging students and youths; achieving OECM principles under the biodiversity framework; expanding forest-dependent livelihood generation and alternative livelihood generation; connectivity maintenance with reservoirs, khals and rivers; conservation of beel sanctuaries; robust monitoring of ecosystems and biodiversity based on high-tech AI and space technologies; necessary

reforms of the legislative framework with stringent enforcement; understanding and exploring ocean dynamics; climate and ecosystem-sensitive planning and development, etc. Extensive field research to develop different EbA options will also be explored.

Specifically, the following areas are attractive for accelerating private sector-led adaptation and finance.

- Agriculture and food security: R&D for stress tolerant varieties and farming system improvement; improved & tolerant seed business

Oyster reefs for coastal shoreline or embankment erosion protection

Kutubdia Island, with its rapidly receding shoreline, exemplifies erosion challenges at their most ferocious. Just off the coast of the island, oyster-encrusted reefs provide a vibrant home for marine life and a potential source of income for locals. They are expected to be a formidable force in defending the island from sea-level rise.

Oyster reefs can serve as a defense mechanism against coastal erosion by calming waves before they reach the shore. Oysters shape their surroundings by assembling on hard, submerged surfaces and fusing to form reef structures. Their role in filtering and retaining nutrients in the water, providing spawning grounds and shelter for fish, and thus increasing biodiversity are well known. Oyster reefs serve as a home for other animals, improve water quality and promote seagrass growth.

3.3.8 Private sector

Private sector stakeholders emphasized developing effective business models for private sector engagement in key areas of the NAP, including agriculture and food systems, research and technological innovations for agriculture and renewable energy, agroforestry, agro-met forecasting and climate advisory services, irrigation and water management, resilient infrastructure, WASH and health risk management, big data-driven decision tools and green growth in urban areas etc. The BDP2100 (GED, 2018) illustrates the prospects for attracting private investment in water treatment, water supply and sewage treatment, irrigation, dredging, land reclamation and the establishment of river port infrastructure.

- Resilient irrigation and flood management by BWDB, the Department of Agricultural Extension (DAE), Local Government and Rural Development (LGRD), BARI and BRRI with the private sector; submergible dikes in the *haor* basin; stopping overuse of water; efficient use of freshwater as part of CCA and response
- Mechanization of agriculture supported by the Government (Ministry of Agriculture [MoA] and the DAE) where the private sector may invest more in the future
- Improving cold storage facilities to protect potatoes and tomatoes from emerging high temperatures (private sector-led where financial institutions can invest)
- The private sector will invest in ensuring the protection of SEZs or EEZs against climate

change-induced disasters to secure their businesses and investments

- Promoting climate-smart agriculture like conservation agriculture, alternate wetting and drying (AWD), agroforestry, irrigation and water management, smart cards for irrigation, floating bed cultivation, and manufacturing and marketing biodegradable green products like jute goods
- Water management and WASH: climate-resilient drinking water and sanitation in partnership with LGIs and NGOs in the coastal zone, and drought and flood-prone areas
- The Government, development partners and the private sector may promote desalinization plants
- Climate disaster management through building cyclone shelters, climate-resilient livestock or poultry sheds, cyclone-resilient SME shops or buildings, etc.
- Waste management and recycling, urban agriculture and farming and rooftop gardening in cities
- Promoting ICT services by developing effective and needs-based ICT tools to translate and transform early warning or agro-met forecast and climate information services among value chain actors, for health risk management, etc.
- Climate-proofing infrastructure
- Private sector-led or PPP in data driven service and apps for farmers
- Renewable energy-based product generation and distribution, such as through expanding solar-based irrigation systems
- Investing in climate-resilient urban drainage and solid and liquid waste management systems by the Government and private enterprises through PPP approach.

Private sector stakeholders called for introducing different innovative financial instruments and incentives to encourage their engagement in climate change adaptation, such as a tax rebate for the most vulnerable firms, such as CMSMEs. Increasing financial stability and the coverage of risk transfer mechanisms for the recovery or repayment of loans by disproportionately impacted and vulnerable CMSMEs or informal sector stakeholders are highly recommended as part of the NAP implementation. Mass awareness-raising and skills development for vulnerable groups are seen as urgent actions for effective private sector engagement. Giving greater attention to women-led and women-focused CMSMEs should emphasize awareness-raising on climate change impacts, enhancing capacity and technical knowledge, and increasing resources for taking adaptation measures and DRR for resilience-building.

3.3.9 Policies and institutions

The NAP implementation process will facilitate development of required policies, improved governance and a structured framework for catalyzing smooth implementation. It will help formulate and amend necessary policies, plans, strategies, guidelines or acts. These include Local Level Adaptation Program of Action, City Climate Action Plan, Youth-Led Adaptation Plan etc., an exclusive policy regime for adaptation, an update of the BCCSAP as sector action plan and its synergies with the NAP, and updates of different sectoral plans reflecting the NAP and issues of social inclusion related to gender, disability, age, etc.

High preference to stakeholder recommendations will be given on assigning roles and responsibilities for the NAP implementation, based on existing institutional arrangements with minimal reform. Other priorities entail developing a robust M&E mechanism; establishing a conducive policy regime for private sector engagement in adaptation; devising strategies for enhanced climate financing; and mainstreaming the NAP into the development planning process following 'whole-of-government and whole-of-society' approaches. Empowering local

government for locally led adaptation and social inclusion will also be given priority.

3.3.10 *Capacity development, research, and innovations*

System transitions for climate-resilient development in multiple sectors will be achieved through transformative capacity development under the NAP. Implementation of NAP will support field-level research and piloting in priority and cross-cutting sectors; collaborative studies and action-oriented research innovation using AI, ICT, geo-informatics and space technologies; climate change-related relevant knowledge generation and dissemination among wider audiences, stakeholders and communities; and transnational knowledge sharing. The cultivation of skills and capacities will emphasize reaching vulnerable communities including women, people with diverse gender identities, the elderly, persons with disabilities, youth and children, ethnic communities, urban slum dwellers, climate migrants and other socially disadvantaged groups.

This process will advance alternative livelihoods, climate risk reduction and recovery, awareness-raising and behavioral changes offering continued support for transformation. Inventing stress-tolerant (salinity, stagnant water, heat, cold, lodging, short-duration HYV) crop varieties (rice and non-rice) and pest- and disease-resistant varieties will be emphasized. Another priority entails developing an early warning and dissemination system for sudden and slow-onset events impacting agriculture, fisheries, livestock and urban areas. Research on population dynamics and the migratory routes of climate-sensitive fish species will take place along with the introduction of stress-tolerant fish varieties and high-yield genotypes. Measures related to shifting crop calendars and crop phenology and climate-smart livestock and poultry fodder and feed will be highly prioritized.

The NAP implementation will further emphasize ideas for research and development identified by stakeholders in the following areas: a climate simulation lab; regional climate downscaling and publishing a national climate outlook report; development of AI, crowdsourcing and big data-based climate monitoring tool; cultivation of oyster reefs to combat erosion; research and innovation related to ocean circulation, marine meteorology, chemical and physical oceanography, marine observations, managed aquifer recharge (MAR), sediment dynamics, and delta formation and progradation; precision agriculture using GIS and Remote Sensing; Unmanned Arial Vehicle (UAV) technology to face Fourth Industrial Revolution (4IR) challenges; climate-resilient houses, shelters, livestock sheds and WASH technologies; low-cost desalinization techniques, EbA, NbS and locally led adaptation; sustainable drainage systems, green infrastructure and low-impact development; climate-proofing of infrastructure and eco-engineering solutions, etc.

At the community level, hands-on training on alternative income generation activities (AIGA), such as sewing, handicrafts, mixed farming, fish or livestock feeding and rearing; CMSMEs; shopkeeping; e-commerce; mixed farming; small-scale climate-smart agriculture practices; floating or sack gardening; dry fish processing; mariculture

or nature-based crab fattening, etc. will be promoted. Enhanced allocation fund will be ensured to support capacity development, research and innovation.

Apart from these priority sectors, the NAP implementation process will also explore preferred adaptation choices or practices for WASH and health. Giving priority to stakeholders' demand, it will implement climate-resilient rural and urban WASH technologies, pedestrian sheds, lightning arresters, climate-resilient health-care facilities and boat ambulances. It will encourage extensive research on the climate sensitivity of health as well as vector or water-borne diseases, etc.

3.4 Adaptation Strategy

The NAP has 23 adaptation strategies, with 113 interventions under 8 sectors to reinforce implementation, all towards achieving its vision and 6 goals. The strategies aim to address adaptation needs for short- (2030s), medium- (2041) and long-term (2050s) planning horizons. They are based on eight guiding principles; the cross-cutting, multidisciplinary, complementary nature of the priority sectors; country ownership; participatory potential; social inclusion including in terms of gender, the elderly, youth and persons with disabilities; locally led adaptation in line with community preferences as described in Section 3.3; alignment with the national and international sustainable development agenda; synergy with the BDP2100; private sector engagement potential; horizontal and vertical coordination; the latest scientific and indigenous knowledge; and M&E for improved governance and transparency. Table 3.2 shows the proposed strategies and their corresponding 28 outcomes.

Table 3.3 includes the proposed 113 adaptation interventions for different sectors, their implementation suitability in climate stress areas and direct or indirect links with adaptation strategies.

The 113 interventions cover different climate stress areas (described in Section 2.4.1) and in some cases the whole country. These interventions were devised based on the adaptation entry points identified in Section 3.2 and the priority adaptation preferences described in Section 3.3 expressed by stakeholders from multiple sectors and levels, including the public and private sectors, local governments, local representatives and vulnerable communities, women, the elderly, persons with disabilities, youth, ethnic communities and other socially disadvantaged people. The interventions heavily emphasize locally led adaptation, ecosystem-based adaptation, nature-based solutions, green growth and private sector engagement.

The interventions have been designed to achieve anticipated outcomes by focusing on priority sectors and institutional aspects. These include structural/physical, institutional and social types of adaptation; interventions promoting nature-based solutions; climate-resilient water resources management; climate-smart agriculture, fisheries and aquaculture, and livestock; climate-resilient and smart cities; climate-resilient WASH and health-care facilities for urban communities; ecosystem, forestry, wetlands and biodiversity conservation; required policy and institutional reforms; multisectoral and multilevel mainstreaming; private sector engagement; enhanced financing for smooth implementation of the NAP; innovative research; transformative capacity development and knowledge management.

In Table 3.3, each intervention is marked with a generic identification code reflecting the sectoral theme, such as WRM1, WRM2, CSA1, CSA2, etc. In the right column, the abbreviations indicate different climate stress areas as the implementation domain of each specific intervention. One intervention can be implemented under single or multiple climate stress areas based on its effectiveness and similarities with prominent climate stresses over a given region. Adaptation measures may be different under the same interventions but not for different stress areas.

Appendix II presents more country-driven adaptation actions under each of the proposed interventions, considering the diversity of climate stresses in different regions of Bangladesh.

Table: 3.2: Strategies of the National Adaptation Plan

Strategic focus	Goal	Adaptation strategy	Outcome
Sectoral	**Goal 1:** Ensure protection against climate change variability and induced natural disasters	**S 1.1:** Combat cyclonic storm surges, sea-level rise and salinity intrusion **S 1.2:** Manage floods, erosion and drought risks **S 1.3:** Protect life, livelihoods, infrastructures and ecosystems against slow-onset and other climate extremities	**Outcome 1:** Increased adaptive capacity of human, natural and economic systems to reduce risks and vulnerabilities and ensure protection against climate change-induced disasters in coastal areas **Outcome 2:** Increased adaptive capacity of human, natural and economic systems to reduce risks and vulnerabilities and ensure protection against climate change-induced disasters in the floodplain or drought areas **Outcome 3:** Enhanced adaptive capacity and protection of life, livelihoods and ecosystems against slow-onset and other extreme events of climate change
	Goal 2: Develop climate-resilient agriculture for food, nutrition and livelihood security	**S 2.1:** Promote extension of climate-smart agriculture **S 2.2:** Develop climate-resilient fisheries, aquaculture and livestock **S 2.3:** Manage sustainable agro-inputs and transformative value chains **S 2.4:** Strengthen extension services for agriculture, fisheries and livestock	**Outcome 1:** Increased agricultural productivity and resilience, and reduced emissions from the adoption of climate-smart agriculture (CSA) practices **Outcome 2:** Enhanced climate resilience in aquaculture, fisheries and livestock **Outcome 3:** Abundance of quality inputs for agriculture, fisheries and livestock, and transformed value chains **Outcome 4:** Improved extension services related to agriculture, fisheries and livestock
	Goal 3: Develop climate-smart cities for an improved urban environment and well-[illegible]	**S 3.1:** Promote green and blue infrastructure for urban environmental management and conservation **S 3.2:** Develop climate-smart cities to increase urban resilience **S 3.3:** Develop climate-resilient health care and WASH facilities for improved human well-being and livability in cities	**Outcome 1:** Improved urban environment and resilient urban infrastructure **Outcome 2:** Enhanced urban resilience and improved standard of living **Outcome 3:** Improved human health, livability and well-being
	Goal 4: Promote nature-based solutions for the conservation of forestry, biodiversity and the well-being of communities	**S 4.1:** Scale up ecosystem-based adaptation for wetlands conservation **S 4.2:** Restore and conserve habitat, ecosystems and biodiversity **S 4.3:** Expand community-based afforestation and/or reforestation	**Outcome 1:** Increased use of nature-based solutions and conservation of biodiversity ensured **Outcome 2:** Increased practice of ecosystem-based adaptation (EbA) for reducing climate change risks **Outcome 3:** Critical and fragile ecosystems restored and conserved **Outcome 4:** Expansion of forest coverage, mangroves and biodiversity **Outcome 5:** Community and youth-led conservation of nature for improved well being

Strategic focus	Goal	Adaptation strategy	Outcome
Institution	**Goal 5**: Impart good governance through the integration of adaptation into the planning process	**S 5.1:** Reform policies for mainstreaming adaptation **S 5.2:** Develop a framework for adaptation monitoring, evaluation and learning **S 5.3:** Engage the private sector in adaptation implementation **S 5.4:** Empower local government institutes, community-based organizations, women, people with disabilities and youth for locally led adaptation **S 5.5:** Enhance climate financing for adaptation	**Outcome 1:** New or updated policies, plans, regulations and institutions developed or reformed to support mainstreaming of the NAP into government risk-informed planning and implementation processes **Outcome 2:** Effective and robust M&E for CCA developed to support the national monitoring, reporting and verification (MRV) system **Outcome 3:** Private sector-led CCA initiatives implemented **Outcome 4:** Decentralized environmental and climate change management ensured **Outcome 5:** Locally led, gender-, disability- and youth-inclusive adaptation initiatives increased **Outcome 6:** Adaptation investment gap declines
	Goal 6: Ensure transformative capacity-building and innovation for climate change adaptation	**S 6.1:** Develop transformative capacities and management of knowledge **S 6.2:** Introduce innovation in reducing climate change and disaster risks and consequent losses and damages **S 6.3:** Research and innovation for agriculture, fisheries and livestock **S 6.4:** Advanced research on climate change impacts on ecosystems and application of ecosystem-based adaptation **S 6.5:** Action research for innovation in climate-resilient infrastructure, improved health and WASH technologies	**Outcome 1:** A paradigm shift in capacity development and behavioral change happens and persists over time **Outcome 2:** Sustainable CCA knowledge management ensured **Outcome 3:** Capacity development at the individual, institutional and process levels **Outcome 4:** Development of innovative technologies and adaptation practices to support risk-informed planning and damage mitigation **Outcome 5:** Development of tools and methodologies, and increased capacities of actors to improve research and extension services related to agriculture, fisheries and livestock **Outcome 6:** Knowledge generated on ecosystem sensitivity to climate change and its impacts **Outcome 7:** Scientific knowledge and guidelines for climate-resilient health, adaptive rural and urban WASH infrastructure, and urban development

Table 3.3: Proposed adaptation interventions for different climate stress areas in Bangladesh

Code	Interventions for NAP sectors	Domain[7]	NAP strategy
Sector:	**Water resources**		
WRM1	Integrated management of coastal polders, sea dikes and cyclone shelters against tropical cyclone, sea-level rise and storm surges	SWM | SEE | CHI	S1.1, S1.3, S4.1, S4.2, S4.3, S2.1, S2.2, S2.3, S2.4
WRM2	Management of freshwater resources and monitoring of salinity for reducing vulnerabilities in existing and potential salinity-prone areas	SWM | SEE | CHI	S1.1, S1.3, S4.1, S4.2, S2.1, S2.2, S2.3, S2.4
WRM3	Protection and management of potentially vulnerable areas due to sea-level rise, tropical cyclone, extreme storm surges and flooding	SWM | SEE | CHI	S1.1, S1.2, S1.3, S4.1, S4.3, S2.1, S2.2, S2.3, S2.4
WRM4	Strengthen early warning and dissemination services for climate change-induced slow-onset and sudden extreme water hazards using ICT and AI	Nationwide	S1.1, S1.2, S1.3, S2.1, S2.2, S2.3, S2.4
WRM5	Community-based rainwater harvesting through indigenous techniques and conservation of wetlands, reservoirs and natural springs for drinking water supplies in hard-to-reach and water-stressed areas	SWM | SEE |CHT | DBA CBL| NNW| CHI | URB	S1.1, S1.3, S4.1, S4.2, S2.1, S2.2, S2.3, S2.4
WRM6	Dredging of all major and medium rivers for accommodating the smooth drainage of excess floods during climate-induced extreme events	FPE | HFF	S1.2, S1.3, S4.1, S4.2, S2.1, S2.2, S2.3, S2.4
WRM7	Construction and rehabilitation of flood and drainage management measures with eco-engineering solutions	FPE | HFF	S1.2, S1.3, , S4.1, S4.2, S4.3, S2.1, S2.2, S2.3, S2.4
WRM8	Drainage management of economic/industrial zones and critical infrastructure, and reinforced climate resilience through risk assessment	SWM | SEE | FPE | HFF |URB	S1.1, S1.2, S1.3, S4.1, S2.1, S2.2, S2.3, S2.4
WRM9	Internal drainage management and climate-resilient development of the *char* and islands areas	CHI	S1.1, S1.2, S1.3, S4.1, S2.1, S2.2, S2.3, S2.4
WRM10	Protection against flash floods, wave action, erosion and sedimentation	FPE | HFF | CHI	S1.2, S1.3, S4.2, S4.3, S2.1, S2.2, S2.3, S2.4
WRM11	Erosion risk management through erosion prediction, improved early warning and its dissemination	FPE | HFF	S1.2, S1.3, S4.1, S2.1, S2.2, S2.3, S2.4

[7] ***SWM:*** *south-western coastal area and Sundarbans,* ***SEE:*** *south-east and eastern coastal area,* ***CHT:*** *Chattogram Hill Tracts,* ***FPE:*** *river, floodplain and erosion-prone area,* ***HFF:*** *haor and flash floods area,* ***DBA:*** *drought-prone barind area,* ***CBL:*** *chalan beel and low-lying area of the north-western region,* ***NNW:*** *northern and north-western region,* ***CHI:*** *char and islands area,* ***BoB:*** *Bay of Bengal and* ***URB:*** *urban areas*

Code	Interventions for NAP sectors	Domain[7]	NAP strategy
WRM12	Sustainable shoreline erosion management based on eco- or bioengineering measures	SWM | SEE |CHT | HFF | NNW	S1.2, S1.3, S4.1, S4.2, S2.1, S2.2, S2.3, S2.4
WRM13	Reclamation and development of lands for the expansion of afforestation, agriculture, shrimp cultivation and settlements	SEE |CHI	S1.3, , S4.1, S4.2, S4.3, S2.1, S2.2, S2.3, S2.4
WRM14	River management through bank stabilization and other ancillary works	FPE | HFF	S1.2, S1.3, S4.2, S2.1, S2.2, S2.3, S2.4
WRM15	Ecosystem-based sediment management along coasts and in estuaries	SWM | SEE | CHI	S1.2, S1.3, S4.1, S4.2, S2.1, S2.2, S2.3, S2.4
WRM16	Drought management measures for enhanced groundwater recharge and increased soil moisture in water-stressed areas	DBA|NNW|CBL|CHT|SWM	S1.2, S1.3, S4.1, S4.2, S2.1, S2.2, S2.3, S2.4
WRM17	Development of a national drought monitoring system	Nationwide	S1.2, S1.3, S4.1, S4.2, S2.1, S2.2, S2.3, S2.4
WRM18	Planned, participatory and coordinated land and water resources management	SWM | SEE |CHT | FPE | HFF | DBA CBL| NNW| CHI |URB	S1.1, S1.2, S1.3, S4.1, S4.2, S4.3, S2.1, S2.2, S2.3, S2.4
WRM19	Transboundary river basin management and basin-level cooperation	Nationwide	S1.1, S1.2, S1.3, S4.1, S4.2, S4.3, S2.1, S2.2, S2.3, S2.4
WRM20	Development of a basin wide and participatory watershed management framework to restore, harvest and optimize the use of water resources	SWM | CHT | FPE | HFF | DBA CBL| NNW	S1.1, S1.2, S1.3, S4.1, S4.2, S4.3, S2.1, S2.2, S2.3, S2.4
WRM21	Remodelling of water-regulating and cross-drainage structures considering climate change scenarios	Nationwide	S1.1, S1.2, S1.3, S4.1, S4.2, S2.1, S2.2, S2.3, S2.4
Sector:	**Disaster, social safety and security**		
CDM1	Construction and rehabilitation of gender-, age- and disability-sensitive, multipurpose, climate-resilient and accessible cyclone and flood shelters with safe drinking water, sanitation and livestock shelter facilities	SWM|SEE|CHI| FPE|HFF	S1.1, S1.2, S1.3, S2.1, S2.2
CDM2	Landslide early warning system and risk management measures based on eco- or bioengineering measures	CHT|HFF|NNW	S1.3, S4.2, S4.3
CDM3	Implementation of thunderstorm and lightning risk management measures in highly susceptible areas	Nationwide	S1.3, S2.4, S2.1, S2.2
CDM4	Protection and enhanced resilience of climate migrants with a particular focus on gender and disability	Nationwide	S1.1, S1.2, S1.3, S2.1, S2.2
CDM5	Gender-, age- and disability-responsive, youth-led disaster preparedness and emergency rescue and evacuation services	SWM | SEE |CHT | FPE | HFF | CBL| NNW| CHI | URB	S1.1, S1.2, S1.3
CDM6	Increase the resilience of vulnerable poor communities by introducing gender-, age- and disability-responsive	Nationwide	S1.1, S1.2, S1.3, S2.1, S2.2, S2.3

Code	Interventions for NAP sectors	Domain[7]	NAP strategy
	diversified livelihoods, effective insurance mechanisms and climate resilience funds		
CDM7	Behavioral change and development of awareness among vulnerable communities for emergency responses and livelihood protection due to climate-induced disasters	Nationwide	S1.1, S1.2, S1.3, S2.1, S2.2, S2.3
CDM8	Increase the coverage of social security/social safety net programmes for building community-based resilience and adaptive capacity	Nationwide	S1.1, S1.2, S1.3, S2.1, S2.2
CDM9	Halt child abuse, early marriage and domestic violence triggered by climate-induced disasters	Nationwide	S1.1, S1.2, S1.3
CDM10	Accelerated livelihood improvements for women, people with disabilities and young entrepreneurs through vocational training on adaptation practices and ICT	Nationwide	S1.1, S1.2, S1.3, S2.1, S2.2, S2.3
CDM11	Introduction of risk transfer and insurance mechanisms for protection of critical and disaster protection infrastructure, vulnerable MSMEs and farmers	Nationwide	S1.1, S1.2, S1.3, S2.1, S2.2, S2.3
CDM12	Building climate-resilient houses, education & communication infrastructure in areas with high climate risk	Nationwide	S1.1, S1.2, S1.3, S2.1, S2.2, S2.3
Sector:	**Agriculture**		
CSA1	Extension of climate-smart technologies for increasing irrigation water use efficiency	SWM | SEE | CHT | FPE | HFF|DBA |CBL | NNW | CHI | URB	S2.1, S2.2, S2.4, S1.2, S1.3, S4.1, S4.2
CSA2	Augmentation of surface water for irrigation and multipurpose use	SWM | SEE | CHT | FPE | HFF | DBA| CBL | NNW | CHI	S2.1, S2.2, S2.4, S1.1, S1.2, S1.3, S4.1, S4.2
CSA3	Extension of stress-tolerant, pest and disease-resistant rice and non-rice crops	SWM | SEE | CHT | FPE | HFF | DBA| CBL | NNW | CHI | URB	S2.1, S2.4, S1.3, S4.1, S4.2
CSA4	Introduction and scaling up of innovative and indigenous agriculture	Nationwide	S2.1, S2.4, S1.3, S4.1, S4.2
CSA5	Crop diversification/intensification for natural resources optimization and reduction of climate stress	SWM | SEE | CHT | FPE | HFF | DBA| CBL | NNW | CHI	S2.1, S2.4, S1.3, S4.1, S4.2
CSA6	Farm modernization/mechanization to reduce climate vulnerability	SWM | SEE | CHT | FPE | HFF | DBA| DBL | NNW | CHI	S2.1, S2.3, S2.4, S1.3
CSA7	Increased fertilizer use efficiency for enhancing production	SWM | SEE | CHT | FPE | HFF | DBA| CBL | NNW | CHI	S2.1, S1.3, S4.1, S4.2
CSA8	Extension of good agricultural practices, modern agricultural technology and sloping agricultural land technology (SALT)	SWM | SEE | CHT | FPE | HFF | DBA| CBL | NNW | CHI	S2.1, S2.4, S1.3, S4.1, S4.2, S4.3
CSA9	Strengthening and development of impact-based early warning systems and data management for agriculture	Nationwide	S2.1, S2.2, S2.3, S1.3

Code	Interventions for NAP sectors	Domain[7]	NAP strategy
CSA10	Improvement of storage or post-harvest facilities, transport, communications and e-commerce-based market facilities for agricultural products	Nationwide	S2.3, S1.3
CSA11	Development of agrofood processing industries based on climate-sensitive crop zoning	Nationwide	S2.3, S1.3
CSA12	Development of e-commerce and engagement of women, people with disabilities and youth in e-commerce-based entrepreneurship	Nationwide	S2.1, S2.3, S1.3, S4.2
Sector	**Fisheries, aquaculture and livestock**		
CFL1	Extension of climate-resilient technology for combating climate-related stresses in aquaculture	SWM | SEE | CHT | FPE | HFF | DBA| CBL | NNW | CHI | URB	S2.2, S2.4, S1.3
CFL2	Development of climate-ready open water fisheries management	SWM | SEE | HFF | DBA CBL | NNW | CHI | BoB | URB	S2.2, S2.4, S1.3, S4.1, S4.2
CFL3	Development and management of coastal and marine fisheries to foster blue economy	SWM | SEE | BoB	S2.2, S2.4, S1.3, S4.1, S4.2
CFL4	Validation and extension of indigenous knowledge-based adaptation techniques to combat climatic effects on fisheries	SWM | SEE | CHT | HFF | DBA CBL | NNW	S2.2, S2.4, S1.3, S4.1, S4.2
CFL5	Monitoring, evaluation and enforcement to ensure the conservation of fish biodiversity and habitat	SWM | SEE | CHT| DBA CBL | NNW | CHI | BoB | URB	S2.2, S2.4, S1.3, S4.1, S4.2
CFL6	Development of shrimp culture planning and zoning	SWM | SEE | BoB	S2.2, S2.4, S1.3, S4.1, S4.2
CFL7	Improvement of post-harvest facilities and e-commerce-based market facilities for fisheries and aquaculture	Nationwide	S2.2, S2.3, S1.3
CFL8	Development of fish industries based on climate-sensitive crop zones	Nationwide	S2.2, S2.3, S1.3
CFL9	Extension of climate-stress-tolerant livestock and poultry breeds, farms, feed and fodder	Nationwide	S2.2, S2.4, S1.3, S4.2
CFL10	Development of a national livestock and poultry database and information	Nationwide	S2.2, S2.4, S1.3
CFL11	Extension of indigenous and advanced livestock and poultry farming practices	Nationwide	S2.2, S2.4, S1.3, S4.1, S4.2
CFL12	Climate-resilient infrastructure development for the safety of livestock and poultry during disasters	Nationwide	S2.2, S2.3, S1.3
CFL13	Development of livestock product processing industries and transportation systems	Nationwide	S2.2, S2.3, S1.3
Sector:	**Ecosystems, wetlands and biodiversity**		
EWB1	Extension and expansion of the coastal greenbelt for protecting coastal habitats, including the Sundarbans, mangroves, salt marshes, etc.	SWM | SEE | CHI	S4.1, S4.2, S4.3, S1.1, S1.3

Code	Interventions for NAP sectors	Domain[7]	NAP strategy
EWB2	Community-based afforestation and reforestation for biodiversity conservation, enhancement of ecosystem resilience and increased carbon sequestration	Nationwide	S4.1, S4.2, S4.3, S1.1, S1.3
EWB3	Expand ecosystem-based adaptation for the restoration of mangroves, hill areas and wetlands to tackle the adverse impacts of climate change	Nationwide	S4.1, S4.2, S4.3, S1.2, S1.3
EWB4	Strengthen ecosystem and biodiversity monitoring and law enforcement systems	Nationwide	S4.1, S4.2, S4.3, S1.3
EWB5	Maintenance of the environmental flows of aquatic ecosystems, rivers and wetlands	Nationwide	S4.1, S4.2, S4.3, S1.2, S1.3
EWB6	Restore eco-hydraulics for wetlands, rivers and canal systems, including through the establishment of connectivity and protection of wetlands	Nationwide	S4.1, S4.2, S4.3, S1.1, S1.2, S1.3
EWB7	Development of multifunctional hill and forest management and conservation system	SEE | CHT | HFF | NNW	S4.1, S4.2, S4.3, S1.3
EWB8	Management of marine protected areas and development of a monitoring system to protect the rights of fishing communities	BoB	S4.1, S4.2, S4.3, S1.3
EWB9	Adopt other effective area-based conservation measures to fulfil the biodiversity framework target	SWM | CHT | HFF | CHI | URB	S4.1, S4.2, S4.3, S1.1, S1.3
EWB10	Combat desertification through planting regenerative indigenous species	CHT | HFF | DBA	S4.1, S4.2, S4.3, S1.2, S1.3
EWB11	Conservation of agroecosystems through expanded agroforestry, good agricultural practices and regenerative agriculture	SWM | SEE | CHT | FPE | HFF CBL | NNW | CHI	S4.1, S4.2, S4.3, S1.3, S2.1
EWB12	Development of a participatory wetlands management framework for the sustainable management of wetlands	SWM | SEE | CHT | HFF | CBL | URB	S4.1, S4.2, S4.3, S1.1, S1.2, S1.3, S2.2, S3.1
EWB13	Conservation of village common forests (VCFs) through community-based spring, watershed and agricultural landscape management, and soil conservation in the Chattogram Hill Tracts	CHT	S4.1, S4.2, S4.3, S1.2, S1.3
EWB14	Halda River ecosystem restoration and conservation	SEE | CHT	S4.1, S4.2, S4.3, S1.1, S1.3, S2.2
EWB15	Watershed management of Kaptai Lake for ecosystem resilience and water retention	CHT | SEE	S4.1, S4.2, S4.3, S1.1, S1.2, S1.3, S2.2
EWB16	Monitoring of sea surface temperature and other physical and biological parameters and the marine species composition in the Bay of Bengal	BoB	S4.1, S4.2, S4.3, , S1.1, S1.3, S2.2
EWB17	Develop and update ocean ecosystem management policies, guidelines and institutional capacities for management of the blue economy	BoB	S4.1, S4.2, S4.3, , S1.1, S1.3, S2.2
EWB18	Development of species or gene inventories and recovery plans for endangered species due to climate change	Nationwide	S4.1, S4.2, S4.3, S1.3

Code	Interventions for NAP sectors	Domain[7]	NAP strategy
EWB19	Restoration of the coral reef ecosystem and associated fish and benthic communities in the St. Martin Islands	CHI | BoB	S4.1, S4.2, S4.3, , S1.3
EWB20	Revitalization of natural springs and sustainable management of waterbodies for reducing water scarcity, and the restoration and conservation of ecosystems and biodiversity	CHT |DBA	S4.1, S4.2, S4.3, , S1.1, S1.2, S1.3
EWB21	Development of a national management system for wetlands, biodiversity, oceans and coastal information for supporting monitoring and surveillance	Nationwide	S4.1, S4.2, S4.3, , S1.3, S2.2
Sector:	**Urban areas**		
CRC1	Improvement of natural and artificial stormwater drainage networks for reducing vulnerabilities to urban flooding and drainage congestion	URB	S3.1, S3.2, S1.2, S1.3, S4.1, S4.2
CRC2	Expansion and conservation of green and blue infrastructure for improvement of urban environments and drainage systems	URB	S3.1, S3.2, S1.2, S1.3, S4.1, S4.2, S4.3
CRC3	Stormwater management in cities through attenuating peak flow and allowing infiltration in line with the concept of low-impact development	URB	S3.1, S3.2, S1.2, S1.3, S4.1, S4.2, S4.3
CRC4	Development of city climate action plans for major urban and peri-urban areas emphasizing the resilience of urban-poor communities and climate migrants	URB	S3.1, S3.2, S3.3, S1.2, S1.3, S4.2
CRC5	Expand innovative climate-resilient, gender-, age- and disability-sensitive WASH technologies and facilities for urban communities	URB	S3.2, S3.3, S1.2, S1.3
CRC6	Increase access to water supply, sanitation and hygiene services in cities for reducing exposure to flooding and waterborne diseases during or after extreme weather events	URB	S3.2, S3.3, S1.2, S1.3
CRC7	Adopt integrated water management for urban and peri-urban areas	URB	S3.1, S3.2, S1.2, S1.3, S4.1, S4.2, S4.3
CRC8	Carry out initiatives to improve the well-being of children and youth and reduce the effects of climate stress	URB	S3.1, S3.2, S3.3, S1.2, S1.3, S4.1, S4.2, S4.3
CRC9	Improvement of surveillance, early warning systems and monitoring of psychosocial impacts and mental health risks from extreme weather events	URB	S3.2, S3.3, S1.2, S1.3, S4.1, S4.2, S4.3
CRC10	Extension of resilient and eco-friendly materials and engagement of the private sector through incentives and tax rebates for climate-resilient infrastructure development in urban areas	URB	S3.1, S3.2, S3.3, S1.2, S1.3, S4.1, S4.2, S4.3
CRC11	Establishment of climate-resilient health-care facilities in urban areas	URB	S3.2, S3.3, S1.2, S1.3, S4.2
CRC12	Development of heatwave and disease outbreak advisory services for city dwellers	URB	S3.2, S3.3, S1.2, S1.3

Code	Interventions for NAP sectors	Domain[7]	NAP strategy
Sector:	**Policies and institutions**		
PIN1	Preparation of a roadmap for implementing the NAP	Nationwide	S5.1, S5.2, S5.3, S5.4, S5.5
PIN2	Development of a regulatory and institutional framework for advancing the NAP	Nationwide	S5.1, S5.2, S5.3, S5.4
PIN3	Update and reform policies and plans for mainstreaming CCA	Nationwide	S5.1, S5.2, S5.3, S5.4, S5.5
PIN4	Operationalize the NAP monitoring, evaluation and learning framework based on a theory of change.	Nationwide	S5.1, S5.3
PIN5	Reform local government institutes towards the inclusion of community-based organizations, women, people with disabilities and youth in the implementation of locally led adaptation	Nationwide	S5.1, S5.4
PIN6	Innovative, appropriate and enhanced financial instruments for supporting CCA	Nationwide	S5.1, S5.3, S5.5
PIN7	Private sector finance in leading CCA implementation	Nationwide	S5.3, S5.5
Sector:	**Capacity development, research and innovation**		
CDR1	Transformative capacity development and knowledge management for integrating CCA into planning processes and climate financing	Nationwide	S6.1, S6.2, S6.3, S6.4, S6.5
CDR2	Awareness-raising, training on skills for enhanced adaptive capacities and improved diversified livelihoods at the community level	Nationwide	S6.1, S6.2, S6.3, S6.4, S6.5
CDR3	Coordinated research, field-level demonstrations, knowledge management and communication of adaptation at the local level	Nationwide	S6.1, S6.2, S6.3, S6.4, S6.5
CDR4	Capacity development for the implementation of nature-based solutions and locally led adaptation	Nationwide	S6.1, S6.2, S6.3, S6.4, S6.5
CDR5	Generation of national, regional and local-level evidence and scenario-based climate information through climate downscaling and publication of a national climate outlook, risk and vulnerability atlas	Nationwide	S6.1, S6.2, S6.3, S6.4, S6.5
CDR6	Research on the impact of climate change on land and water resources	Nationwide	S6.1, S6.2, S6.4, S6.5
CDR7	Action research and field demonstrations on climate-smart agriculture	Nationwide	S6.1, S6.2, S6.3, S6.4, S6.5
CDR8	Research and innovation related to climate-resilient fisheries and aquaculture	Nationwide	S6.1, S6.2, S6.3, S6.4, S6.5
CDR9	Research and innovation related to climate-smart livestock and poultry	Nationwide	S6.1, S6.2, S6.3, S6.4, S6.5
CDR10	Action research for locally led and indigenous climate change adaptation	Nationwide	S6.1, S6.2, S6.3, S6.4, S6.5
CDR11	Action research for developing and exploring the potential use of EbA and NbS	Nationwide	S6.1, S6.2, S6.3, S6.4, S6.5

Code	Interventions for NAP sectors	Domain[7]	NAP strategy
CDR12	Research on climate change impacts on land, water and ocean ecosystems	Nationwide	S6.1, S6.2, S6.3, S6.4, S6.5
CDR13	Research and popularize climate-stress-tolerant plant species	Nationwide	S6.1, S6.2, S6.3, S6.4, S6.5
CDR14	Research on and piloting of climate-resilient infrastructure, improved health measures and WASH technologies	Nationwide	S6.1, S6.2, S6.4, S6.5
CDR15	Action research for low-impact development techniques, green infrastructure and integrated drainage management for smart city development	Nationwide	S6.1, S6.2, S6.4, S6.5

3.5 Adaptation Pathways

Adaptation pathways are developed to promote adaptive management in tackling a wide range of climate change uncertainties and achieving climate-resilient development. Such pathways allow the implementation of multiple combinations of measures in a system, the observation of lessons, and adjustments to the adaptation trajectory at certain threshold points to accommodate learning and the unfolding uncertainties of climate change. The 'no regret' or 'less regret' pathways with robust and flexible adaptation efforts will build the resilience of the country.

The proposed strategic interventions will be implemented with multiple combinations of adaptation measures based on the preferences of local communities and locally led and indigenous approaches to reducing climate risks and vulnerabilities, enabling sustainable development, equity and justice, and sustaining ecosystem health and human health and well-being.

The efficacy of implemented adaptation measures will depend on their robustness and 'adaptation tipping points'[8] or limits,[9] split into the 'soft' and 'hard' limits of adaptation based on the IPCC AR6 (IPCC, 2022). The NAP develops sector-specific adaptation pathways for illustrative purposes, providing strategic and indicative implementation guidelines for stakeholders. The adaptation pathways were developed considering adaptation tipping points and the effectiveness of adaptation measures in fulfilling targeted climate risk reduction objectives by a certain time.

In the pathways, implementation of adaptation actions is anticipated to stop beyond tipping points, when actions would no longer be capable of achieving the target objectives and would become

[8] ***An adaptation tipping point*** *is reached when the magnitude of external change is such that a policy no longer can meet its objectives, and new actions are needed to achieve the objectives (Haasnoot, et al. 2013).*

[9] ***Adaptation limits:*** *The point at which an actor's objectives (or system needs) cannot be secured from intolerable risks through adaptive actions (IPCC, 2022).*

Hard adaptation limit*—No adaptive actions are possible to avoid intolerable risks.*

Soft adaptation limit*—Options may exist but are currently not available to avoid intolerable risks through adaptive action. But such limits can be overcome by addressing a range of constraints such as financial, governance, institutional and policy constraints.*

a maladaptation. Shifting to a new adaptation action would be required. Single or multiple adaptation actions can be undertaken at that point to improve the efficacy of the previous measure as a combined effort. Sometimes, hard limits are reached at that tipping point so even supplementary actions would not improve the situation. Other measures, in contrast, may continue until the end of the planning horizon, given their robustness and flexible nature.

The tipping points of adaptation measures are understood and anticipated for the 2030s and 2050s under the shared socioeconomic pathways scenarios elaborated in Chapter 2. They correlate with future projections of climate signals (temperature, rainfall, sea-level rise, cyclone frequency, SST rise) and extreme thresholds of hazards (modelling of storm surge heights/flood inundation progression, the extent of salinity intrusion, drought severity, lightning frequency, erosion rates, the frequency of extreme heat, etc.). The correlation of future projected thresholds and the need to achieve the vision of the NAP, the robustness of adaptation measures and the potential for adaptation to contribute to socioeconomic development and help Bangladesh become a climate-resilient, prosperous and developed country by 2041 are also considered.

The developed adaptive pathways considered trajectories of temperature rise in Bangladesh for SSP1-2.6 and SSP5-8.5, which are almost similar until 2030 based on the downscaled IPCC AR6 projections. Considering both SSPs, the annual average temperature may increase by 0.7°C in the 2030s from the climate normal of 1981-2010. After the 2030s, the range of uncertainties of the two shared socioeconomic pathways starts to widen, and the average annual temperature may increase by 2°C in the 2050s under extreme scenarios, i.e., SSP5-8.5. The developed pathways are thus based on appraised adaptation measures for different NAP sectors and conservative perceptions that Bangladesh will follow the extreme temperature rise trajectory after 2030. Projected thresholds of other climate signals and hazards are also considered, following the same trajectories and considerations.

For instance, the technical feasibility of raising polder height or rehabilitation has been considered up to 10 m. Beyond that, polder raising may not be possible with the conventional method as chances of failure due to structural instability would increase and a crisis in terms of the available land required for the foundation and maintaining the design slope could be severe. That means raising the polder as an adaptation measure will be possible up to 10 m as its tipping point. Other measures such as sea wall construction over the polder, planned relocation of settlements, pumping of excess water, etc., may need to be explored. Coastal modeling (CEGIS, 2021) estimates that a Sidr-equivalent cyclone, in addition to a 0.2 m sea-level rise by the 2050s, could generate a maximum storm surge height of about 7.5 m PWD along the southern coastal belts of Bangladesh under the extreme climate change scenario.

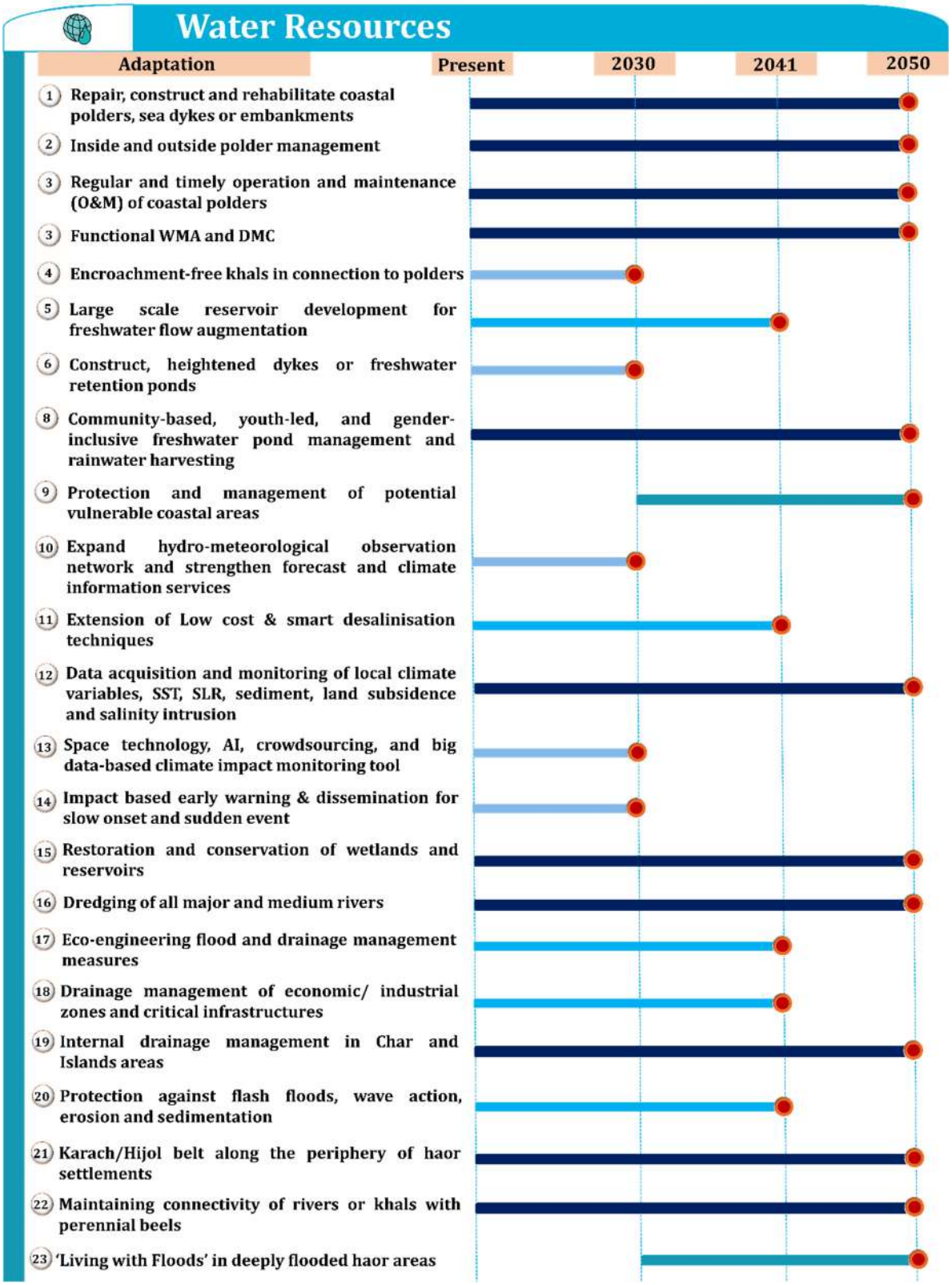
Polder-related interventions could continue until the 2050s as the projected threshold or storm surge height is within the limits of tipping points of the adaptation measures, even considering +2 m freeboard in design of polder height. All polders may not face a similar situation, however. Therefore, pumping during excess floods, sea wall construction over sea dikes or polders, and planned relocation of settlements are anticipated to start earlier than the 2050s. Similarly, some planning or non-structural measures would stop by the 2030s as undertaking those measures would not bring any desired benefits beyond that time, considering the development thrust and national targets of the country. Other non-structural measures will continue until the 2050s given their robustness and flexibility.

Following global trends, most adaptation measures in Bangladesh are in or passing the 'soft limits' of adaptation, especially for poor and marginal communities in coastal areas. Developed adaptive pathways showed anticipated limits of adaptation by short-, medium- and long-term

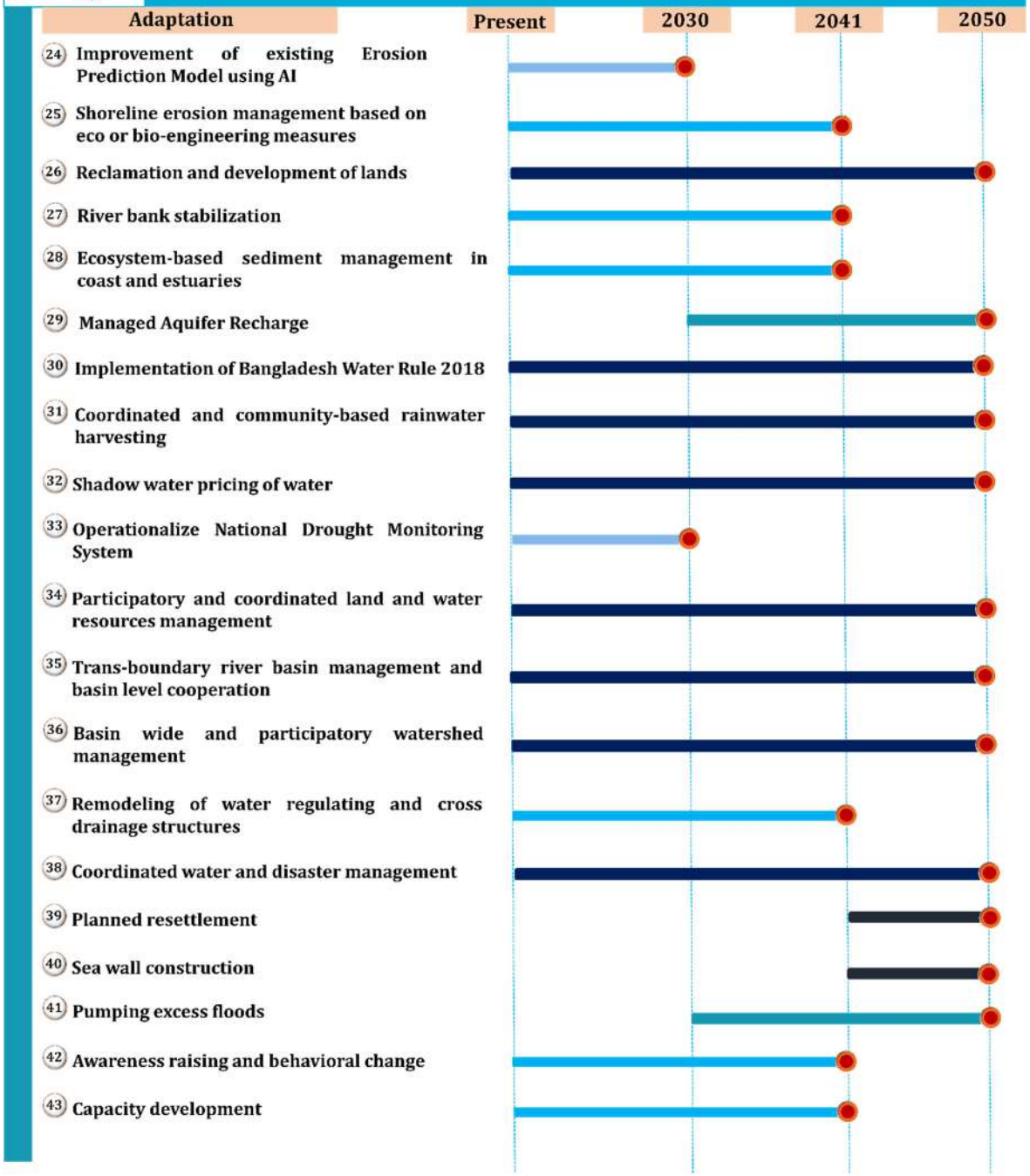
timelines corresponding to the 2030s, 2041, and 2050s. The pathways beyond the 2050s are not considered, anticipating the significant uncertainties and biases of future projections. Many adaptation measures would reach 'hard limits' by 2041, the 2050s and beyond, however, as depicted in the IPCC AR6 (IPCC, 2022). A choice of feasible, appropriate and nature-based adaptation options for the medium and long term are thus highly recommended to avoid maladaptation and mitigate hard limits, and to extend the robustness and flexibility of the measures.

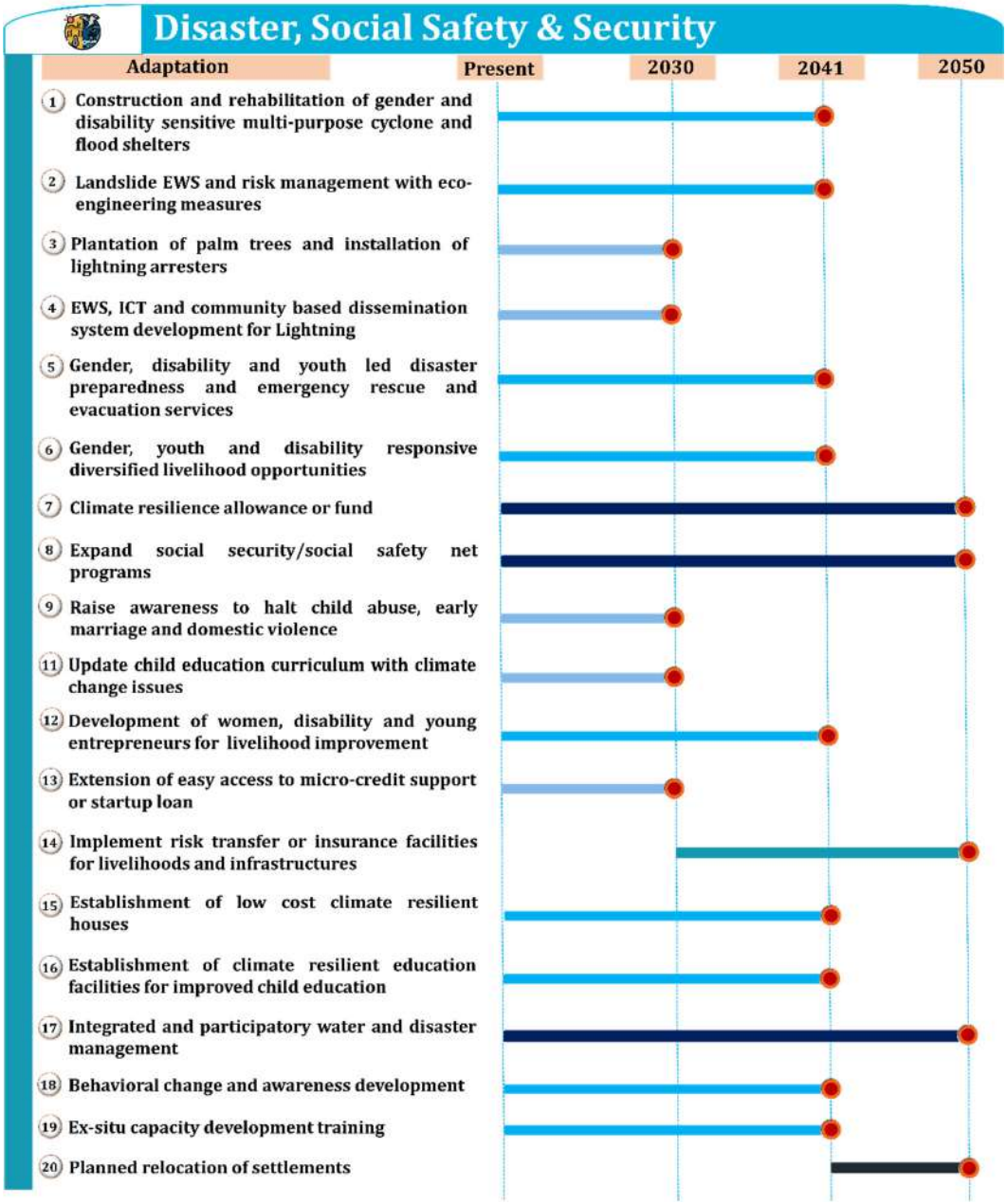
Adaptation pathways can become more specific and concrete through rigorous impact-based modelling assessing the effectiveness of a combination of alternative measures in a single system. Understanding the combined effect of multiple adaptation measures for shifting a tipping point in a system as per a dynamic adaptive policy pathway (DAPP) in order to set tipping points for adaptation goals will be performed in the next steps of the NAP process. Implementation will further establish links between robust M&E and tipping points to monitor and track anticipated tipping points and update adaptation measures per the adjusted pathway.

The following figures illustrate developed indicative adaptation pathways of the NAP for six key development sectors. They mainly encompass structural interventions and combinations of structural and non-structural interventions.

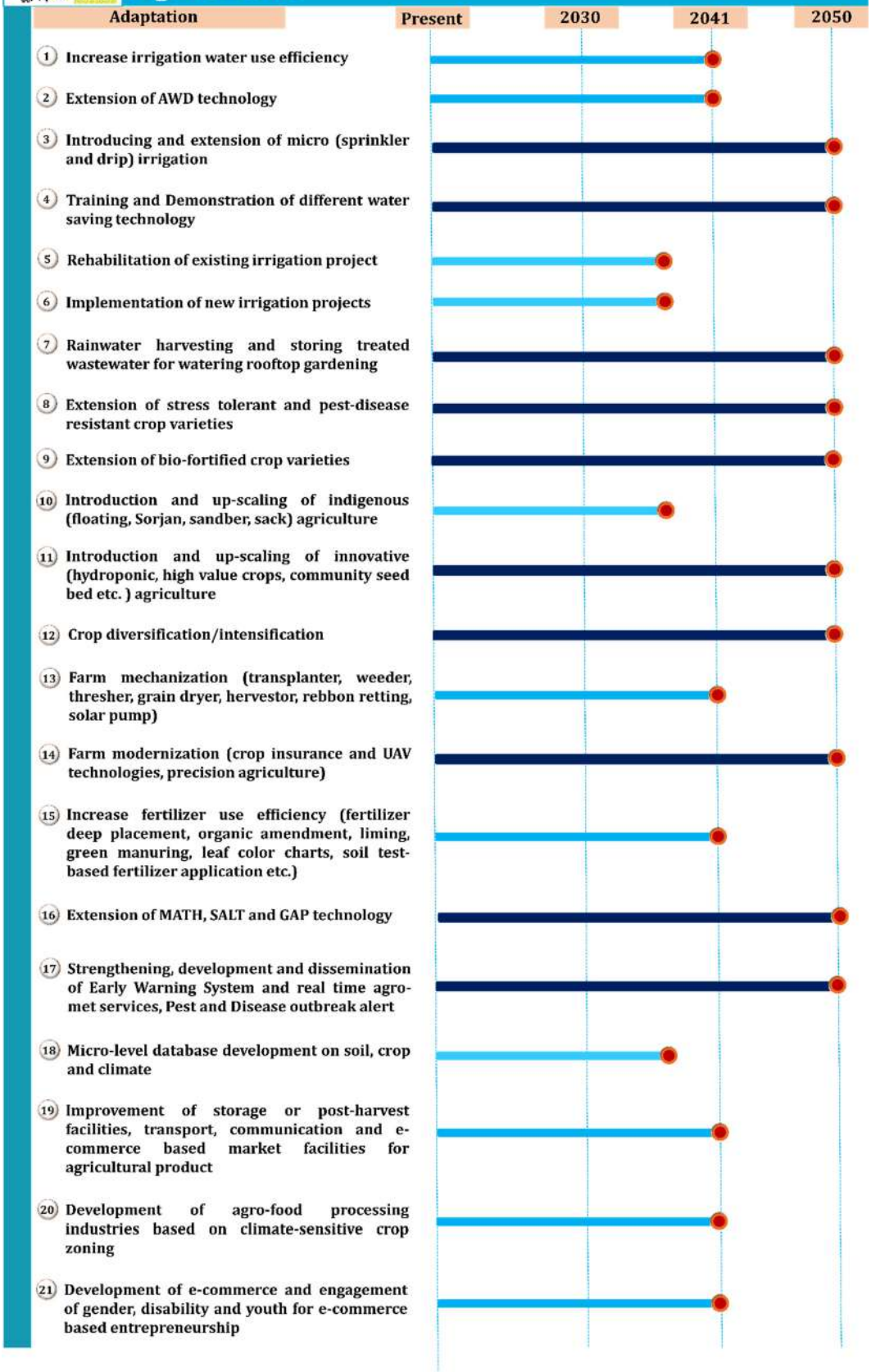

Water Resources
Adaptation
Present
2030
2041
2050
1 Repair, construct and rehabilitate coastal polders, sea dykes or embankments
2 Inside and outside polder management
3 Regular and timely operation and maintenance (O&M) of coastal polders
3 Functional WMA and DMC
4 Encroachment-free khals in connection to polders
5 Large scale reservoir development for freshwater flow augmentation
6 Construct, heightened dykes or freshwater retention ponds
8 Community-based, youth-led, and gender-inclusive freshwater pond management and rainwater harvesting
9 Protection and management of potential vulnerable coastal areas
10 Expand hydro-meteorological observation network and strengthen forecast and climate information services
11 Extension of Low cost & smart desalinisation techniques
12 Data acquisition and monitoring of local climate variables, SST, SLR, sediment, land subsidence and salinity intrusion
13 Space technology, AI, crowdsourcing, and big data-based climate impact monitoring tool
14 Impact based early warning & dissemination for slow onset and sudden event
15 Restoration and conservation of wetlands and reservoirs
16 Dredging of all major and medium rivers
17 Eco-engineering flood and drainage management measures
18 Drainage management of economic/ industrial zones and critical infrastructures
19 Internal drainage management in Char and Islands areas
20 Protection against flash floods, wave action, erosion and sedimentation
21 Karach/Hijol belt along the periphery of haor settlements
22 Maintaining connectivity of rivers or khals with perennial beels
23 'Living with Floods' in deeply flooded haor areas

Water Resources

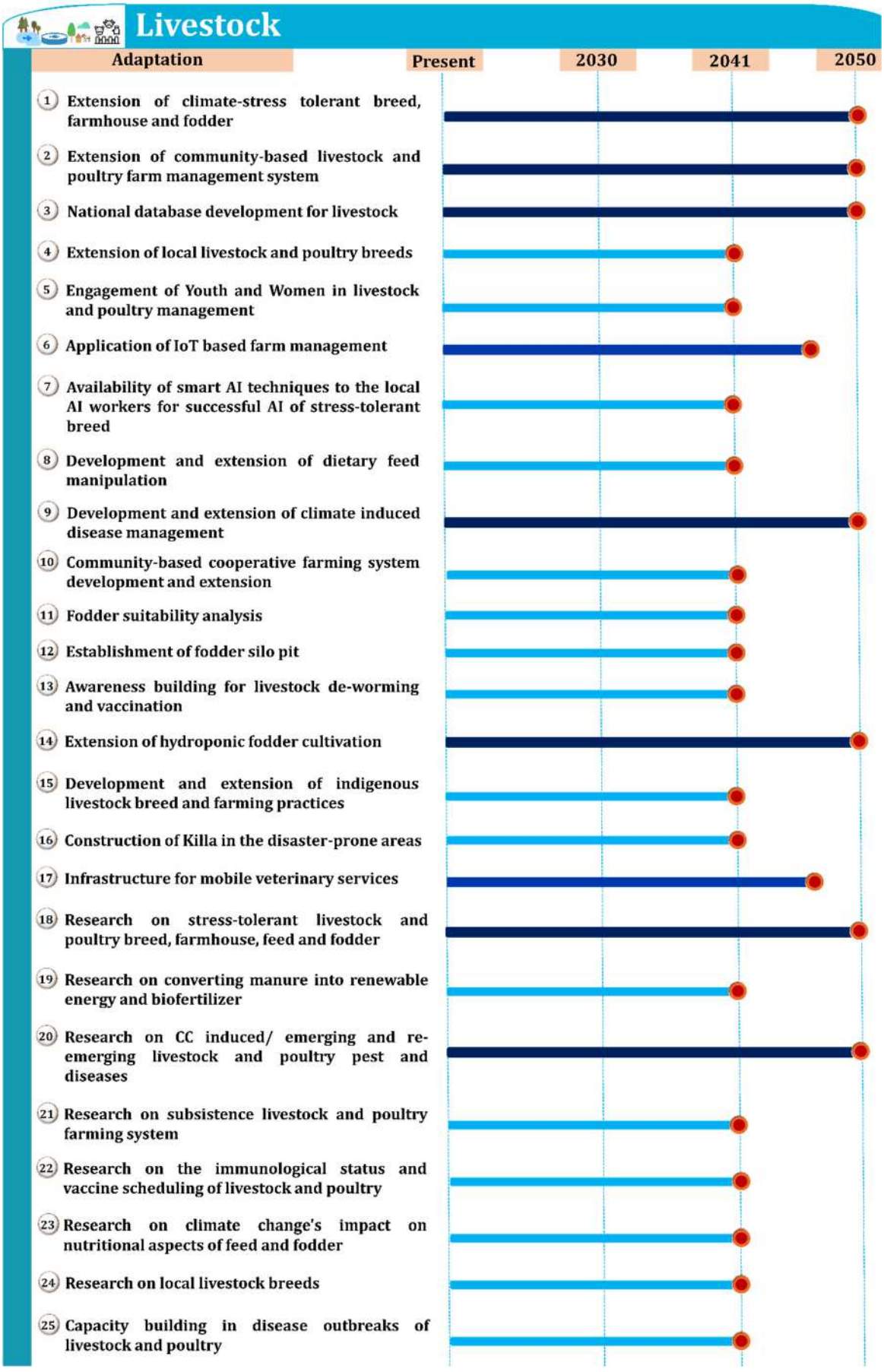



Disaster, Social Safety & Security
Adaptation
Present
2030
2041
2050
1 Construction and rehabilitation of gender and disability sensitive multi-purpose cyclone and flood shelters
2 Landslide EWS and risk management with eco-engineering measures
3 Plantation of palm trees and installation of lightning arresters
4 EWS, ICT and community based dissemination system development for Lightning
5 Gender, disability and youth led disaster preparedness and emergency rescue and evacuation services
6 Gender, youth and disability responsive diversified livelihood opportunities
7 Climate resilience allowance or fund
8 Expand social security/social safety net programs
9 Raise awareness to halt child abuse, early marriage and domestic violence
11 Update child education curriculum with climate change issues
12 Development of women, disability and young entrepreneurs for livelihood improvement
13 Extension of easy access to micro-credit support or startup loan
14 Implement risk transfer or insurance facilities for livelihoods and infrastructures
15 Establishment of low cost climate resilient houses
16 Establishment of climate resilient education facilities for improved child education
17 Integrated and participatory water and disaster management
18 Behavioral change and awareness development
19 Ex-situ capacity development training
20 Planned relocation of settlements

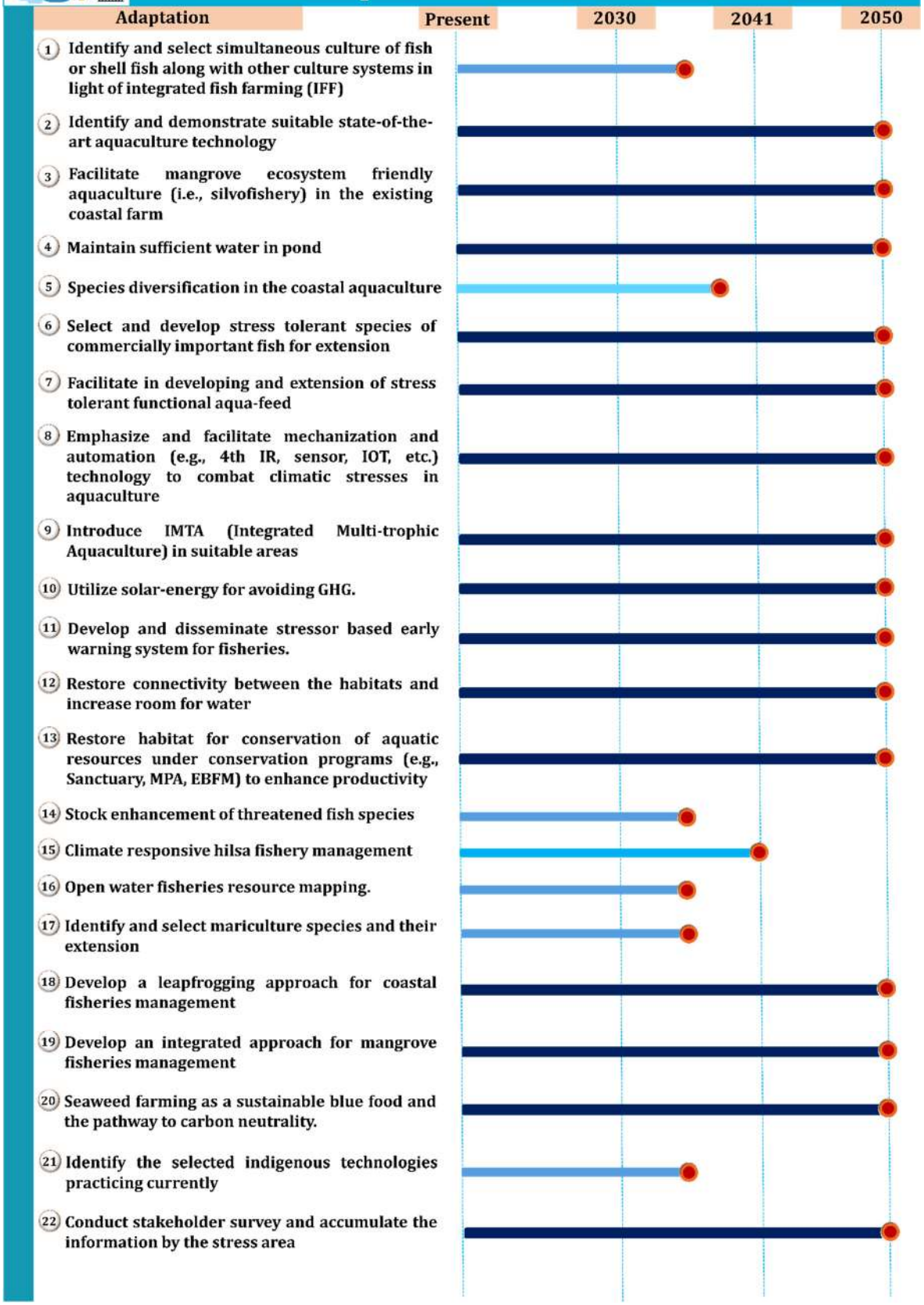
Agriculture



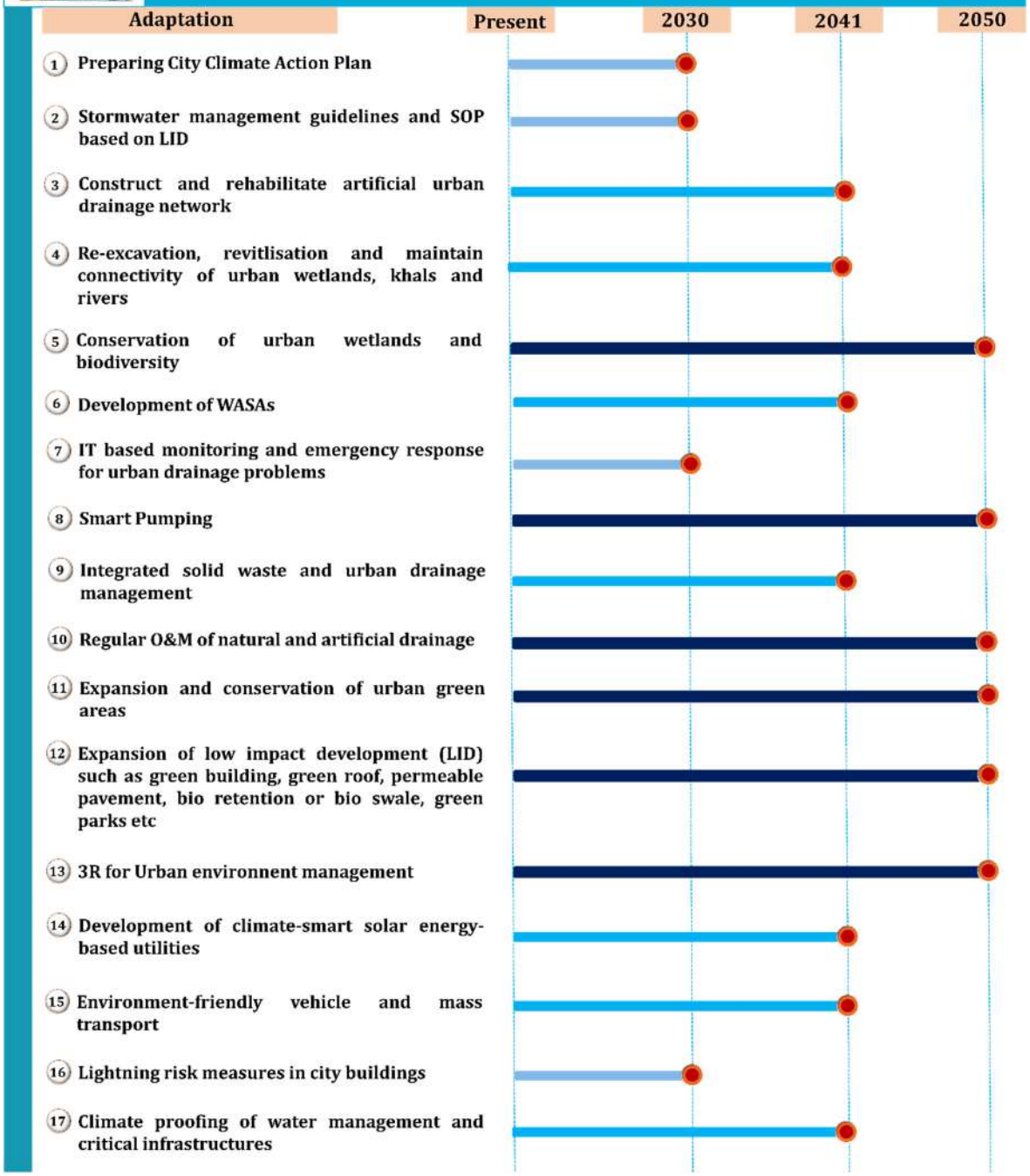
Livestock

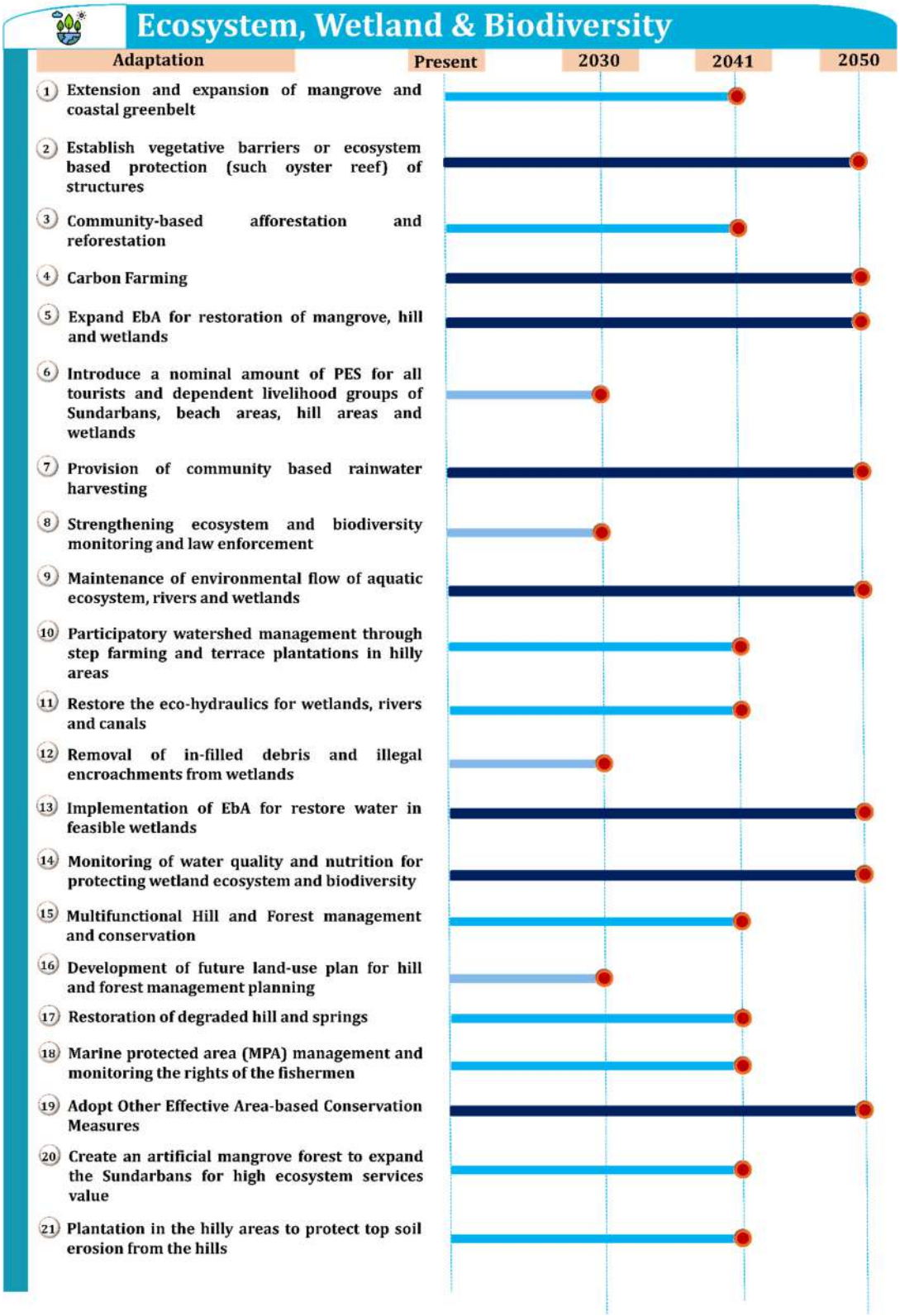

Adaptation
Present
2030
2041
2050
1 Extension of climate-stress tolerant breed, farmhouse and fodder
2 Extension of community-based livestock and poultry farm management system
3 National database development for livestock
4 Extension of local livestock and poultry breeds
5 Engagement of Youth and Women in livestock and poultry management
6 Application of IoT based farm management
7 Availability of smart AI techniques to the local AI workers for successful AI of stress-tolerant breed
8 Development and extension of dietary feed manipulation
9 Development and extension of climate induced disease management
10 Community-based cooperative farming system development and extension
11 Fodder suitability analysis
12 Establishment of fodder silo pit
13 Awareness building for livestock de-worming and vaccination
14 Extension of hydroponic fodder cultivation
15 Development and extension of indigenous livestock breed and farming practices
16 Construction of Killa in the disaster-prone areas
17 Infrastructure for mobile veterinary services
18 Research on stress-tolerant livestock and poultry breed, farmhouse, feed and fodder
19 Research on converting manure into renewable energy and biofertilizer
20 Research on CC induced/ emerging and re-emerging livestock and poultry pest and diseases
21 Research on subsistence livestock and poultry farming system
22 Research on the immunological status and vaccine scheduling of livestock and poultry
23 Research on climate change's impact on nutritional aspects of feed and fodder
24 Research on local livestock breeds
25 Capacity building in disease outbreaks of livestock and poultry

Fisheries & Aquaculture



Urban Areas


Adaptation
Present
2030
2041
2050
1 Preparing City Climate Action Plan
2 Stormwater management guidelines and SOP based on LID
3 Construct and rehabilitate artificial urban drainage network
4 Re-excavation, revitlisation and maintain connectivity of urban wetlands, khals and rivers
5 Conservation of urban wetlands and biodiversity
6 Development of WASAs
7 IT based monitoring and emergency response for urban drainage problems
8 Smart Pumping
9 Integrated solid waste and urban drainage management
10 Regular O&M of natural and artificial drainage
11 Expansion and conservation of urban green areas
12 Expansion of low impact development (LID) such as green building, green roof, permeable pavement, bio retention or bio swale, green parks etc
13 3R for Urban environnent management
14 Development of climate-smart solar energy-based utilities
15 Environment-friendly vehicle and mass transport
16 Lightning risk measures in city buildings
17 Climate proofing of water management and critical infrastructures


Ecosystem, Wetland & Biodiversity
Adaptation
Present
2030
2041
2050
1 Extension and expansion of mangrove and coastal greenbelt
2 Establish vegetative barriers or ecosystem based protection (such oyster reef) of structures
3 Community-based afforestation and reforestation
4 Carbon Farming
5 Expand EbA for restoration of mangrove, hill and wetlands
6 Introduce a nominal amount of PES for all tourists and dependent livelihood groups of Sundarbans, beach areas, hill areas and wetlands
7 Provision of community based rainwater harvesting
8 Strengthening ecosystem and biodiversity monitoring and law enforcement
9 Maintenance of environmental flow of aquatic ecosystem, rivers and wetlands
10 Participatory watershed management through step farming and terrace plantations in hilly areas
11 Restore the eco-hydraulics for wetlands, rivers and canals
12 Removal of in-filled debris and illegal encroachments from wetlands
13 Implementation of EbA for restore water in feasible wetlands
14 Monitoring of water quality and nutrition for protecting wetland ecosystem and biodiversity
15 Multifunctional Hill and Forest management and conservation
16 Development of future land-use plan for hill and forest management planning
17 Restoration of degraded hill and springs
18 Marine protected area (MPA) management and monitoring the rights of the fishermen
19 Adopt Other Effective Area-based Conservation Measures
20 Create an artificial mangrove forest to expand the Sundarbans for high ecosystem services value
21 Plantation in the hilly areas to protect top soil erosion from the hills

3.6 Alignment with Development Agenda

Perspective Plan of Bangladesh 2021-2041

Through the Perspective Plan 2021-2041, Bangladesh aims to become a high-income country by 2041 through transforming agriculture so it is sustainable and achieves food and nutrition security, digitalization, industrialization and the creation of an innovative economy, managing urban transition with green growth, and tackling environmental issues and climate change for sustainable growth. The NAP vision and goals complement this transformation through climate-resilient development realized through the different strategies outlined in the national development plan.

Bangladesh Delta Plan 2100

The BDP2100 developed a 100-year strategic framework for managing adaptive water resources and making the delta climate-resilient and prosperous. Delta strategies are essential vehicles for the Government to transform its Vision 2041 into reality. NAP adaptation strategies and interventions are highly synergistic with and complementary to the delta plan and vice versa. Water, disaster and land-use management for reducing climate-induced disaster risks, safeguarding wetlands and ecosystems, and equitable governance-related interventions are directly aligned with BDP2100 goals. The delta plan's 52 climate change adaptation projects link directly with the 23 NAP interventions and are implementable under the NAP portfolio. They will contribute to achieving the vision of the NAP.

The Sustainable Development Goals

The Government developed an SDG Action Plan in 2017 to transform and align national development pathways with the global development agenda of achieving 17 SDGs by 2030. Bangladesh has made remarkable progress so far in realizing the goals.[10] National strategies under the six national goals of the BDP2100 complement this process. Climate-resilient development through the NAP will further accelerate the journey towards the SDGs.

SDG13 focuses on urgent actions to combat climate change and its impacts. The NAP will be the national platform for achieving this goal through adaptive pathways to reach SDG targets by 2030. Other aligned SDGs are on sustainable cities and communities, life below water, clean water and sanitation, good health and well-being, resilient infrastructure and reducing hunger through achieving food security under a climate change regime. Most other SDGs directly or indirectly align with the NAP's strategic interventions.

The NAP implementation process will follow an optimistic adaptation pathway, adjusting dynamically and synchronizing with the BDP2100 and the SDGs to fulfil the development vision by 2030, 2041 and beyond.

Appendix I illustrates the alignment of proposed medium- and long-term NAP interventions with the 6 goals of the BDP2100 and the 17 SDGs. Further, the NAP portfolio (Appendix II) specifically tags the 52 climate change adaptation projects of the BDP2100 under different NAP interventions to highlight direct alignment of the NAP with the delta plan.

3.7 Appraisal, Prioritization and Investment Plan

Appraisal and prioritization of identified interventions entailed conducting analysis based on the LEG guidelines under the UNFCCC. This followed eight criteria:

[10] *See the SDG progress tracker: https://www.sdg.gov.bd/*

1. Time of action based on the emergence of adaptation projects by the 2030s, 2041 or beyond following the development vision
2. Climate change risk reduction potential or the effectiveness of adaptation
3. Costs of adaptation
4. Benefits of adaptation
5. Robustness or flexibility of adaptation
6. Gender and social inclusiveness potential
7. Environmental friendliness
8. Co-benefits socially and environmentally

To support the appraisal process, the economics of adaptation were assessed, estimating the costs and tangible and intangible benefits of interventions. Indicative cost estimation considers using current investment allocations and trends in annual development programme (ADP) and climate budget reports; the cost of local government; the cost quoted in national development plans such as the BDP2100, the SDG Action Plan, and country investment or sector action plans; the unit cost derived from different ongoing investments like the Coastal Embankment Improvement Project (CEIP), the Community-based Coastal Afforestation project, the Char Development and Settlement Project (CDSP), dredging projects of major rivers etc.; investment costs mentioned in the annual reports of different implementing agencies; factors suggested in *Public Climate Finance Tracking in Bangladesh* (MoF, 2018); the implementation duration of proposed interventions; and the rationale and assumptions in establishing a correlation based on the budgets of past similar initiatives. Private sector investment potential in terms of a percentage of the total cost of the intervention was estimated by summing the costs of sub-activities under a proposed intervention. Potentially attractive sub-activities identified by private sector stakeholders during consultative processes (described in Section 3.3.8) were considered for the estimation.

Tangible and intangible benefits have been assessed identifying direct and indirect impacts of the interventions. Benefits are assessed in terms of climate risk reduction or ensuring the protection of life, properties, livelihoods and ecosystems, i.e., reducing the costs of losses and damages to crops, fisheries, livestock, infrastructure, forestry and biodiversity by climate-induced disaster; and additional benefits and co-benefits attributed to opportunities created by adaptation, such as improved livelihoods and employment generation, additional food production, better human health, improved ecosystem health and services, carbon sequestration, increased resilience of communities, etc.

Multicriteria analysis (MCA) involved equally scoring weighted arithmetic aggregation and normalizing scores for the eight selected criteria against each intervention. Scores and weights were given based on expert judgment, assessed costs and benefits, adaptive pathways, etc. (Table 3.4). The economics of adaptation and appraisal through simplified multicriteria analysis is elaborated further in *Volume III: NAP Investment Portfolio.*

Table 3.4: Prioritization criteria and scores for MCA

SL.	Criteria	Definition of criteria	Scoring criteria		
			Score '1'	Score '2'	Score '3'
1	Timing or urgency for action	Initiating actions where further delay could increase vulnerability or lead to increased costs at a later stage in alignment with the Government's development vision	Can be considered a long-term action beyond 2041	Action may be started between 2031-2041 to achieve Vision 2041	Take action by 2030
2	Effectiveness	The extent to which the measure can reduce risk effectively	Low	Medium	High
3	Cost	Cost of interventions, including human and other resources	High	Medium	Low

SL.	Criteria	Definition of criteria	Scoring criteria		
			Score '1'	Score '2'	Score '3'
4	Benefits	Sum of tangible and intangible benefits of the intervention	Low	Medium	High
5	Flexibility or robustness	Measures that allow a spectrum for adjustment or changes in a flexible way to achieve 'no' or 'low regret'	Low	Medium	High
6	Gender and social inclusion	The extent to which the measure is conducive to accommodating local adaptation needs through participatory processes responsive to gender dimensions, persons with disabilities, youth, children, elderly people, ethnic communities or other socially disadvantaged groups, leaving no one behind	Low	Medium	High
7	Environmental friendliness	The level of potentially negative impacts on the environment by the measures	High	Medium	Low
8	Co-benefits	Interventions that would have positive impacts on other sectors or systems, including on vulnerable populations or the environment/ecosystems, and/or have synergies with other multilateral environmental agreements	Low	Medium	High

Ninety high-priority and 23 moderate-priority interventions have a total investment cost of BDT 20,037 billion for 27 years (2023-2050) until the Thirteenth Five-Year Planning cycle. This required investment is equivalent to $230 billion at the current price. The Government now spends approximately $1.2 billion per year for climate adaptation (MoF, 2021). Successful

Investment summary of the NAP

implementation of the NAP will require seven times more or $8.5 billion per year. Future inflation of prices will increase the investment cost. A sectoral distribution defines the portions of investment as BDT 16,042 billion or $184.5 billion required for water resources (52 percent), urban areas (17 percent), and the disaster, social safety and security sectors (12 percent), which will ensure protection of other resource-based sectors, food and nutrition security, livelihoods and infrastructure. A total of BDT 3,519 billion or $40.4 billion will be required for making the agriculture; fisheries, aquaculture and livestock; and ecosystems, wetlands and biodiversity sectors climate-resilient. A total of BDT 404 billion or $4.6 billion is needed to create an enabling environment with required policy reforms, mainstreaming, research and innovation, capacity development and knowledge management.

Bangladesh would need approximately BDT 5,250 billion or $60.3 billion by 2030 to meet the immediate development thrust for achieving the SDGs and stimulating climate-resilient development against a projected 2°C temperature rise and its associated risks. The NAP proposes mobilizing and effectively utilizing more than 70 percent of the total investment cost of climate change adaptation by 2040 to become a developed country by 2041.

Private sector investment potential is around $11.5 billion or 5.1 percent of total investment cost at an annual rate of $420 million.

This huge investment burden will require accelerated efforts to harness climate funds from domestic and external sources. Various innovative financing windows will need to be explored to meet demand from domestic sources at double the present rate, along with the Annual Development Programme (ADP) and Bangladesh Climate Change Trust Fund's (BCCTF), Delta Fund. The remaining investment gap will need to be fulfilled from external sources, development partners and international climate or environment funds at a rate of $6.0 billion per year, even if full private sector potential is realized.

Given the immense climate risks, vulnerabilities, consequential losses and damages that Bangladesh confronts, this adaptation cost is required for making the country climate-resilient by the 2050s. The Government will need to ensure the expected investment from the private sector to support the mobilization of resources from domestic sources. Capacity development for institutions, officials and the private sector supported by a robust existing policy environment and the NAP are prerequisites for harnessing and mobilizing these resources and those from international, domestic and external sources. Green bonds, resilience bonds, blended finance, risk transfers or insurance, etc. are options requiring further exploration.

The fiduciary standards of international climate funds like the GCF should be revisited and relaxed to ease the climate finance gap in highly climate vulnerable countries like Bangladesh Bangladesh as per Article 9 of Paris Agreement (2015). A Simplified Approval Process (SAP) and an increased quota for international funds in the budget of the Private Sector Facility (PSF) need to be introduced and popularized as part of supporting the readiness of the country for CCA.

Implementing the NAP will reduce climate risks and vulnerabilities by increasing the adaptive capacity of vulnerable communities, reduce damages from climate-induced disasters, enhance the resilience of society and ecosystems, and complement the national development agenda vision of becoming a high-income country by 2041 and achieving the SDGs by 2030 through climate-resilient development.

The NAP implementation will protect 1.1 Million hectares of croplands from storm surges/flood inundation, sea-level rise and salinity. Annually, 300,000 households will be protected from flood-related sicknesses, rice production will increase by 10.3 million tons a year with immediate benefits for 70 percent of crop-dependent households, the livelihoods of about 4 million households dependent on fisheries will be protected from water-related disasters, livestock production will increase by 5 percent, and communication

infrastructure operation and maintenance costs after disasters will fall 60 percent.

A total of 30 million people in 43 urban areas will benefit from improved drainage, with a 10 percent reduction in transport costs, 15 percent reduction in treatment costs for waterborne diseases and a 30 percent increase in income for marginal urban communities due to better drainage and a lower heat island effect. Protection of critical infrastructure like EEZs, power hubs, houses and other basic infrastructure from extreme water-related disasters would save 500,000 jobs and $5 billion in exports of goods and services. Overall ecosystem health and human well-being will improve. Biodiversity will be enriched and nutrition uptake will increase. Tree coverage will increase by 5 percent through mangrove planting and the stabilization of 0.5 Million hectares of land, the facilitation of social forestry, multifunctional hill forests and afforestation. Annual deaths from climate-induced disasters will fall. The vulnerabilities of 15 million climate migrants will decline; forest-dependent livelihoods will improve; property values will increase; carbon sequestration will rise and emissions will decline.

Table 3.5 includes the summary investment plan of the NAP (see also Appendix II). *Volume III: NAP Investment Portfolio* includes the detailed portfolio of interventions comprising key activities, tentative costs, durations, benefits, private sector potential, alignment with CCAP, BDP2100 adaptation projects, lead and supporting implementing entities, etc..

Table 3.5: Investment plan for the NAP

Code	Interventions for NAP sectors	Priority	Duration	Cost (billions of BDT)	Private sector investment potential
Total adaptation investment cost for water resources (21 interventions)				**10,383**	
WRM1	Integrated management of coastal polders, sea dikes and cyclone shelters against tropical cyclone, sea-level rise and storm surges	High	Medium to long	2,212	3%
WRM2	Management of freshwater resources and monitoring of salinity for reducing vulnerabilities in existing and potential salinity-prone areas	High	Medium to long	59	5%
WRM3	Protection and management of potentially vulnerable areas due to tropical cyclone, sea-level rise, extreme storm surges and flooding	Moderate	Medium to long	271	5%
WRM4	Strengthen early warning and dissemination services for climate change-induced slow-onset and sudden extreme water hazards using ICT and AI	High	Short to medium	91	7%
WRM5	Community-based rainwater harvesting through indigenous techniques and conservation of wetlands, reservoirs and natural springs for drinking water supplies in hard-to-reach and water-stressed areas	High	Short to medium	30	7%
WRM6	Dredging of all major and medium rivers for accommodating and smooth drainage of excess floods during climate-induced extreme events	High	Medium to long	1,501	7%
WRM7	Construction and rehabilitation of flood and drainage management measures with eco-engineering solutions	Moderate	Medium to long	754	5%
WRM8	Drainage management of economic/industrial zones and critical infrastructure and	High	Medium to long	326	3%

Code	Interventions for NAP sectors	Priority	Duration	Cost (billions of BDT)	Private sector investment potential
	reinforced climate resilience through risk assessment				
WRM9	Internal drainage management and climate-resilient development of the *char* and islands areas	Moderate	Medium to long	461	3%
WRM10	Protection against flash floods, wave action, erosion and sedimentation	High	Medium to long	1,909	5%
WRM11	Erosion risk management through erosion prediction, improved early warning and its dissemination	Moderate	Short to medium	7	7%
WRM12	Sustainable shoreline erosion management based on eco- or bioengineering measures	High	Medium to long	755	2%
WRM13	Reclamation and development of lands for the expansion of afforestation, agriculture, shrimp cultivation and settlements	Moderate	Medium to long	490	7%
WRM14	River management through bank stabilization and other ancillary works	High	Medium to long	587	5%
WRM15	Ecosystem-based sediment management along coasts and in estuaries	High	Medium to long	83	
WRM16	Drought management measures for enhanced groundwater recharge and increased soil moisture in water-stressed areas	High	Medium to long	99	
WRM17	Development of a national drought monitoring system	High	Short to medium	6	7%
WRM18	Planned, participatory and coordinated land and water resources management	High	Medium to long	170	
WRM19	Transboundary river basin management and basin-level cooperation	High	Medium to long	9	
WRM20	Development of a basinwide and participatory watershed management framework to restore, harvest and optimize the use of water resources	High	Medium to long	21	
WRM21	Remodelling of water-regulating and cross-drainage structures considering climate change scenarios	High	Medium to long	542	5%
Total adaptation investment cost for disaster, social safety and security (12 interventions)				**2,352**	
CDM1	Construction and rehabilitation of gender-, age- and disability-sensitive multipurpose, climate-resilient and accessible cyclone and flood shelters with safe drinking water, sanitation and livestock shelter facilities	High	Medium to long	592	3%
CDM2	Landslide early warning systems and risk management measures based on eco- or bioengineering measures	High	Medium to long	19	7%
CDM3	Implementation of thunderstorm and lightning risk management measures in highly susceptible areas	Moderate	Short to medium	14	7%
CDM4	Protection and enhanced resilience of climate migrants with a particular focus on gender and disability	High	Medium to long	124	5%

Code	Interventions for NAP sectors	Priority	Duration	Cost (billions of BDT)	Private sector investment potential
CDM5	Gender-, age- and disability-responsive, youth-led disaster preparedness and emergency rescue and evacuation services	High	Medium to long	20	7%
CDM6	Increase the resilience of vulnerable poor communities by introducing gender-, age- and disability-responsive diversified livelihoods, effective insurance mechanisms and climate resilience funds	High	Medium to long	535	7%
CDM7	Behavioral change and development of awareness among vulnerable communities for emergency responses and livelihood protection from climate-induced disasters	High	Short to medium	3	5%
CDM8	Increase the coverage of social security/social safety net programmes for building community-based resilience and adaptive capacity	High	Medium to long	625	
CDM9	Halt child abuse, early marriage and domestic violence triggered by climate-induced disasters	High	Short to medium	7	7%
CDM10	Accelerated livelihood improvements for women, people with disabilities and young entrepreneurs through vocational training on adaptation practices and ICT	High	Medium to long	230	7%
CDM11	Introduction of risk transfer and insurance mechanisms for protection of critical and disaster protection infrastructure, vulnerable MSMEs and farmers	High	Short to medium	23	10%
CDM12	Building climate-resilient houses, education& communication infrastructure in areas with high climate risk	High	Medium to long	160	7%
Total adaptation investment cost for agriculture (12 interventions)				**1,666**	
CSA1	Extension of climate-smart technologies for increasing irrigation water use efficiency	High	Medium to long	313	10%
CSA2	Augmentation of surface water for irrigation and multipurpose use	High	Medium to long	846	3%
CSA3	Extension of stress-tolerant, pest- and disease-resistant rice and non-rice crops	High	Medium to long	20	7%
CSA4	Introduction and scaling up of innovative and indigenous agriculture	Moderate	Medium to long	15	7%
CSA5	Crop diversification/intensification for natural resources optimization and reduction of climate stress	Moderate	Medium to long	15	5%
CSA6	Farm modernization/mechanization to reduce climate vulnerability	High	Medium to long	106	15%
CSA7	Increased fertilizer use efficiency for enhancing production	High	Medium to long	103	10%
CSA8	Extension of good agriculture practices (gap), modern agriculture technology (math) and sloping agricultural land technology (SALT)	High	Medium to long	25	5%

Code	Interventions for NAP sectors	Priority	Duration	Cost (billions of BDT)	Private sector investment potential
CSA9	Strengthening and development of impact-based early warning systems and data management for agriculture	High	Medium to long	15	7%
CSA10	Improvement of storage or post-harvest facilities, transport, communications and e-commerce-based market facilities for agricultural products	High	Medium to long	145	10%
CSA11	Development of agro-food processing industries based on climate-sensitive crop zoning	High	Medium to long	52	10%
CSA12	Development of e-commerce and engagement of women, people with disabilities and youth for e-commerce-based entrepreneurship	Moderate	Medium to long	11	10%
Total adaptation investment cost for fisheries, aquaculture and livestock (13 interventions)				**1,410**	
CFL1	Extension of climate-resilient technology for combating climate-related stresses in aquaculture	High	Medium to long	162	7%
CFL2	Development of climate-ready open water fisheries management	High	Medium to long	88	5%
CFL3	Development and management of coastal and marine fisheries to foster the blue economy	Moderate	Medium to long	45	5%
CFL4	Validation and extension of indigenous knowledge-based adaptation techniques to combat climatic effects on fisheries	Moderate	Medium to long	14	2%
CFL5	Monitoring, evaluation and enforcement for ensuring the conservation of fish biodiversity and habitat	High	Medium to long	246	
CFL6	Development of shrimp culture planning and zoning	Moderate	Short to medium	7	5%
CFL7	Improvement of post-harvest facilities and e-commerce-based market facilities for fisheries and aquaculture	High	Medium to long	288	10%
CFL8	Development of fish industries based on climate-sensitive crop zones	Moderate	Short to medium	46	10%
CFL9	Extension of climate-stress-tolerant livestock and poultry breeds, farm, feed and fodder	High	Medium to long	41	7%
CFL10	National livestock and poultry database and information development	Moderate	Medium to long	11	5%
CFL11	Extension of indigenous and advanced livestock and poultry farming practices	Moderate	Medium to long	120	5%
CFL12	Climate-resilient infrastructure development for the safety of livestock and poultry during a disaster	High	Medium to long	207	5%
CFL13	Development of livestock product processing industries and transportation systems	High	Medium to long	135	10%
Total adaptation investment cost for ecosystems, wetlands and biodiversity (21 interventions)				**515**	
EWB1	Extension and expansion of the coastal greenbelt for protecting coastal habitats, including the Sundarbans, mangroves, salt marshes, etc.	High	Medium to long	32	5%

Code	Interventions for NAP sectors	Priority	Duration	Cost (billions of BDT)	Private sector investment potential
EWB2	Community-based afforestation and reforestation for biodiversity conservation, enhancement of ecosystem resilience and increased carbon sequestration	High	Medium to long	32	5%
EWB3	Expand ecosystem-based adaptation for the restoration of mangroves, hill areas and wetlands to tackle the adverse impacts of climate change	High	Medium to long	53	5%
EWB4	Strengthen ecosystem and biodiversity monitoring and law enforcement systems	High	Medium to long	57	2%
EWB5	Maintenance of the environmental flows of aquatic ecosystems, rivers and wetlands	High	Medium to long	16	
EWB6	Restore the eco-hydraulics for wetlands, rivers and canal systems, including through the establishment of connectivity and protecting wetlands	High	Medium to long	42	2%
EWB7	Development of multifunctional hill and forest management and conservation systems	High	Medium to long	19	7%
EWB8	Management of marine protected areas and development of monitoring systems for the rights of fishing communities	Moderate	Medium to long	16	3%
EWB9	Adopt other effective area-based conservation measures to fulfil the biodiversity framework target	Moderate	Medium to long	13	3%
EWB10	Combat desertification through planting regenerative indigenous species	High	Medium to long	5	3%
EWB11	Conservation of agroecosystems through expanded agroforestry, good agricultural practices and regenerative agriculture	High	Medium to long	13	5%
EWB12	Development of a participatory wetlands management framework for the sustainable management of wetlands	High	Medium to long	8	3%
EWB13	Conservation of village common forests (VCFs) through community-based spring, watershed and agricultural landscape management and soil conservation in the Chattogram Hill Tracts areas	High	Medium to long	38	5%
EWB14	Halda River ecosystem restoration and conservation	High	Short to medium	52	5%
EWB15	Watershed management of Kaptai Lake for ecosystem resilience and water retention	High	Short to medium	24	
EWB16	Monitoring of sea surface temperature and other physical and biological parameters and marine species composition in the Bay of Bengal	Moderate	Medium to long	8	3%
EWB17	Develop and update ocean ecosystem management policies, guidelines and institutional capacities for management of the blue economy	High	Medium to long	9	
EWB18	Development of species or gene inventories and recovery plans for endangered species due to climate change	Moderate	Medium to long	37	2%

Code	Interventions for NAP sectors	Priority	Duration	Cost (billions of BDT)	Private sector investment potential
EWB19	Restoration of the coral reef ecosystem and associated fish benthic communities in the St. Martin Islands	High	Medium to long	21	5%
EWB20	Revitalization of natural springs and sustainable management of waterbodies for reducing water scarcity, and the restoration and conservation of ecosystems and biodiversity	High	Medium to long	13	5%
EWB21	Development of a national management systems for wetlands, biodiversity, oceans and coastal information for supporting monitoring and surveillance	High	Short to medium	7	3%
Total adaptation investment cost for urban areas (12 interventions)				**3,307**	
CRC1	Improvement of natural and artificial stormwater drainage networks for reducing vulnerabilities to urban floods and drainage congestion	High	Medium to long	1,914	5%
CRC2	Expansion and conservation of green and blue infrastructure for improvement of urban environments and drainage systems	High	Medium to long	189	10%
CRC3	Stormwater management in cities through attenuating peak flow and allowing infiltration in line with the concept of low-impact development	High	Medium to long	37	10%
CRC4	Development of city climate action plans for major urban and peri-urban areas emphasizing the resilience of urban-poor communities and climate migrants	High	Short to medium	4	
CRC5	Expand innovative climate-resilient, gender-, age- and disability-sensitive WASH technologies and facilities for urban communities	High	Medium to long	65	10%
CRC6	Increase access to water supply, sanitation and hygiene services in cities for reducing exposure to flooding and waterborne diseases during or after extreme weather events	High	Medium to long	593	10%
CRC7	Adopt integrated water management for urban and peri-urban areas	High	Medium to long	13	5%
CRC8	Carry out initiatives to improve the well-being of children and youth and reduce the effects of climate stress	Moderate	Medium to long	138	5%
CRC9	Improvement of surveillance, early warning systems and monitoring of psychosocial impacts and mental health risks from extreme weather events	Moderate	Medium to long	52	10%
CRC10	Extension of resilient and eco-friendly materials and engagement of the private sectors through incentives and tax rebates for climate-resilient infrastructure development in urban areas	High	Medium to long	58	15%
CRC11	Establishment of climate-resilient health-care facilities in urban areas	Moderate	Medium to long	214	15%

Code	Interventions for NAP sectors	Priority	Duration	Cost (billions of BDT)	Private sector investment potential
CRC12	Development of heatwave and disease outbreak advisory services for city dwellers	High	Short to medium	30	10%
Total adaptation investment cost for policies and institutions (7 interventions)				**140**	
PIN1	Preparation of a roadmap for implementing the NAP	High	Short to medium	2.2	
PIN2	Development of a regulatory and institutional framework for advancing the NAP	High	Short to medium	9	2%
PIN3	Update and reform policies and plans for mainstreaming CCA	High	Short to medium	6.85	
PIN4	Operationalize the NAP monitoring, evaluation and learning framework based on a theory of change.	High	Short to medium	6.5	2%
PIN5	Reform local government institutes towards the inclusion of community-based organizations, women, people with disabilities and youth in the implementation of locally led adaptation	Moderate	Short to medium	34.3	2%
PIN6	Innovative, appropriate and enhanced financial instruments for supporting climate change adaptation	High	Short to medium	72.4	7%
PIN7	Private sector finance in leading the implementation of climate change adaptation	High	Short to medium	8.5	10%
Total adaptation investment cost for capacity development, research and innovation (15 interventions)				**265**	
CDR1	Transformative capacity development and knowledge management for integrating climate change adaptation into planning processes and climate financing	High	Medium to long	12.5	3%
CDR2	Awareness-raising, training on skills for enhanced adaptive capacities and improved diversified livelihoods at the community level	High	Short to medium	7.2	5%
CDR3	Coordinated research, field-level demonstrations, knowledge management and communication of adaptation at the local level	High	Medium to long	44.5	5%
CDR4	Capacity development for the implementation of nature-based solutions and locally led adaptation	High	Short to medium	4.5	3%
CDR5	Generation of national, regional and local-level evidence and scenario-based climate information through climate downscaling and publication of a national climate outlook, risk and vulnerability atlas	High	Short to medium	5	
CDR6	Research on the impact of climate change on land and water resources	High	Medium to long	3.5	
CDR7	Action research and field demonstrations on climate-smart agriculture	High	Medium to long	60	5%
CDR8	Research and innovation related to climate-resilient fisheries and aquaculture	High	Short to medium	15	5%
CDR9	Research and innovation related to climate-smart livestock and poultry	High	Medium to long	54	5%
CDR10	Action research for locally led and indigenous climate change adaptation	High	Short to medium	4.5	

Code	Interventions for NAP sectors	Priority	Duration	Cost (billions of BDT)	Private sector investment potential
CDR11	Action research for developing and exploring the potential use of ecosystem-based adaptation and nature- based solutions	High	Medium to long	8	3%
CDR12	Research on climate change impacts on land, water and ocean ecosystems	High	Medium to long	15	
CDR13	Research and popularize climate-stress-tolerant plant species	High	Medium to long	21	7%
CDR14	Research on and piloting of climate-resilient infrastructure, improved health measures and WASH technologies	High	Short to medium	6	7%
CDR15	Action research for low-impact development techniques, green infrastructure and integrated drainage management for smart city development	High	Short to medium	4	5%
Grand total in billions of BDT for a 27-year implementation period (2023-2050) for 113 interventions				**20,037**	

Implementation of these interventions will need to be integrated and coordinated, avoiding ad hoc initiatives. This will increase the effectiveness of adaptation in the system, prevent overlapping issues or overuse of investment and reduce maladaptation. Implementing through programmatic approaches rather than on a project basis is strongly recommended as it will allow the active and effective involvement of multiple stakeholders from multiple sectors.

Programmes can be developed based on different areas of climate stress towards integrated and holistic implementation that considers system dynamics and desired transitions to reach climate resilience goals. Each programme may consist of a combination of multiple interventions involving multiple sectors. For instance, a coastal polder management programme should not just focus on activities to raise polders. It should consider water and disaster management, climate-smart agricultural interventions, climate-resilient infrastructure, and actions to improve WASH, health and livelihoods. Such programmes will allow stakeholders to select and implement locally led adaptation actions from the 113 proposed interventions and their activities, and prioritize these based on an adaptive pathway. Implementation will help the nation and communities build forward, minimize climate change risks and widen the scope of climate-resilient development.

Implementation Strategies

4. Implementation Strategies

A well-organized, inclusive, active institutional set-up is necessary for smooth NAP implementation, M&E and updating. Bangladesh has long experience in planning and implementing climate change adaptation, starting in the early 1990s. The MoEFCC has been the focal ministry for climate-related issues. Under it, Department of Environment (DoE) serve as the technical support units for the UNFCCC and climate-related agreements, and the development of strategies and action plans for addressing climate change in Bangladesh. An Interministerial Steering Committee based at the MoEFCC coordinates and facilitates adaptation and mitigation actions and Bangladesh's role in climate change negotiations under the UNFCCC and COPs.

Bangladesh has a broad and complex constituency of institutional interests in climate actions. These include central and line ministries and departments, multilateral and bilateral agencies, local governments, NGOs, CBOs, households, the private sector and development partners. Although the country has gained much institutional capacity to plan and implement adaptation and mitigation through the NAPA, BCCSAP and NDC, there is room for improvement in institutional and human capacities for climate data generation, integration of CCA into development planning processes, financing and implementation, M&E, and effective coordination among actors and stakeholders.

Apart from institutional challenges, noteworthy implementation challenges relate to: reinforcement of required policies, accessing readiness support and harnessing required funds from committed developed countries, international funds or development partners, ensuring effective coordination and monitoring mechanisms, establishing functional operation and maintenance systems, introducing a climate change integration framework into development planning processes, building institutional capacity and technical knowledge among implementing entities and officials from the national to local level, updated climate risk information and structured management of data and knowledge, raising awareness of the private sector and marginal communities, and enhance representation of women, youth, persons with disabilities, the elderly, ethnic communities and other marginalized groups in decision-making.

The following sections include a slightly new and wider institutional structure proposed for the NAP implementation and coordination, considering experiences and learning from the NAPA, BCCSAP and NDCs, and highlighting strategies to overcome implementation challenges.

4.1 Regulations, Institutions, and Coordination

4.1.1 Policies and regulations

The current policy, institutional and legislative regime for climate change and adaptation has significant scope for gradual reform and updating to support the integration of climate change adaptation into planning, implementation, resource mobilization and use, horizontal and vertical coordination, M&E and transformative capacity development. A structured policy

framework is essential to ensure proper integration of climate change into the development planning process and uphold transparency & policy compliance.

Following the NAP, a required update of the 'rules of business' for relevant ministries should integrate climate actions relevant mandates, delegate responsibilities and encourage strategic thinking across all ministry levels to ensure smooth implementation of the NAP. Later, a **Climate Change Policy Regime** should be developed with required policy reforms which will facilitate the strong inter-ministerial coordination for the NAP implementation to achieve climate resilient development by protecting vulnerable communities and ecosystems and achieving the vision of NAP.

Key mandates of the proposed policy regime would provide relevant guidance to:

- Convey a pathway to a national aspirations for the NAP implementation process being a signatory of the UNFCCC and the Paris Agreement
- Take appropriate measures for adaptation, mitigation, reducing losses and damages, and means of implementation, including finance, technology, capacity-building and research
- Oversee implementation by developing monitoring, evaluation, transparency and compliance frameworks at the national and local levels
- Develop a practical implementation framework that orchestrates effective and efficient institutional arrangements in a coordinated and integrated manner, aligning with horizontal and vertical links
- Ensure the integration of climate change into sectoral and local policies and plans through necessary reforms and amendments of 'rules of business' and 'allocations of business'
- Create a framework for climate action that is participatory, locally led, and gender, disability, youth and socially inclusive.

Revision of the Climate Change Trust Fund Act (2010) and the development of its subsequent rules requires immediate action to broaden the scope for accessing and arranging climate finance from domestic and international resources for the BCCTF, in collaboration with the MoEFCC, ERD, MoF and other relevant entities, including different financial mechanisms of the UNFCCC and the Paris Agreement. Mandates must include periodically reviewing and updating the NAP and other relevant and aligned policies and plans. The MoEFCC can refer to the ***Constitution of the People's Republic of Bangladesh***[11] ***and Article 18A*** on the protection and improvement of the environment and biodiversity to develop required policy.

Under the proposed climate change policy regime, the existing National Environment Policy (2018) would act as an overarching umbrella policy instrument to integrate and update climate change adaptation, mitigation, finance and capacity development-related directives. This policy should integrate the vision of the NAP and NDCs; align with the BDP2100, national vision and SDGs; and provide necessary directives as a means of implementing the national aspirations for NAP and NDCs as a member parties of UNFCCC in its Section 3.19.[12] The policy should widen the window in this regard with a flexible revision and update procedure to reflect evolving national and international climate policy instruments, including

[11] *The Constitution of the People's Republic of Bangladesh' (Act No. of 1972), Article 18A: The State shall endeavour to protect and improve the environment and to preserve and safeguard the natural resources, bio-diversity, wetlands, forests and wild life for the present and future citizens [accessible at: http://bdlaws.minlaw.gov.bd/act-367/section-41505.html]*

[12] *Section 3.19 of the National Environment Policy (2018) includes policy directives on climate change preparedness.*

decisions at the COPs and meetings of the UNFCCC Parties (Article 6 of the Paris Agreement, for example, is still changing).

The BCCSAP will be updated to develop sector plans for adaptation, mitigation, capacity development, financing and technology transfer based on the NAP and NDCs, and in alignment with the BDP2100, the Perspective Plan, the Five-Year Plan, and the SDGs. This updated BCCSAP should consider all development sectors in devising their respective climate actions for the next five years. It can act as the Integrated Sector Action Plan on Climate Change (ISAP-CC) to implement planned climate actions through the Annual Development Programme (ADP) of the Five-Year Planning Cycle.

The NAP further proposes developing the Local Adaptation Programme of Action (LAPA), the Youth-Led Adaptation Plan (YLAP), the Chattogram Hill Tracts Climate Action Plan (CHT-CAP), the Adaptation Plan for Persons with Disabilities, the City Climate Action Plan (City-CAP) for major urban and rural cities, the Sector Adaptation Plan for Infrastructure and the Sector Adaptation Plan for WASH. The National Adaptation Plan for Health (H-NAP) is being developed and the Climate Change Gender Action Plan (ccGAP) is being updated. All these plans will be mainstreamed into the NAP implementation process through the BCCSAP update or preparation of the Integrated Sector Action Plan on Climate Change. A comprehensive roadmap or action plan for the NAP implementation will be developed to determine the next actions for implementation, with a development result framework (DRF) as an essential element.

4.1.2 Institutional arrangements and coordination

The NAP offers a multilevel, inclusive institutional structure based on the existing institutional framework, conforming with horizontal and vertical links to carry locally led adaptation towards the national level and vice versa. The NAP enforces adoption of this multilevel structure for better use of existing institutional arrangements. As such, adaptation-related scopes of work, roles and responsibilities will be defined and integrated into the existing organogram and mandated under the proposed policy regime.

The National Environment Council (NEC), headed by the Honourable Prime Minister of the Government of the People's Republic of Bangladesh, provides necessary oversight of the implementation of National Environment Policy. The council should be renamed as the ***National Council on Environment and Climate Change (NCECC)*** with responsibilities added to oversee strategy and policy-level progress and outcomes of the NAP and the NDCs under the umbrella of the National Environment Policy.

The existing ***Interministerial Steering Committee on Climate Change, (ISCCC)*** headed by the Minister of MoEFCC will steer the NAP implementation and conduct regular interministerial coordination meetings, keeping NAP implementation and monitoring high on the list of priorities. This committee will play key roles in coordination, communication and engagement among the Ministry of Planning (MoP), MoF, ERD, and other sectoral ministries. The committee will be mandated to meet biannually to take stock of strategic and policy-level progress monitoring and evaluation of the NAP (Tier 1, see Chapter 5) and report to the NCECC for regular monitoring and supervision.

The Interministerial Steering Committee on Climate Change (ISCCC) will form the ***National Technical Advisory Committee on Climate Change (NTACCC)*** for the NAP, headed by the Senior Secretary/Secretary of the MoEFCC, to provide regular updates on the NAP implementation. It will also address gaps or challenges to the smooth implementation of the NAP. The National Technical Advisory Committee *on Climate Change (NTACCC)* will involve national focal points equivalent to additional/joint secretaries or deputy secretaries (where appropriate), selected by sectoral ministries, departments, divisions, top-tier representatives from the private sector, NGOs, CSOs, women's and youth associations, CBOs, etc. The committee will provide technical support and advice, facilitate the effective participation of and inputs from NAP actors, and endorse adaptation plans and budgets

for implementation. A dedicated unit in the MoEFCC may be set up to facilitate development budget allocation for climate actions, coordinating with the ERD, MoP, MoF, development partners, the Public Private Partnership Authority (PPPA), international climate funds, private sector representatives and other external sources.

The National Technical Advisory Committee (NTACCC) will play a key role in coordination, communication and engagement within the MoEFCC, MoP, MoF, ERD and other sectoral ministries. It will liaise and coordinate with focal points from BCCT, the MoP and the ERD as gateways for external finance, iBAS++, development partners, bilateral and multilateral partners, CSOs, the private sector, media, NGOs, and representatives of women, youth, persons with disabilities and ethnic communities. The committee will meet quarterly and guide sectoral focal points on updates, revisions or challenges and the scaling up of initiatives. This committee will undergo reform every one to two years.

The National Technical Advisory Committee will carry out required planning, monitoring and evaluation of the implementation of adaptation strategies and actions outlined in the NAP at the planning level with the support of relevant wings of the MoEFCC. A Technical Working Group on NAP and NDC Implementation will assist the advisory committee in this regard. The working group will be headed by the Additional Secretary of the MoEFCC. The Technical Working Group on NAP and NDC Implementation, in consultation and coordination with the Implementation Monitoring and Evaluation Division (IMED) of the MoP and the General Economics Division (GED) of the Bangladesh Planning Commission, will prepare an M&E report on NAP implementation (Tier 2, see Chapter 5).

The Technical Working Group on NAP and NDC Implementation will maintain coordination of adaptation- and mitigation-related activities across relevant thematic stakeholders and in terms of the allocation of the development budget for adaptation from the MoEFCC. The NTACCC, NAP will delegate responsibilities to focal points from sectoral ministries for different thematic areas such as water and disasters; agriculture, fisheries and livestock; biodiversity and ecosystems; urban resilience; infrastructure; health and WASH; and different cross-cutting areas like gender, the elderly, youth, persons with disabilities, ethnic minorities, the private sector, GCA, CVF, etc. The DoE can provide secretarial support to facilitate this process.

The Technical Working Group will supervise and generate CCA relevant information and communicate it to broader audiences. It will publish an annual National Climate Status or Outlook report covering historical trends in climate and climate change-induced hazards, future projections, risks and vulnerabilities, successes of and barriers to adaptation, and the need for adaptation, innovation, climate investment, adaptation M&E, adaptation-related communication, etc. The working group will liaise with the Bangladesh Meteorological Department (BMD), the Department of Disaster Management (DDM), the Bangladesh Bureau of Statistics (BBS), DoE, BCCT and other relevant sector departments or agencies or knowledge institutes under the policy regime to support in publishing the report.

The NTACCC will select and delegate prominent sector experts and representatives from research and knowledge institutes in the government and private sector to support the Technical Working Group and NTACCC. National research and knowledge institutes experienced in this arena, like CEGIS and universities, will play significant roles in providing support, intellectual services and advice. The Technical Working Group will meet bimonthly to monitor and supervise assigned activities.

The NAP implementation will enable transformative capacity development of the relevant wings of MoEFCC. It will increase human resources, infrastructure, training and networking to meet given mandates.

Existing ***District Development Coordination Committees (DDCC)*** chaired by the deputy commissioners in each district will be given the scope to stocktake, guide, supervise and administer climate change adaptation initiatives

mandated by the policy regime. The committees will play a central role in local, regional and sectoral planning and implementation of CCA with community and value chain actors. The NAP institutional framework will include representatives of LGIs, municipalities, city corporations, and *upazilla* and union *parishads* in the DDCC. The mandates of the existing DDCC will need to be revised to include representatives from the private sector, CBOs, CSOs, NGOs, women, the elderly, youth, persons with disabilities, ethnic communities and other marginalized groups, towards ensuring locally led, gender-, age- and disability-responsive and socially inclusive NAP implementation. The DDCC will coordinate with local disaster management committees at the district, *upazilla* and union levels as well as Cyclone Preparedness Programme representatives to ensure their contributions to NAP implementation. The DDCC will include a stocktaking of adaptation projects in the agenda for monthly coordination meetings.

The committees will consider locally led adaptation needs defined by local representatives from the community, LGIs, the private sector, NGOs, development partners, etc., and their transfer to the national level as well as vice versa. The committees will track local adaptation needs, priorities and feedback and distribute research support, training and capacity-building through decentralized management. Committees will regularly report to the Technical Working Group on NAP Implementation with a copy to national sectoral focal points and relevant adaptation project implementation entities to equip them with up-to-date information and convey identified adaptation needs, implementation status and challenges, resources and capacity-building needs, etc. to local governments, private sector entities and communities for planning-level M&E.

In the proposed inclusive institutional arrangement, development partners will offer support through assessing, prioritizing and providing development assistance based on the needs of the Government and local communities. Media will be used extensively to communicate and build awareness of climate change impacts, risks, vulnerabilities, adaptation and mitigation.

The NAP implementation will maintain effective multilateral coordination with stakeholders at multiple levels to carry out smooth strategic and technical decisions, ensure policy coordination, mobilize and use finance, leverage the private sector and maintain synergies with multilateral environmental agreements. It will further enhance the roles and responsibilities of key institutions in the following areas: assessment of impacts and vulnerability; climate information and knowledge management; identification and prioritization of CCA; planning and integration of CCA in national, sectoral and regional planning; fund mobilization and budgeting; implementation and M&E; and coordination and cooperation. The NAP implementation will also enhance institutional and professional capacities for planning, financing, implementation and M&E, and for institutional integration by strengthening coordination mechanisms among sectors and agencies to build synergies and achieve greater impacts.

An effective coordination mechanism will be developed with key sectoral and cross-cutting ministries. The NAP implementation process will initiate and strengthen the following three types of coordination mechanisms at different levels: policy and strategy coordination, technical coordination for planning and implementation; and financial and performance coordination.

The NAP implementation will emphasize capacity-building for technical knowledge generation and management, knowledge and information-sharing and cooperation, stakeholder participation in project planning and implementation, mobilization of financial resources, and effective coordination among institutions, actors and agencies. Transformative capacity-building for individuals, institutions and systems will be developed towards those ends. A national pool of experts is a vital requirement. Relevant professionals, academicians, private sector personnel and individuals will be trained on climate change knowledge management, planning and integration of CCA, climate financing from; implementation of CCA projects and monitoring outcomes so that they

can effectively participate in NAP implementation processes. The skill development training for individuals should be certified/acknowledged by National Skills Development Authority (NSDA) or government accredited training centres in appropriate cases.

4.2 Private Sector Engagement

Two potential windows can be used to engage private sector stakeholders in adaptation. Promoting and accelerating private sector-led adaptation will be the first strategy. Engaging the private sector in financing adaptation or providing financial services for adaptation will be the second. Both options involve challenges that will be overcome by developing an enabling policy environment, innovative incentive mechanisms, the careful selection of potential investors, awareness-raising, required skills and capacity-building.

There is ample scope for the private sector to implement several identified adaptation interventions with government agencies, LGIs and development partners. Large industries are already adopting disaster preparedness measures that will consider and transform into planned adaptation. Risk mapping of informal sector actors and CMSMEs will be undertaken at the local level. Given their higher vulnerability and adaptation needs, coverage of incentives, subsidies and risk recovery mechanisms, such as crop insurance or tax rebates, will be increased based on the risk maps and towards building back better.

Incentives will be provided for climate-resilient CMSMEs, the production of blocks, silage, cooperatives of dairy farmers, fish famers and agro-farmers. Initiatives will include green credit guarantees, relaxed credit facilities and reductions in bureaucratic paperwork at banks to enable easy access to credit or cash incentives by informal actors and CMSMEs. Dialogue with informal sector actors will emphasize the financial inclusion of smallholder farmers and rural SMEs and households. Awareness and skills development programmes will sensitize them to the adverse impacts of climate change, opportunities for alternative livelihoods and increased adaptive capacity. Climate victims near industrial areas could be assisted through skills training centres equipping them with marketable skills in industry.

A set of priority areas identified in Section 3.3.8 will be further scrutinized and streamlined for private sector stakeholders to undertake or finance adaptation initiatives. Large industries or enterprises and financial institutions will be called on to take a lead role in the integration and promotion of climate change adaptation. Extended research and innovation will advance state-of-the-art technologies and develop bankable products and services such as stress-tolerant seeds; climate-resilient and eco-friendly construction materials, housing and infrastructure; dredging and reuse of dredging materials; green and renewable energy-based products; climate-smart WASH and water treatment technologies; eco-tourism; waste management and environmentally friendly recycled products; enhanced climate advisory services; expansion of ports and water transport; improved cold storage facilities; green parks and low-impact development in urban areas; digital SMEs and e-commerce; expanded aquaculture and agriculture value chains, etc.. These products and services will contribute to adaptation and generate higher profits for enterprises. The private sector may also explore new markets with goods and services that support adaptation and build resilience in the economy and society.

Government policy will be to engage the private sector and financial institutions in supporting the mobilization of climate finance for adaptation as well as in accessing climate finance from the GCF and other international climate funds and development partners. Key strategies for private sector engagement in climate finance will include: incentives through innovative financing instruments, de-risking capital & blended finance, and tax and value added tax exemptions; tax holidays; index-based insurance; development of a green bond market; enhanced corporate social and environmental responsibilities for adaptation; and public-private partnerships through discussion with relevant key stakeholders like the Finance Division, Bangladesh Bank, ERD, development partners and NGOs.

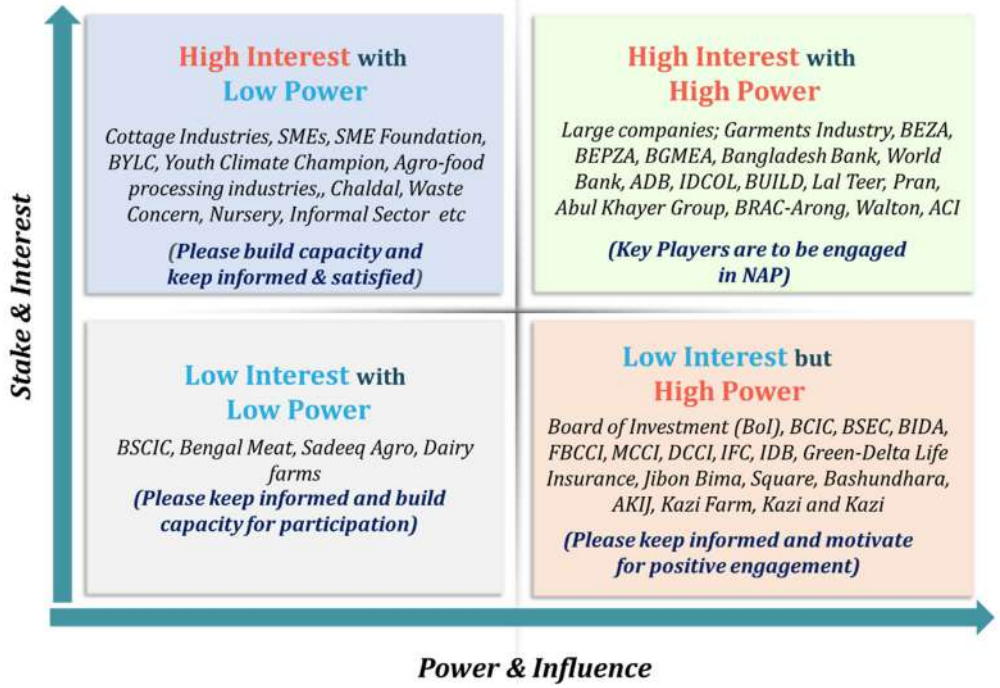
Efforts will be made to review and update the scope of the existing CSER policy to develop and promote an attractive incentive package that enables financing of prioritized adaptation measures and sectoral resilience. Promoting the social responsibilities (ESR) of enterprises could include engaging youth and recognizing their contributions to solving social problems.

The updated Climate Fiscal Framework (MoF, 2020) illustrated the potential scope of private sector engagement through VAT or other tax instruments, which should be piloted in vulnerable areas. The Sustainable Finance Policy of the Bangladesh Bank (2020) has created an avenue for financial investment in green products and renewable and clean energy for mitigation and low-carbon development as well as adaptation in vulnerable sectors. It is a structured mechanism for identifying and recognizing green products in agriculture, CMSMEs or other socially responsible financing categories linked to the SDGs.

The private sector should also access the GCF and multidonor climate funds for adaptation and mitigation efforts and be committed to and prepared for tapping global climate finance. International climate funds like the GCF or GEF and development funds such as those from the World Bank, Asian Development Bank (ADB), KfW, etc. have their own mechanisms to engage private firms, including the Private Sector Facility of the GCF. The Government of Bangladesh will expedite the process and provide readiness support to build the capacity of the private sector in accessing this finance.

The Government has developed public-private partnership guidelines and provided public-private partnership technical assistance and financing for capacity-building on CCA prioritized PPP projects. These incentive mechanisms should be well advertised and an awareness-building programme conducted towards effective private sector engagement (PSE). Different modalities to explore to encourage PPP projects under the NAP include build-own-operate (BOO), build-operate-transfer (BOT), build-own-operate-transfer (BOOT); and design-build-finance-operate-maintain (DBFOM). Key enabling conditions include information-sharing for planning and integration of CCA, financing, institutional arrangements, and coordination and capacity-building.

The Government will expand and improve its existing good relationship with the private sector and mechanisms for private sector engagement



under the NAP through meaningful participation, information-sharing and demonstration of leadership. Major efforts will seek to develop and expand women-led enterprises and support their participation in the implementation of CCA as well as contributions to climate fund mobilization.

The Kampala Principles promote ownership of private sector engagement through development cooperation by partner countries and seek to ensure the alignment of private sector projects and programmes with national sustainable development priorities. Through development cooperation, leveraging innovation and potential and additional private sector finance (grants, low-interest loans, etc.) will be organized for climate-resilient development.

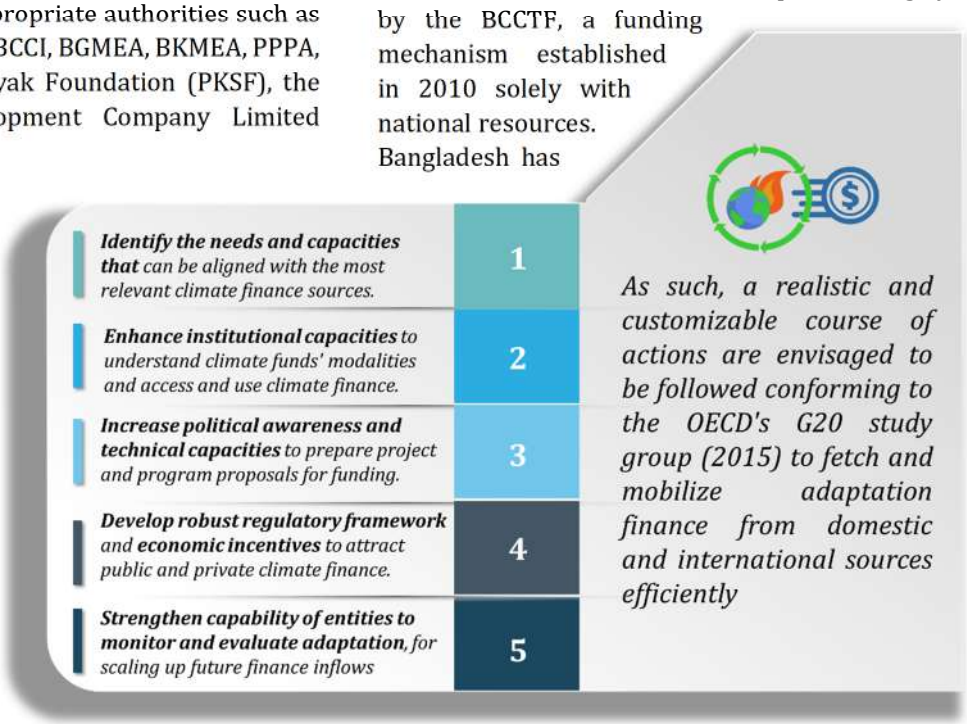
Private sector actors with high interest and power will be engaged in NAP implementation and in mobilizing domestic climate funds for adaptation and resilience. The Ministry of Finance, in association with MoEFCC, MoI, MoC, ERD, BSEC, the Bangladesh Bank and the National Board of Revenue (NBR), will take the lead role in tracking the progress of private sector engagement in adaptation and its financing. They will maintain close liaisons and coordination with representatives of appropriate authorities such as BEZA, BEPZA, BIDA, FBCCI, BGMEA, BKMEA, PPPA, the Palli Karma-Sahayak Foundation (PKSF), the Infrastructure Development Company Limited (IDCOL), etc.

Private sector with high interest but low power will need technical capacity and awareness to integrate adaptation and mitigation in sectoral strategies and activities, however. The Government commits to keeping them well informed of and motivated to engage in NAP implementation.

4.3 NAP Financing Strategies

The climate crisis and an outlook of economic losses warrant devising realistic and robust financing strategies for harnessing, mobilizing and using funds for the NAP implementation. By one estimate, Bangladesh currently faces GDP losses of around 1.3 percent per year due to climatic events, which may rise to 2 percent per year by 2050 under extreme climate change conditions. The government currently spends around 6-7 percent of its annual budget on climate change adaptation (MoF, 2021), with more than 75 percent of this amount coming from domestic sources. Adaptation finance needs will undoubtedly increase with slow-onset and frequent extreme events. By 2050, total adaptation costs for tropical cyclones and storm surges are estimated at $55.167 billion with annual recurrent expenditure of $112 million, while the total adaptation cost for inland monsoons is projected at $26.71 billion with annual spending of $54 million (World Bank, 2010).

The current climate finance landscape is led largely by the BCCTF, a funding mechanism established in 2010 solely with national resources. Bangladesh has



accessed resources from the GCF, Least Developed Countries Fund, Adaptation Fund and other bilateral and multilateral funds. International financial resources are very insignificant compared to prevailing requirements, however. For instance, the 52 climate change adaptation projects in the BDP2100 have a projected cost of $23.23 billion. The plan envisages $2 billion from the GCF every year for financing such an amount.

Bangladesh has become lower middle income country and is set to graduation from least development country status by 2026, which is putting extra pressure on available funds from domestic public and private sources. The need for harnessing opportunities through international climate funds will be higher. As such, a course of action is envisaged to efficiently mobilize adaptation finance from domestic and international sources, in line with the G20 study of the Organisation for Economic Co-operation and Development (OECD, 2015).

With current domestic financing inadequate for building a climate-resilient Bangladesh, the need to mobilize international development finance is urgent, including from bilateral sources, United Nations entities, the World Bank, the ADB, the International Monetary Fund, JICA, KOICA and other appropriate global financing institutions for building resilient infrastructure. But this mobilization must be based on grants and concessional loans for adaptation-related projects. Development partners should play a significant role and allocate enhanced funds for reducing adaptation cost deficits and paving pathways to sustainable and climate-resilient development.

The NAP implementation process will strengthen the climate-inclusive public financial management (PFM) system through an updated climate fiscal framework to access, allocate, prioritize and utilize climate funds from public, private and international sources, efficiently and in a transparent way. Also, it will bolster efforts to access climate finance from international climate funds (GEF, Adaptation Fund, GCF, etc.), and bilateral and multilateral sources. Potential options for harnessing climate funds under readiness support or through direct access should be further explored.

The NAP implementation process will seek to accelerate and scale up the mobilization of funds from domestic sources through exploring innovative financing instruments, such as expanding insurance for risk management or as a risk transfer tool, investment in equity and green/climate bonds, reimbursable project aid, strengthening capital markets, the proper use of green loans, and blended climate finance where public finances can catalyse public-private partnerships (PPP), where public finances can catalyze.

Steps will expand financing for locally led adaptation (LLA), which Bangladesh is leading globally. The NAP implementation process will increase access to low-interest loans for adaptation measures and make EbA funding available following the payment for ecosystem services instrument (PES). Other instruments would entail establishing a local government fund for climate risk management to strengthen the capacities of community and local governments in promoting locally led adaptation, and financing through expanded green banking using or updating CSR policies of Bangladesh or private banks. Bangladesh Bank, for example, may channel 10 percent of its annual CSR budget to a Climate Risk Fund to green its loan portfolio in different sectors.

The potential of other CCA finance will be harnessed through increased awareness in the private sector and among NGOs and CSOs as suggested in the updated Climate Fiscal Framework (MoF, 2021), after rigorous consultations with relevant stakeholders like the NBR, ERD, MoF, Bangladesh Bank, BSEC, NGOs, the private sector, etc. Introducing tax holidays; VAT exemptions; crowdfunding; a green transformation fund and subsidy policies for green products and imports; scaling up inputs (such as eco-friendly brick), infrastructure (cyclone shelters, waste management systems) or products (a climate information services tool) and so on will be considered.

A review and update of the existing lending policy for funding projects will aim to increase adaptive capacity and green growth. Similarly, the insurance policy will be reformed to address the differentiated impacts of climate change on diverse marginalized groups, the informal sector and CMSMEs. Enhanced coordination with PPPA will address the challenges and broaden the scope of private sector engagement for financing and implementing adaptation actions. The MoEFCC will play a supervisory role, while the ERD and Finance Division will oversee the mobilization of climate financing. Introducing innovative financing under PPP, there is a poses a need to reform government tax and incentive policies to foster a conducive environment for all stakeholders.

The BCCT Act will be updated and a dedicated unit will be established under the MoEFCC to coordinate and mobilize funding for the BCCTF from domestic and international sources in collaboration with the ERD, MoP, MoF, PPPA, development partners, the private sector, international climate funds and other external funding sources. Strategies will be formulated and capacities among relevant public or private sector entities will be built to overcome barriers, including capacities related to international standards for fiduciary management, towards transforming the governance of climate financing.

More organizations should secure accreditation as national implementing entities (NIEs) or direct access entities (DAEs); PKSF and IDCOL are already the latter. Other environmental or biodiversity funds should be accessed to promote EbA, NbS, and LLA, such as the Nature+ Accelerator Fund, Reducing Emissions from Deforestation and Forest Degradation Plus (REDD+), the Biodiversity Fund, the CCAFS-CGIAR Readiness Fund, debt for adaptation swaps, etc. Formulating financing solutions and managing the environment and climate change should distribute investment burdens across relevant issues and actors. For instance, funding for waste management systems also reduces the cost of adaptation in terms of urban damages.

Finally, scaling up capacity-building and awareness-raising, developing a transparent audit system, good governance, and coordination among the public and private sectors, NGO actors, DAEs, NIEs, and development partners are continuous processes for mobilizing needed climate finance. Strengthening existing capacities to access national and international funds, improving the climate finance model for better fiduciary management, and better institutional arrangements for the accessibility of funds will be prioritized.

4.4 Mainstreaming Guidelines

Climate Change Policy Regime emphasized in Section 4.1.1 will provide guidelines and directives for this mainstreaming tool and integrating the CCA into different sectoral policies, plans, and guidelines under the policy mandate. Integration of the NAP is proposed in four stages: 1) strategies and policies, 2) operational development planning, 3) resource allocation and implementation, and 4) M&E. The NAP proposes the following key strategies to enable the successful integration of the NAP into the development planning process.

For the strategic and policy level, the NAP emphasizes updating BCCSAP as the Integrated Sector Action Plan on Climate Change, based on the NAP and NDCs, and aligning with the BDP2100, the Perspective Plan, the Five-Year Plan, the MCPP (draft) and the SDGs. The update will act as a bridge to integrate the NAP into the Annual Development Programme (ADP) and to bring climate change into all relevant sectors; translate national NAP strategies to the local level through formulating and fixing coordinated and decentralized implementation modalities for the LAPA, ccGAP, YLAP, City-CAP, Adaptation Plan for Infrastructure and WASH, the Persons with Disabilities and CHT-CAP, etc.; address gender-, age- and disability-inclusive climate change risks and vulnerabilities as compulsory prioritization criteria for ADP formulation; demonstrate a clear awareness of climate-related risks, needs and responses to incorporate adaptation into relevant policies; and adopt a climate-focused approach to

policy and strategy formulation, applying a climate lens and developing strategies for enabling proactive adaptation programmes or projects for climate-resilient development.

Integrating climate change into operational development planning would be the priority immediate action area through a slight reform of the operational development planning manual, guidelines and frameworks in consultation with Planning Commission, Ministry of Finance and other relevant sectoral ministries. Such as, conducting Climate Impact Assessment (CIA) should be made compulsory as part of feasibility studies for the approval of DPP by the Planning Commission. Climate change issues will need to accommodate more specifically, covering both slow-onset and extreme events inside the existing Disaster Impact Assessment (DIA) Framework to make CIA process smooth. The current DIA framework was developed under clause 24.3 of the manuals for the development and appraisal of Development Projects Proforma (DPP) through disaster risk-informed planning. The NAP seeks to rename the framework as the Climate and Disaster Impact Assessment (CDIA) framework to establish synergies CCA and DRR in planning and enabling climate- and disaster risk-informed development planning. Climate change risk-adjusted economic and financial analysis and costs (NPV, IRR, and BCR) should be included during development project formulation and appraisal. This climate-sensitive costing will support climate-sensitive budgeting through the iBAS++ along with harnessing and mobilizing resources.

The scope of redirecting funds towards vulnerable sectors and regions and providing funding for certain adaptation plans or activities will need to be widened. It will emphasize developing and operationalizing climate-resilient guidelines for infrastructure and development. Since the NAP is prioritizing local level adaptation, it will translate national priorities and budgetary envelopes into local and sectoral plans. The Medium-Term Budgetary Framework (MTBF) will include investment ideas from the NAP investment portfolio and extend the fiscal policy horizon for addressing climate change adaptation. The existing Fiscal Policy Framework and iBAS++ will be integrated with the thematic sectors of the NAP for atomization of the climate budgeting and tracking mechanism.

The log framework will be updated in addition to the theory of change, comprising baselines, targets, outcomes, assumptions, etc., to facilitate development project design, climate risk screening, appraisal, implementation and M&E. The MoEFCC will be included mandatorily in all project steering committees (PSC) and project implementation committees as a climate checkpoint for implementation and M&E. Similarly, the obligatory inclusion of the MoEFCC in project evaluation committee (PEC) s or special project evaluation committees (SPEC) will be prioritized for comprehensive evaluation of climate risk-informed development.

4.5 Enhancing Transformative Capacity and Technology Transfer

Transformative capacity development and the transfer of technologies are crucial elements of the NAP formulation and advancement process, both among and by stakeholders at multiple levels and across multiple sectors. There are significant challenges in capacity-building and technology transfer initiatives specific to CCA, especially at the system or planning and institutional levels.

Key barriers include present practices of conducting capacity-building through ad hoc initiatives; frequent changes in posting government officials; a lack of required institutional infrastructure; limited research facilities, country-driven research and knowledge management initiatives; an inadequate supply of funds for research and technological innovation; a lack of coordination among research institutes, etc. While many individual capacity-building initiatives are taking place, there is less continuous development of knowledge and communications skills. Community members, including especially

vulnerable groups like women, youth, people with disabilities, ethnic communities, etc., and private sector stakeholders should be covered under comprehensive capacity-building regimes.

Developing a transformative capacity-building regime and proactive learning sphere is recommended for the system level through implementing the Transformative Capacity-Building Action Plan for Climate Change Adaptation (MoEFCC, 2022a). This action plan was devised to separately assess capacity-building needs at the system or planning, institutional, and individual or community levels, towards implementing innovative measures instigating transformations in capacity development practices that lead to deliberative adaptation. This transformation goes beyond performing tasks like training; instead, it is more about changing mindsets, behaviours and attitudes (UNDP, 2009). Implementing the proposed plan would facilitate desired transformations in capacity development through medium- to longer-term initiatives. Field-level demonstrations or hands-on training on climate-resilient technologies for different sectors, alternative livelihoods, disaster preparedness emergency responses, etc. will prioritize community-level capacity development and engaging LGIs, CBOs, NGOs, youth and the private sector in an inclusive and gender-responsive way.

Further, ongoing development of a separate and complementary Knowledge Management Plan for CCA by MoEFCC (MoEFCC, 2022b) will effectively support capacity-building and the technology transfer process. The NAP implementation process will facilitate ensuring the implementation of innovative ideas in the knowledge management plan to facilitate transformative capacity development, sustainable knowledge management and technology transfer. The knowledge plan proposes the Bangladesh Climate Change Knowledge and Technology Network for creating opportunities and providing technical assistance; connecting all research, academic, training and knowledge institutes from the public and private sectors; and promoting research, innovation and technology transfers. This network will continue collaborating with the UNFCCC's Climate Technology Center and Network and the Global Center on Adaptation. The B-CCKTN will also ensure alignment with global capacity-building programmes, and the regular organization of knowledge exchange and technology transfer programmes to learn lessons from other vulnerable countries and showcase the best adaptation practices.

Increasing national and sectoral budget allocation is proposed to support more intensive research on climate change issues and generate up-to-date knowledge and information on climate risk, vulnerabilities, adaptation and mitigation. In mobilizing enhanced research grants, preference will go to: inventing advanced adaptation technologies and nature-based solutions for priority areas of the NAP in the country context; AI, machine learning and space technology innovations considering the Fourth Industrial Revolution (4IR); research on potential climate change risks; the generation of downscaled local climate information; collaborative research; transfers of technologies; post-graduate research, master's and PhD programmes, and peer reviews of publications; and outreach on all research outcomes, etc.. Sectoral ministries through NTACCC will make their recommendations for selecting priority research areas aligned with the development thrust and adaptation needs to address climate risks and vulnerabilities; potential technological advancement; knowledge generation and innovations for adaptation.

4.6 Strategic Data and Knowledge Management

The NAP implementation process will steer implementation of the Knowledge Management Plan for Climate Change Adaptation (MoEFCC, 2022b) and manage complementary strategic data and knowledge. The plan sets forth strategic actions based on an assessment of knowledge supply, demand and communications need during the NAP formulation process. Strategic data and knowledge management will include the generation of updated science-based and

participatory climate change-related data and information through extensive and innovative research, studies, piloting and multilevel stakeholder consultations. It will also include storing and communicating that knowledge to support the NAP implementation.

The NAP M&E framework, as proposed in Section 5.2, will strengthen this process, helping to substantially overcome data collection challenges related to setting baselines and in terms of collection frequency, and the consistency and synchronization of data sets. It will support the development of required protocols, memorandums of understanding and institutional arrangements. It will also develop the collection, processing, storage and evaluation of data sets based on M&E indicators. To facilitate this process, the Technical Working Group on NAP Implementation in coordination with IMED and GED will maintain liaisons with existing relevant national and international databases or nodal agency for data generation and storage such as the National Water Resources Database (NWRD), the Integrated Coastal Resources Database (ICRD), BBS, the BBS-ECDS, BMD, DoE, iBAS++, the Disaster and Climate Risk Information Platform (DRIP), GeoDash, BWDB, FFWC, WASA, DPHE, UDD, LGED, RHD, DDM, BIWTA, the Survey of Bangladesh (SoB), the BDP2100 Knowledge Portal, the IPCC WGI Interactive Atlas, the SDG Tracker, World Bank and ADB platforms, FAO-AquaStat, etc..

Building the required centralized and up-to-date data management system with stakeholders at multiple levels will help mainstream, design, deliver and improve climate adaptation work. Better data collection and management of inputs, processes, outputs, outcomes and the impacts of an adaptation action through M&E will improve planning systems, adaptive management and the effective allocation of resources.

4.7 Communicating the NAP

The Climate Change Information and Knowledge Management (CCIKM) Portal is being developed by the MoEFCC as an umbrella platform to embed and dynamically connect, store and publish all climate change-related data set reports and adaptation-related information from similar initiatives and by stakeholders. The proposed NAP M&E framework will be linked dynamically with this portal to transparently track and disseminate progress. Using suitable advanced digital technologies, data sharing, updates and access protocols will be developed to ease data communication.

The proposed national climate status outlook report in Section 4.1.2 will be published in collaboration and coordination with relevant knowledge and data generation agencies and national institutes to convey the status of climate change and responses under the NAP and NDCs to all stakeholders. Increased networking with international climate data and knowledge management hubs like the NAP Central Portal of the UNFCCC, the NAP Global Support Programme Portal, the NAP Global Network, the UNCC-ELearn, the Asian Adaptation Hub, etc. will be explored and knowledge exchange programmes or conferences organized.

Effective and clear communication with government and non-governmental stakeholders throughout NAP implementation will help reflect their specific needs and preferences for adaptation actions. Successful and well-circulated communication of the NAP will boost awareness, participation and cooperation among different stakeholders, supporting the pathway to enhanced climate resilience and sustainable socioeconomic development.

A well-organized and inclusive communications strategy will be developed and include important messages tailored for priority audiences and delivered through the most appropriate communications channels to reach audiences locally, nationally, and globally.

Many sectoral ministries, divisions, departments and government institutes have diverse roles in the coordination, implementation and monitoring phases of the NAP process. Apart from policymakers and government bodies, many other influential stakeholders are important audiences

for disseminating messages about climate change impacts. They include the general public, the private sector, technical and financial partners, local authorities, young people, women, journalists, educators, celebrities, civil society and artists. Other sector-specific stakeholders to reach include farmers and fishermen as they are instrumental in building resilience to climate change impacts.

The NAP identifies potential media and tools for communication, such as websites, apps, national workshops, press conferences, online training, webinars, talk shows, media coverage, policy briefs, policy story maps, infographics, flyers, animated short videos, etc. The NAP also identifies potential priority areas for communications as: information about climate impacts, risks and vulnerabilities; climate adaptation and mitigation; national circumstances and responses; institutional aspects and financing; inclusiveness and participation; cooperation and coordination; sharing best practices and lessons learned; barriers, challenges and gaps related to adaptation; synergies between adaptation and mitigation, etc.

NAP communication should be done in gender- and disability-sensitive ways to reach women, men and people with disabilities equally. It should take an inclusive approach to pronouns and avoid language that portrays women as passive recipients of aid. It will craft messages depicting women as agents of change, avoid patronizing statements about women or information that will lead to material or educational deprivations; avoid objectifying women through images and avoid language that victimizes people in marginalized conditions, including women and others. It will use storytelling to demonstrate impacts and show what gender-lens investing is about and how a gender-inclusive NAP can foster a climate-resilient society.

Communication to international audiences in parallel to national ones will also be prioritized, in line with the UNFCCC, Paris Agreement and COPs. Adaptation communication through biennial reports (decision 2/CP.17) will inform global platforms about national circumstances, success stories in adaptation, barriers and challenges, potential cooperation or development assistance or technology transfer needs, and contributions to international efforts to tackle climate change. includes key communication agendas and potential materials for target audiences.

Particular emphasis on the use of national and local languages will be placed when translating communications messages at various levels, as well as when selecting communications channels and messaging systems to facilitate simultaneous dissemination of information, raise awareness, share knowledge and change attitudes towards climate change adaptation on the mass and grass-roots levels.

Audience & Stakeholders	Key Issues	Communication Materials
Government Policymakers and planners	Nature and level of vulnerability Adaptation Needs and Priorities Indicators for adaptation and resilience Steps for mainstreaming and integration of CCA in national and sectoral planning Climate finance and governance Global negotiations and outcomes etc.	Technical paper, reports, fact sheets, policy brief; web portal; Infographic; Press brief for a press conference; Webinars, seminar, workshops, consultation, visit successful adaptation projects, exhibitions
Vulnerable Community and People	Climate change trends and impacts in the regional and local levels Sectoral, regional, and community adaptation options & strategies Adaptation technologies and innovation Sources of information and adaptation technologies Adaptation technology generation and dissemination etc.	Leaflets, booklets, poster, fair for mass awareness, flyer, documentary films; education materials for students & Youth; workshops, public lecture & rallies, consultation, exhibitions, social media
LGIs and Implementing agencies	Local-level climate change vulnerabilities. Climate-development linkages and needs. Strengthening awareness and capacity on climate change adaptation Monitoring, review, and updating of adaptation plans over time	Technical paper, reports, fact sheets, policy brief; web portal (databases; information and knowledge hubs); Infographic; Outreach documents, Webinars, seminar, workshops, consultation, visit successful adaptation projects, exhibitions
NGOs and INGOs	Sector-specific or location-specific climate change adaptation needs and priorities. Vulnerability and economic impacts of climate change . Technology needs assessments. Ongoing and past adaptation activities	Technical paper, reports, fact sheets, policy brief; web portal (databases; information and knowledge hubs); Infographic; Outreach documents, Webinars, seminar, workshops, consultation, visit successful adaptation projects, exhibitions, social media
Private Sector	Enabling factors that facilitate private sector engagement in adaptation Understand NAP financing needs, and develop feasible, bankable project Examples of instances where the private sector has successfully engaged with climate change adaptation	Generate climate data and information and communicate it to the private sector, share stories of success and failure, exhibitions
Mass Media	Strengthening awareness and capacity on climate change adaptation The ability of communicators to handle information relating to climate change adaptation	Reports, fact sheets, policy brief; web portal (databases; information and knowledge hubs); Infographic; Documentary films, Outreach documents, Webinars, seminar, workshops, consultation, visit successful adaptation projects, exhibitions, social media
UN Agencies	Sharing of knowledge and facilitating learning Strengthening technical and institutional capacities Providing financial and technological support	Progress reports, Gap & Need Assessment Reports, Monitoring, and Evaluation reports, fact sheets, policy brief; web portal (databases; information and knowledge hubs); Infographic; Outreach documents, Webinars, seminar, workshops, consultation, visit successful adaptation projects, exhibitions
UNFCCC & COP Process	Submit and periodically update an adaptation communication, including its priorities, implementation and support needs, plans, and actions	NAP document; National Communication; Adaptation Communication (ADCOM)

4.8 Gender, Disability, Youth and Social Inclusion

Ensuring socially inclusive adaptation, including for women, youth and people with disabilities, is an essential guiding principle of the NAP. The formulation process ensured an inclusive approach and fortified engagement with and the participation of women, youth, the elderly, persons with disabilities, ethnic communities, students and other marginalized groups in every stage, especially during the rigorous consultative process to identify adaptation needs and prioritize adaptation options for reducing the disproportionate impacts of climate change.

Recognizing the greater exposure of different vulnerable groups and higher inherent need for adaptive capacity, a friendly environment for adaptation will be established that is gender-, age- and disability-responsive and socially inclusive more broadly. It will ensure equitable access to resources; help design, plan and build skills and capacities for climate-resilient alternative livelihoods; and promote engagement in agriculture, fisheries, livestock and CMSME programmes. Training or awareness-raising programmes on gender, the elderly, persons with disabilities and youth-responsive and socially inclusive adaptation will be designed and implemented, and the Climate Change Gender Action Plan and proposed Youth-Led Adaptation Plan and Adaptation Plan for Persons with Disabilities in sector policies and plans will be mainstreamed. The participation of women, youth, the elderly, persons with disabilities, ethnic communities and socially disadvantaged people in decision-making to shape policies, planning and the prioritizing of local adaptation needs will also be ensured.

Gender is a cross-cutting issue that needs to be included in all stages of development activities, comprising planning, design, implementation, management and monitoring. Any construction of public or private infrastructure (shelters, water collection points, sanitation facilities, etc.) should address accessibility issues. Designing safe shelters should stress adequate space, facilities and accessibility for women and men, with special attention to pregnant and lactating mothers, children, youth, persons with disabilities and elderly people. Increasing and easing accessibility to health-care facilities and introducing gender-, age- and disability-inclusive search and rescue programmes during disasters with the help of local authorities, Cyclone Preparedness Programme (CPP) volunteers and community members will other priorities.

The NAP implementation process will aim to reduce the gender gap in accessing education, livelihoods, services, technology and financial resources. Climate-smart technologies will be introduced while considering gender aspects and women's particular needs and overall socioeconomic suitability. Incentives to use climate-smart technologies (awareness, marketing issues, pricing, subsidies, tax credits) will be introduced for farmers, both men and women. Gender-, age- and disability-responsive and inclusive index-based insurance instruments will be devised to tackle climate change-induced disaster losses and damages.

A dedicated Climate Resilience Fund (CRF) will be set up for vulnerable women through the Local Government Division. It will be similar to the Local Government Initiatives on Climate Change (LoGIC) project, an initiative of the Government, UNDP, the United Nations Capital Development Fund, the European Union and Sweden. The project is now supporting 400,000 of the most climate-vulnerable women to build resilience and improve livelihoods in the face of climate change through small-scale grants under the Community Resilience Fund (CRF). Further, early warning systems will be made more inclusive and accessible to women, the elderly, youth, people of different races and ethnicities and persons with disabilities.

Existing gender-responsive budget reporting will be strengthened to ensure that allocations of public funds address the needs of women, men, girls, boys and people with non-binary genders. This process may involve tracking gender-specific expenditures to ensure targeted allocations of resources for women and groups with diverse

gender identities, promoting equal employment in the public services, and mainstreaming such tracking into national, sectoral and local adaptation budgeting systems.

The Youth-Led Adaptation Plan (YLAP), the Chattogram Hill Tracts Climate Action Plan (CHT-CAP) and the Climate Adaptation Plan for Persons with Disabilities will be developed and the existing Climate Change Gender Action Plan (ccGAP) updated in alignment with the NAP, and given high priority in socially inclusive NAP implementation. The Local-Level Youth Leadership Programme will be introduced and accelerated, immediately engaging LGIs, CBOs and NGOs. The policy and regulatory framework will propose the inclusion of youth voices in NAP institutional arrangements. An Accelerated Youth Innovation Programme will help surface youth-led solutions for climate change through extensive action research and field experiments.

Information, education and communications (IEC) materials will be made accessible to all considering gender, age, ethnicity, language and/or disability. Inclusion of a climate change adaptation-related syllabus into elementary school curricula, training, admissions texts, recruitment exams or other foundational course may build capacity for transformation. Other potential areas for youth inclusion will be: developing career pathways in renewable energy-based technology and innovation; sensitizing young farmers, mainly in climate-vulnerable areas, with knowledge on climate-resilient agricultural practices such as mulching, raised agricultural beds, agroforestation, etc.; and equipping youth with knowledge on disaster risk reduction (DRR) through voluntary activities. Experiences from similar initiatives such as the LoGIC project will be gathered and used to accelerate youth engagement in NAP processes through an inclusive youth network that is being developed at the local and national levels for youth engagement in climate risk assessment, local adaptation planning, and adaptation tracking and monitoring.

The NAP has provisions for capacity development for women, persons with disabilities, the elderly and youth, and relevant representatives of different ministries, departments, government organizations, NGOs, civil society and the private sector, gender experts, women's organizations, and marginalized groups. For inclusive and expedited NAP implementation, awareness-raising programmes and behavioural change strategies for enhanced awareness across society are essential and will be done appropriately.

The NAP process will emphasize the impactful engagement of women and other vulnerable groups, including youth, the elderly, diverse ethnic communities, persons with disabilities and other marginalized groups in decision-making. Furthermore, effective M&E will build on generating data and indicators disaggregated by sex, age and disabilities.

Adaptation for women, the elderly, persons with disabilities and other disadvantaged people

- Ensuring adequate space, facilities and equitable access to disaster preparedness such as through the establishment of multipurpose and climate-resilient cyclone and flood shelters with safe WASH, lactation and maternities facilities, disability-friendly entries and rooms, etc.
- Gender-, age- and disability-inclusive search and rescue programmes during disaster periods
- Ensuring better access to inclusive and responsive early warning systems in appropriate languages and modalities
- Building climate-resilient houses and health-care facilities with accessible communication facilities
- Monitoring and surveillance of mental and physical health due to climate-induced disasters
- Green infrastructure development and nature-based solutions for improved well-being
- Increase inclusive coverage of social security and social safety net programmes
- Design and implement specialized training, skills and awareness development programmes
- Design, plan and build capacities for climate-resilient alternative livelihoods
- Prioritize and ensure effective participation in decision-making for adaptation
- Collect and use data and indicators disaggregated by gender, age and disability for M&E
- Generate climate adaptation relevant materials and communicate them to reach people regardless of gender, age, ethnicity, language or disability
- Prepare local adaptation plans inclusive of the issues and perspectives of women, the elderly, persons with disabilities and other socially disadvantaged people

Adaptation Monitoring and Evaluation

5. Adaptation Monitoring and Evaluation

5.1 Purpose of M&E

The NAP includes a national M&E system for tracking adaptation progress towards achieving set goals, deciding the efficacy of implemented interventions in reducing the desired level of risk, and assessing adaptation priorities. This robust system will provide stakeholders and policymakers with information on the current status of targets and outcomes. In doing so, it will promote accountability and transparency in public spending, ensuring effective and efficient resource utilization.

The Bali Action Plan (2007) established the integration of monitoring, reporting and verification (MRV) systems in tracking NDC implementation. This refers to the process by which a country tracks implementation and subsequent impacts of adaptation and mitigation actions and the finance used to support these actions. The Paris Agreement provided a framework for submitting adaptation communications on a particular frequency to track the progress of national adaptation actions in contributing to global efforts.

The NAP M&E system in Bangladesh will be integrated as one of the key components of the national MRV system, providing a framework for monitoring adaptation implementation. This MRV-based system will incorporate the concept of 'learning by doing' for adaptation, effective measurement, and the reporting and verification of adaptation initiatives, outcomes and impacts. At the same time, the M&E system will act as a tool for monitoring, evaluating and reporting on implementation targets via a set of monitoring indicators. The framework will be further reinforced through a Development Results Framework (DRF) with SMART indicators, baseline information and target values for the short-, medium- and long-terms in next steps of the NAP implementation.

5.2 M&E Framework

The NAP has developed a national M&E framework based on a combination of simple and comprehensive monitoring, a sophisticated approach to identifying and assessing achievements. The NAP followed LEG guidelines under the UNFCCC to develop the framework. The first 'simple' monitoring system summarizes NAP progress with traffic light colours. The second and more comprehensive approach includes a process and outcome or results-based framework to monitor and evaluate the efficacy of implemented adaptations against set targets.

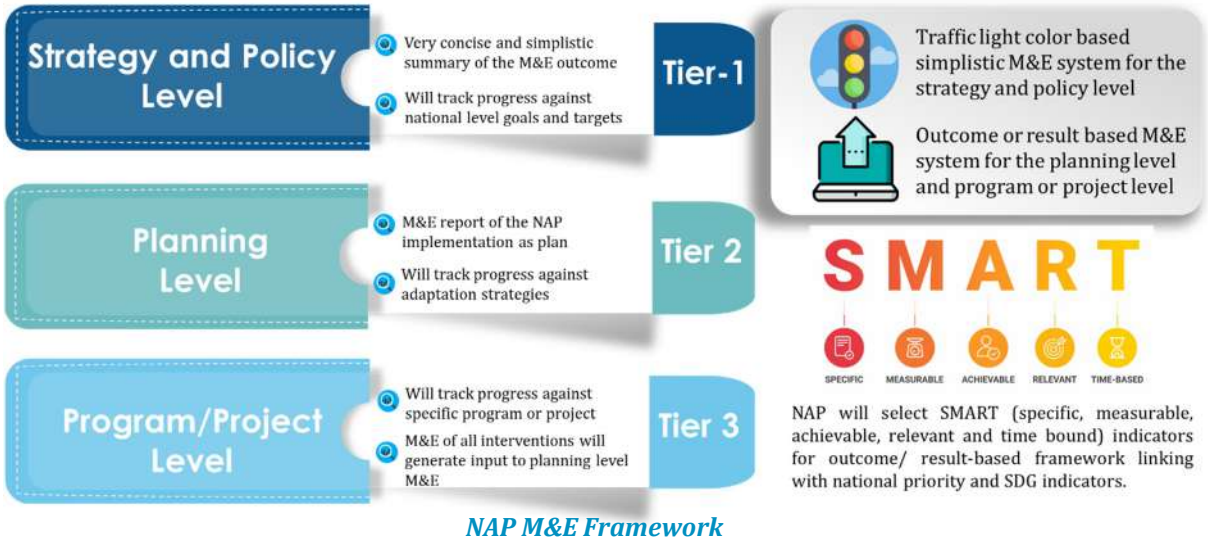
In addition to a log frame, the NAP adopts the theory of change concept in structuring M&E and developing it based on and aligned with existing national M&E initiatives. Similar initiatives could complement the NAP M&E process, such as the SDG trackers where the BBS has collected a large data set on SDG indicators, and environment, climate change and disaster statistics (ECDS) data; the inclusion of result-based frameworks in sector action plans; the introduction of national priority

indicators in the Perspective Plan and Five-Year Plan; financial tracking with the iBAS++; project implementation monitoring by the IMED; developing an M&E framework for the BDP2100; and developing MRV for tracking the progress of the GCF country programme and the NDCs. Synchronization in tracking the physical and financial progress of adaptation will be done integrating the existing iBAS++ with required updates to reflect priority thematic sectors of the NAP.

The NAP M&E framework involves a threefold system to monitor, evaluate and report adaptation progress as elaborated below.

- ✓ Strategic action not implemented/lack of progress in delivering results (**RED**)
- ✓ Strategic move partially implemented/some progress in providing results (**AMBER**)
- ✓ Strategic action fully implemented/significant strides in delivering activities, i.e., completed or on-track (**GREEN**)

The implementation status and threshold for the above three criteria will be set based on weighted aggregation techniques generating progress status in percentages of 0 to 100, amalgamating Tier 2 M&E reporting. This will present the highest-level policymakers with an easy, quick and effective decision-making tool based on simple 'good-moderate-bad' signals, on which they can make simple 'yes or no' decisions. Table 5.1 illustrates a summary of strategic actions with this monitoring system.



NAP M&E Framework

5.2.1 Tier 1: Strategy- and policy-level M&E

Relatively simple strategy- and policy-level M&E will use indicators based on three light traffic colours, **RED**, **AMBER** and **GREEN** as follows:

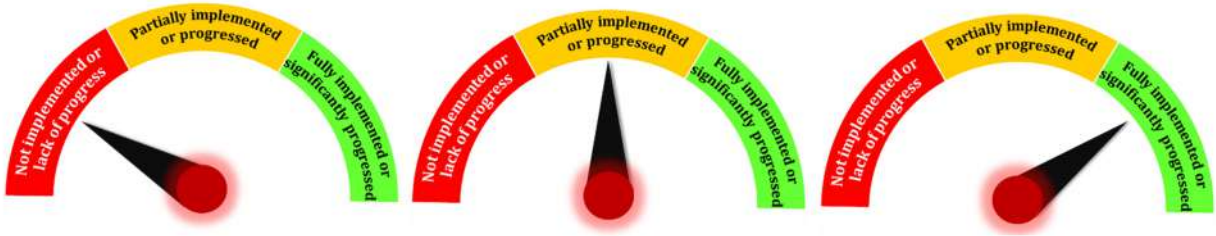
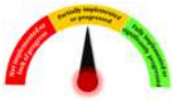
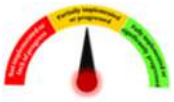
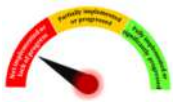
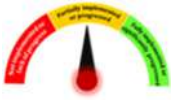
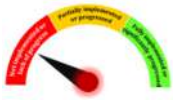
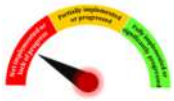
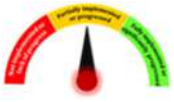
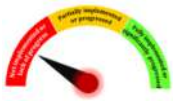
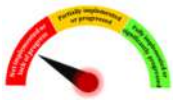
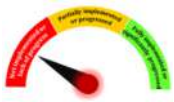
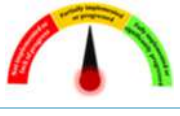
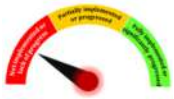
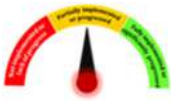
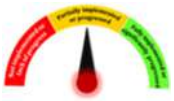
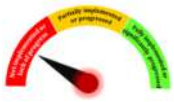
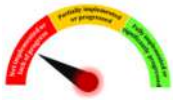
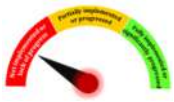
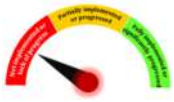
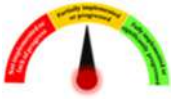
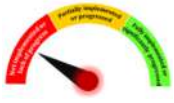


Table: 5.1:Example of strategy- and policy-level M&E (Tier 1)

Adaptation strategies	Simple indicators of status
Goal 1: Ensure protection against climate change variability and induced natural disasters	
S 1.1: Combat cyclonic storm surges, sea-level rise, and salinity intrusion	
S 1.2: Manage floods, erosion and drought risks	
S 1.3: Protect lives, livelihoods, infrastructure and ecosystems against slow-onset and other climate extremities	
Goal 2: Develop climate-resilient agriculture for food, nutrition and livelihood security	
S 2.1: Promote the extension of climate-smart agriculture	
S 2.2: Develop climate-resilient fisheries, aquaculture and livestock	
S 2.3: Manage sustainable agro-inputs and transformative value chains	
S 2.4: Strengthen extension services for agriculture, fisheries and livestock	
Goal 3: Develop climate-smart cities for an improved urban environment and well-being	
S 3.1: Promote green and blue infrastructure for the management and conservation of urban environments	
S 3.2: Develop climate-smart cities to increase urban resilience	
S 3.3: Develop climate-resilient health-care and WASH facilities for improved human well-being and livability in cities	
Goal 4: Promote nature-based solutions for the conservation of forestry, biodiversity and the well-being of communities	
S 4.1: Scale up ecosystem-based adaptation for wetlands conservation	

Adaptation strategies	Simple indicators of status
S 4.2: Restore and conserve habitats, ecosystems and biodiversity	
S 4.3: Expand community-based afforestation and/or reforestation	
Goal 5: Impart good governance through the integration of adaptation into the planning process	
S 5.1: Reform policies for mainstreaming adaptation	
S 5.2: Develop a framework for adaptation monitoring, evaluation and learning	
S 5.3: Engage the private sector in adaptation implementation	
S 5.4: Empower local government institutes, community-based organizations, women, people with disabilities and youth for locally led adaptation	
S 5.5: Enhance climate financing for adaptation	
Goal 6: Ensure transformative capacity-building and innovation for climate change adaptation	
S 6.1: Develop transformative capacity and management of knowledge	
S 6.2: Introduce innovation in reducing climate change and disaster risks and consequential losses and damages	
S 6.3: Research and innovation for agriculture, fisheries and livestock	
S 6.4: Advanced research on climate change impacts on ecosystems and application of ecosystem-based adaptation	
S 6.5: Action research for innovation in climate-resilient infrastructure, improved health and WASH technologies	

5.2.2 Tier 2: Planning-level M&E

Tier 2 represents a more in-depth approach than Tier 1, in which a decisive outcome for each strategy is devised and a set of potential indicators is selected. Measurements using Tier 2 indicators will be both quantitative and qualitative. Decisions based on them will guide top-level strategic choices with more nuance. Findings from this framework will not always be as simple as 'yes or no' as the element of 'maybe' comes into play. The thought process in making a decision becomes more complex, and, as a result, more considerations can be factored into holistically monitoring and evaluating progress. As the mid-tier framework maintains a link between the policy and project-level frameworks, careful consideration must be given to fixing indicators and establishing a mode for measuring values. SMART indicators are emphasized in line with the Tier 2 M&E framework to facilitate tracking the progress of the NAP as a plan, evaluation and learning, and updating.

Table 5.2 provides some examples of an outcome-based framework and potential indicators for a planning-level M&E system. Appendix III presents the Tier II M&E framework with potential indicators for the rest of the NAP goals.

Table 5.2: Example of planning-level M&E (Tier 2)

Strategic focus	Adaptation strategy	Outcome	Potential indicators
Sectoral	**Goal 1: Ensure protection against climate change variability and induced natural disasters**		
	S 1.1: Combat cyclonic storm surges, sea-level rise and salinity intrusion	**Outcome 1:** Increased adaptive capacity of human, natural and economic systems to reduce risks and vulnerabilities and ensure protection against climate change-induced disasters in coastal areas	1. Affected areas or exposure to different climate change-induced hazards (storm surges, sea-level rise, salinity intrusion) 2. Measurement of discharges, water levels, salinity in designated locations 3. Measures regarding infrastructure development (embankment height, number of regulators , access by disability, etc.) 4. Vulnerable population by sex, age and disability 5. Losses and damages due to climate change-induced slow-onset and extreme events (coastal areas) 6. Household-level potable drinking water facilities 7. Per capita freshwater availability in salinity-prone areas 8. Loss of food (crops, fish, meat and eggs) production 9. Number of gender- and disability-inclusive and co-management initiatives for CCA 10. Income from alternative sources
	S 1.2: Manage floods, erosion, and drought risks	**Outcome 2:** Increased adaptive capacity of humans, natural and economic systems to reduce risks and vulnerabilities and ensure protection	1. Affected areas or exposure to different climate change-induced hazards (floods, erosion and droughts) 2. Losses and damages due to climate change-induced slow-onset and extreme events (floodplain and drought-prone areas) 3. Loss of food (crops, fish, meat and eggs) production 4. Soil moisture content

Strategic focus	Adaptation strategy	Outcome	Potential indicators
		against climate change-induced disasters in the floodplain or drought areas	5. Groundwater depth 6. Number of gender-inclusive and co-managed initiatives for CCA 7. Income from alternative sources
	S 1.3: Protect lives, livelihoods, infrastructure and ecosystems against slow-onset and other climate extremities	**Outcome 3:** Enhanced adaptive capacity and protection of lives, livelihoods and ecosystems against slow-onset and other extreme events of climate change	1. Affected areas or exposure to different climate change-induced hazards 2. Losses and damages due to climate change-induced slow-onset and extreme events (land, coast, hills, ocean and islands) 3. Human health (medical expenses, diseases occurrences, mortality rate, risk of disability, etc.) 4. Ecosystem (water quality, land degradation, soil nutrient, native species, etc.) health 5. The environmental flow of rivers and ecosystems during the dry season 6. Death or injuries and damages due to lightning and landslides 7. Heatstroke rate during the summer 8. Pre-mature childbirth and high blood pressure or other comorbidity rates in coastal areas 9. Sea surface temperature and pH level of the ocean 10. Density and diversity of coral reefs 11. Marine stocks

5.2.3 Tier 3: Programme- or project-level M&E

Tier 3 presents the comprehensive and inclusive programme- and/or project-level M&E framework. This is a process-based framework in which the outcomes for each programme/project will be deduced via process(es) that will include an input, an activity and an output. These three elements make up the overall process through which outcomes are determined. The indicators devised thus cater specifically to the outcomes of each programme/project and make result monitoring and evaluation at this level possible. Indicators of outcomes or impacts allow the monitoring and assessment of medium-term results or broad long-term changes and the effectiveness of adaptation actions towards the ultimate NAP goals.

Evaluation outcomes under Tier 3 will easily feed into the coarser planning level (Tier 2) framework as the programmes/ projects are directly linked to the strategies and goals of the NAP. As such, a bottom-up process will be followed where the programme-/project-level M&E report will feed into preparing the planning-level M&E report and the strategy- and policy-level M&E report. Programme-/project-level M&E will monitor, evaluate and capture learning about the progress of proposed NAP interventions in different sectors.

Table 5.3 illustrates an example of the process and results- or outcome-based framework for programme-/project-level M&E following the theory of change.

5.2.4 Reporting and verification

term impacts of adaptation projects, emphasizing gender dimensions.

The Technical Working Group on NAP & NDC implementation under the MoEFCC will be responsible for the NAP M&E system with the sole responsibility of preparing and submitting Tier 1

Table 5.3: Example of programme or project-level M&E (Tier 3)

Goal	Programme/project	Process	Outcome	Possible indicators
	S 2.1: Promote the extension of climate-smart agriculture			
	Programme/project 1: Improve irrigation water efficiency	**Input:** • Guidelines for installation of buried pipes and water-saving technologies • Strengthen extension services **Activity:** • Extension of water saving technologies like alternate wetting and drying • Installation of buried pipes, etc. **Output:** • Irrigation water efficiency increased	**Outcome:** • Agricultural productivity increased for the Boro rice crop • Emissions from agricultural practices decrease • Resilience enhanced for the crop sector	• Boro rice crop production • Irrigation water efficiency • Coverage of buried pipes • Groundwater level • Emissions from agriculture

The M&E report on the strategy and policy level will be a very concise and simple summary of the planning-level M&E outcomes. Planning-level M&E will be the summary of programme-/project-level M&E. Tier 1 and Tier 2 will track progress against NAP strategies and Tier 3 against specific programmes/projects based on the proposed interventions. Reporting on Tier 3 can include cross-learning and data-sharing, documentation of scalable best practices and learning, mapping of existing and completed projects, and preferably *upazilla*-wide statistics. The reporting will also include M&E processes (definitions, protocols, methodologies, etc.) and post-project evaluation through documenting short-, medium- and long-

and Tier 2 M&E reports in coordination with the IMED, GED and MoF. The planning-level M&E summary report will be based on the project-level Tier 3 summary report prepared by the IMED. The financial tracking of projects, programmes and plans through iBAS++ will be integrated with NAP M&E to enable tracking of both the physical and financial progress of adaptation.

The IMED will be charged with preparing the summary Tier 3 M&E report and collecting data and information on proposed outcome-based indicators from relevant multisectoral stakeholders at the national and local levels. A standard format for the IMED will be developed to facilitate this process in line with existing practices, UNFCCC guidelines and synchronization

with the iBAS++ and Medium-Term Budget Framework. Responsible entities or agencies for implementing the NAP will collect data relevant to process- and/or outcome-based indicators of a programme or specific intervention or project for tracking adaptation progress internally, following a comprehensive process and/or outcome-based framework. Data management strategies will be devised to overcome different challenges in indicator data collection; new data will need identification and necessary cost arrangements in implementing entities. To facilitate this process, implementing entities will maintain coordination with existing relevant national and international databases and nodal agencies for data generation and storage such as iBAS++, NWRD, ICRD, BBS, BBS-ECDS, BMD, DoE, DRIP, GeoDash, BWDB, FFWC, WASAs, DPHE, UDD, LGED, RHD, DDM, BIWTA, SoB, IPCC WGI Interactive Atlas, SDG Tracker, BDP2100 Knowledge Portal, World Bank, ADB, FAO-AquaStat etc..

Responsible entities will provide collected/ monitored data and information to the IMED as the national implementation monitoring (impact monitoring, compliance monitoring, i.e., the Environment and Social Management Framework, Climate Risk Management, etc.) and evaluation agency tracking adaptation programme-/project-level M&E towards assessing physical and financial progress. Monitoring localized adaptation initiatives and locally led monitoring mechanisms will be important additions to the NAP M&E framework that will be developed later through engaging LGIs, district development coordination committees (DDCC), *upazilla* and union committees, representatives of communities, NGOs, CSOs and CBOs, and ensuring gender, youth, disability and social inclusion.

Coordinating bodies from the MoEFCC will liaise with the IMED to summarize the Tier 1 and Tier 2 M&E reports. The National Council on Environment and Climate Change (NCECC), the Interministerial Steering Committee on Climate Change (ISCCC) and the National Technical Advisory Committee (NTACCC) will regularly guide national actors after analysis of M&E reports for further updates and/or revisions of NAP actions based on lessons learned. The IMED will direct local actors in updates or corrections to tackle any implementation barriers, including finance-related matters, ensuring robust transparency and accountability. Data collection on programme or project monitoring indicators and evaluations should be carried out monthly.

Monitoring. Evaluation, Accountability and Learning (MEAL) will be adopted, incorporating a 'learning by doing' approach. Proper communication will be implemented to report and inform stakeholders on NAP progress, including on the global NAP stocktaking platform through submission of biennial reports based on the national M&E report and its outcome. The MoEFCC will publish an annual M&E report to facilitate this process. The report will be reflected in the proposed annual national climate status report to communicate adaptation progress to global audiences and stakeholders.

5.2.5 Web-based monitoring tool

A dynamic, web-based M&E system will be developed to support data collection and monitoring, and updating and generating Tier 1, Tier 2 and Tier 3 reports with appropriate weighted aggregation techniques using the values of selected indicators based on a timeline established through a comprehensive study. The proposed system will collect, upload, process and update data from relevant stakeholders in the developed standard results-based framework, under the data protocol. The MoEFCC and IMED would jointly develop a standardized protocol for data collection, sharing, processing, storing, uploading and updating, and for user rights by/among critical stakeholders.

The initial framework should include baseline data and set major targets for indicators against each strategic action for Tier 1 and Tier 2 and against each programme/specific project for Tier 3, respectively, in different future timelines, i.e., the 2030s, 2041 and the 2050s to track progress. Later, interim targets will be set for a yearly timeline by concerned national focal points to keep up the drive to achieve the major targets of the

NAP. Aggregation will follow a bottom-up approach, i.e., the Tier 3 report will give inputs to the Tier 2 report and the Tier 2 report will culminate in the Tier 1 report. Any missing baseline data will be collected through developing standard data collection, and a processing and sharing protocol. Existing similar initiatives such as the SDG trackers, the BDP2100 M&E tool, iBAS++ and the NDC MRV tool can be coordinated with the NAP M&E tool. To ease the operation of web-based monitoring, an online-offline Android-based open data kit (ODK) will be developed for quick and effective real-time data collection, processing, upload, verification and publishing.

5.2.6 Capacity development

The NAP M&E Framework will include a comprehensive capacity development regime that will periodically, through structured iteration, train relevant professionals involved in NAP implementation and exclusively with M&E.

5.2.7 Revising and updating the NAP

The NAP will be considered a living document with a planning horizon until the 2050s comprising at least five cycles of five-year updating and revision, considering that climate change manifests in diverse ways with varying consequences throughout different periods. After a certain period of execution, the plan must be regularly reviewed, revised or updated in an iterative way, using effective and regular M&E. A feasible mechanism will be adopted taking into account progress and addressing past adaptation barriers, new adaptation issues, social and environmental trends, new policies, and national and international government pledges

Reviews, revisions and updates will take place in the following ways:

- A ***regular review*** and ***major revision or update*** at the end of each five-year implementation cycle that incorporates lessons learned during the previous five years to increase the plan's effectiveness, tackle uncertainties posed by climate change, and maximize the country's resilience and sustainable development gains. This five-year regular revision will be performed in coordination with the five-year national planning cycle. The revision process will start one year before each five-year planning cycle so that by the time the initiation of each cycle approaches, the revision phase is done and mainstreamed into the development planning process as described in Section 4.4. After that, the revised NAP will be executed in accordance with each successive planning cycle. The MoEFCC will conduct the regular reviews and revisions or updates. The annual M&E and biennial reports produced by the MoEFCC and submitted to the UNFCCC will substantially complement regular reviews and major revisions or updates.

The review, revision and update process should consider the following issues but is not limited to these:

- Addressing the gaps and challenges of the previous NAP
- New findings on climate change, and risks and vulnerabilities in Bangladesh
- Position of the country in reducing anticipated risks and enhancing resilience based on the M&E report
- Progress and obstacles in achieving goals and strategies
- Setting adjusted adaptation standards or tipping points and revision of adaptation pathways based on M&E results
- Recommendations for future steps and measures
- Harnessing climate financing and readiness programmes
- Capacity development, knowledge management and technology transfers
- Indication for detailed communication and visibility strategies
- Major decisions and agreements in climate negotiations under the UNFCCC and COPs
- Necessary policies, institutions and regulatory support

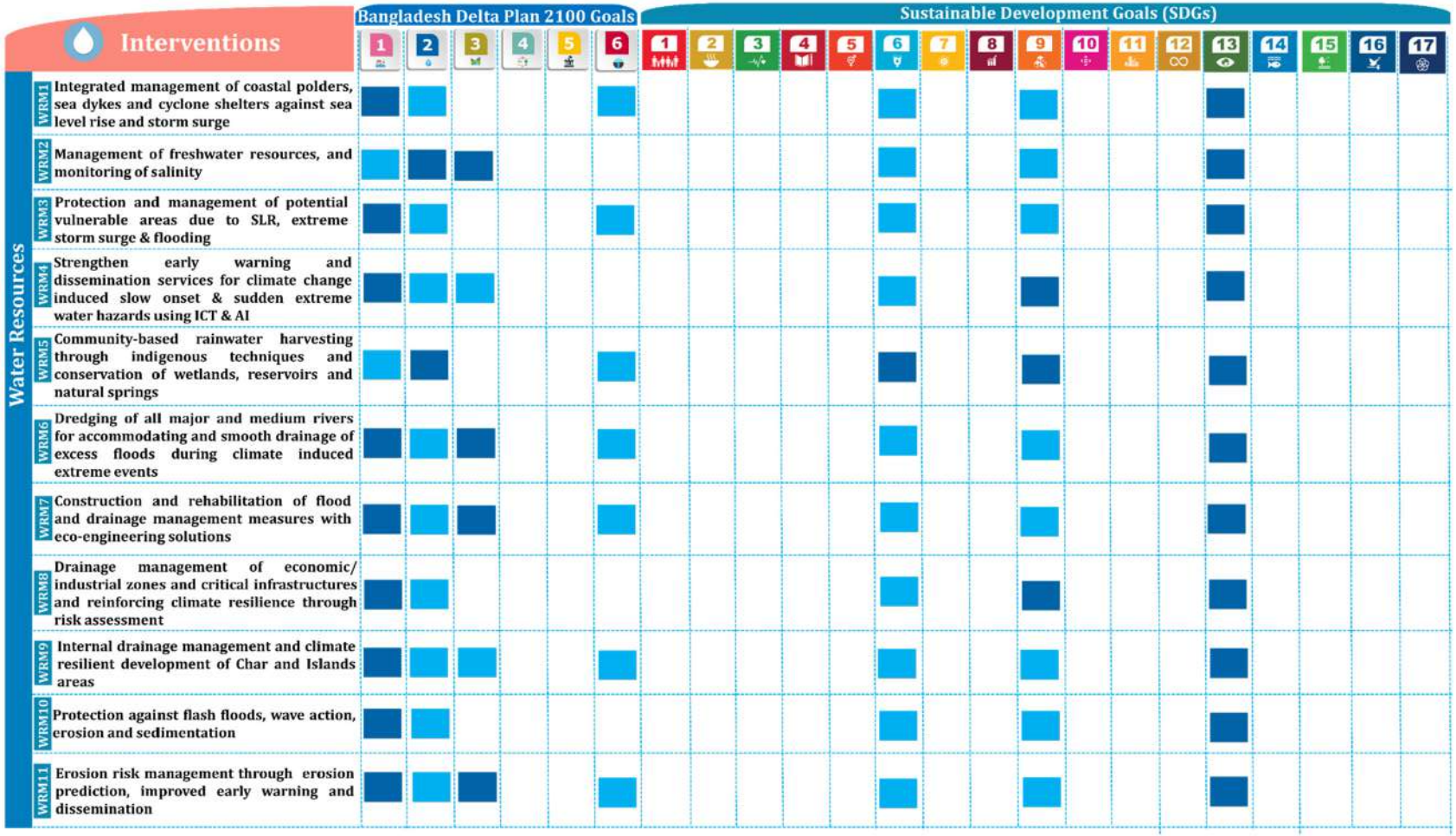
Appendices

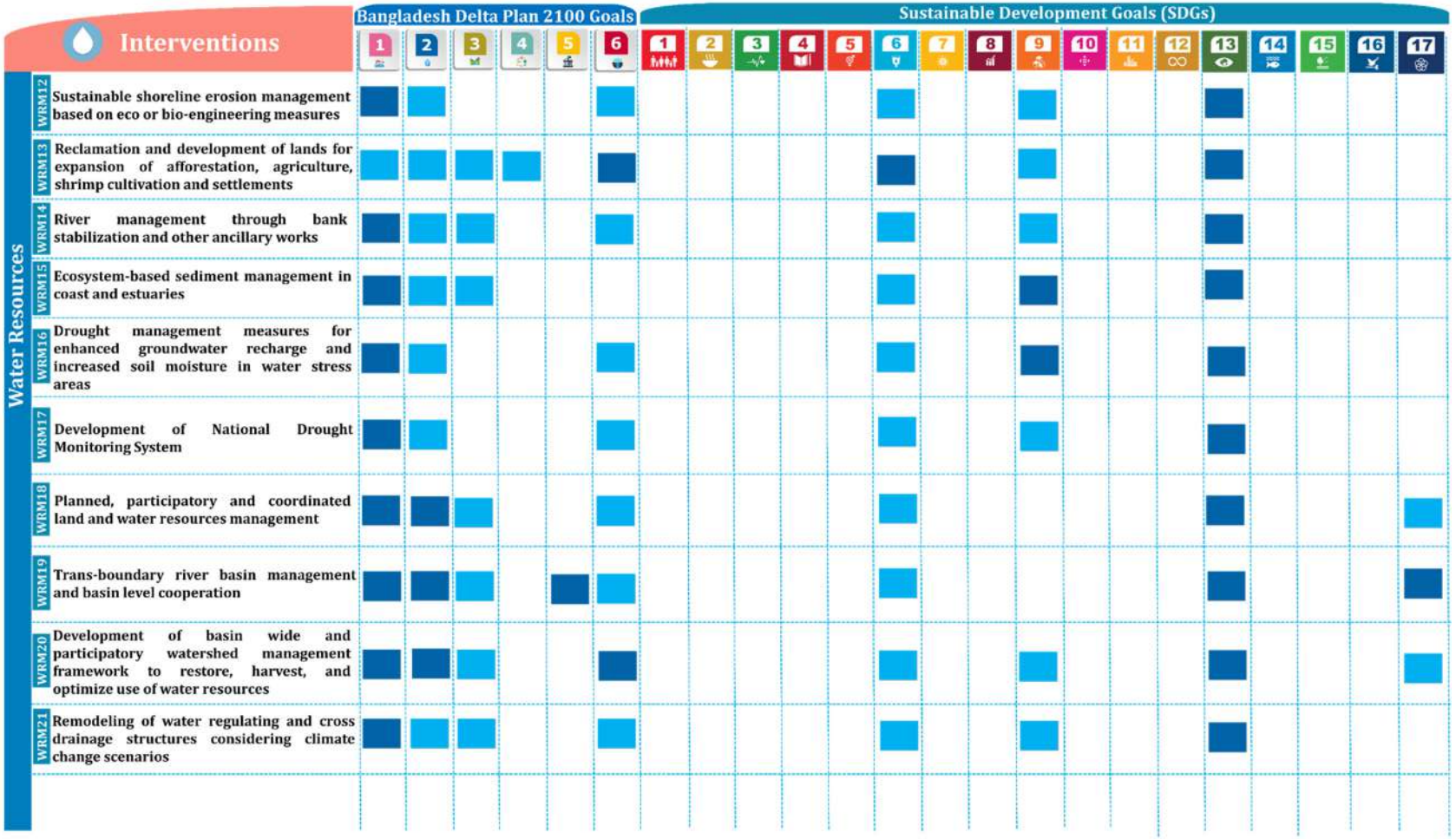
Appendix I: BDP2100 and SDG Alignment

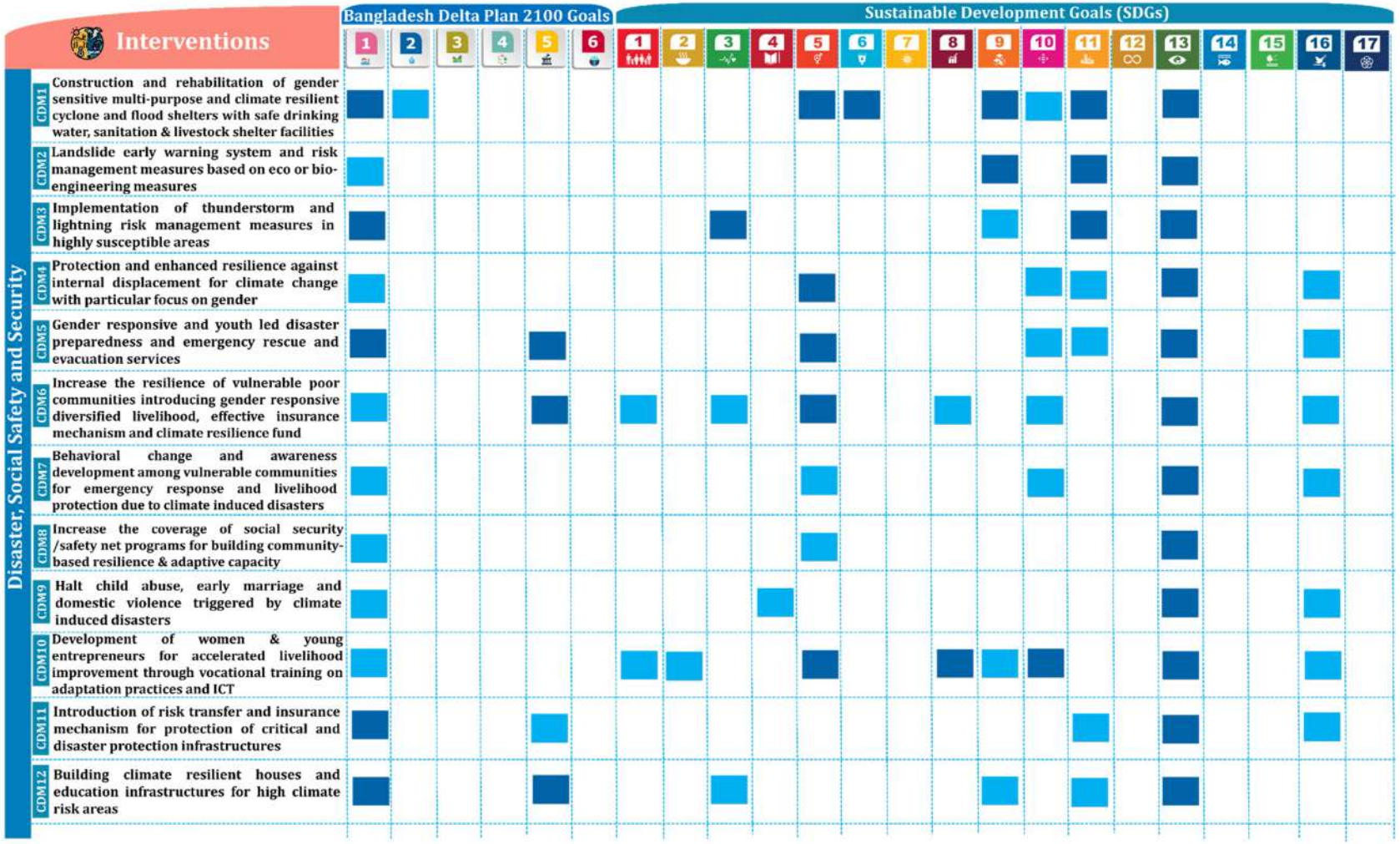
Table AI.1: Alignment of climate stress areas, BDP2100 and hydrologic regions

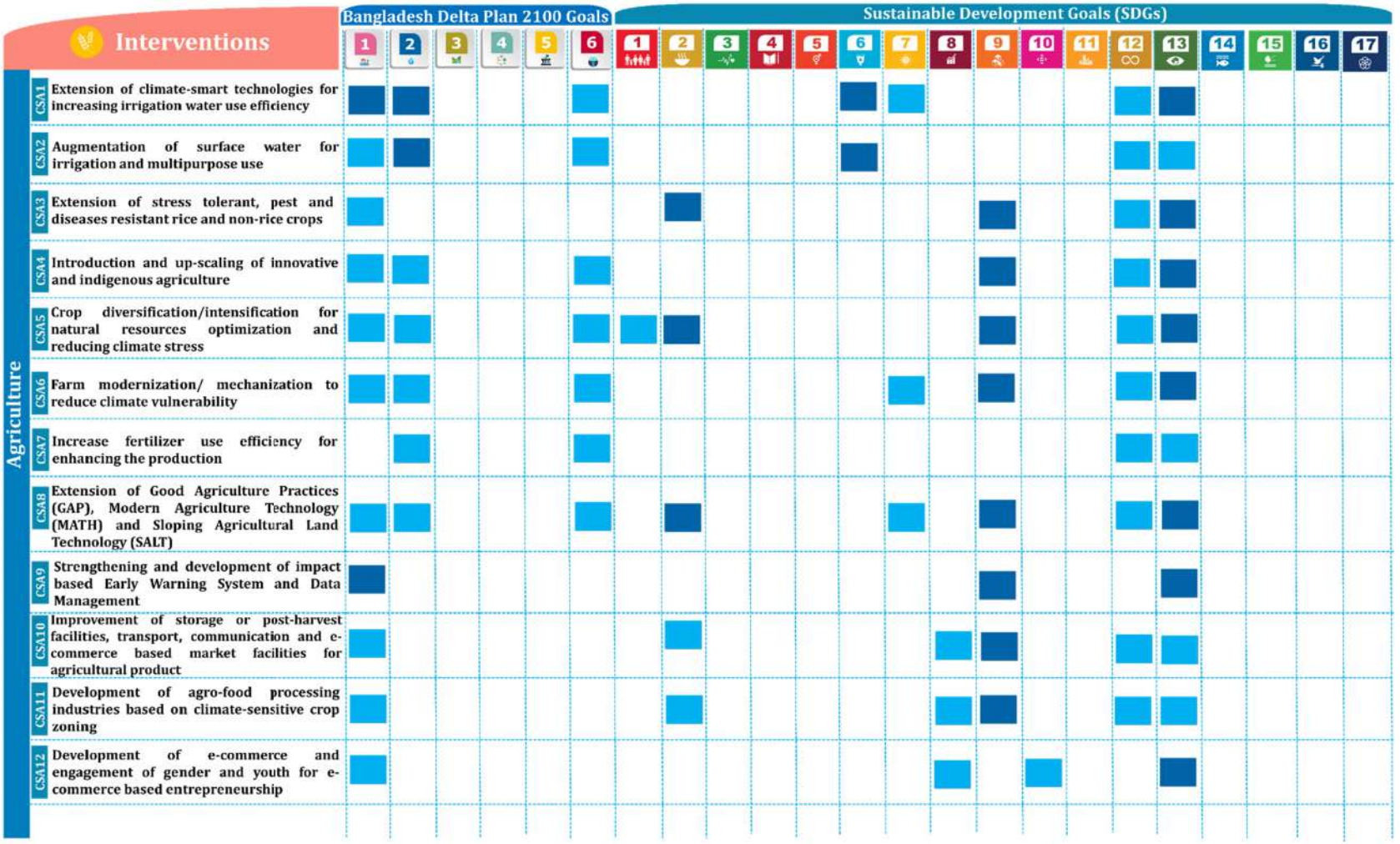
Climate stress areas	Linked BDP2100 hotspot areas	Linked hydrological regions
South-western coastal area and Sundarbans (SWM)	Coastal Zone	South-west & South-central Region
Southeast and eastern coastal area (SEE)	Coastal Zone	South-east Region
Chattogram Hill Tracts (CHT)	Chattogram Hill Tracts	Eastern Hills
River, floodplain, and erosion-prone area (FPE)	River systems and estuaries	river and estuary & north-central region
Haor and flash floods area (HFF)	Haor and flash floods areas	north-east region
Drought Prone and Barind Area (DBA)	Barind and drought prone areas	north-west region
Northern, north-western region (NNW)		north-west region
Chalan Beel and low-lying area of the north-western region (CBL)	Barind and drought prone areas	north-west region
Char and Islands (CHI)	River systems and estuaries	river and Estuary
Bay of Bengal and Ocean (BoB)		
Urban Areas (URB)	Urban areas	

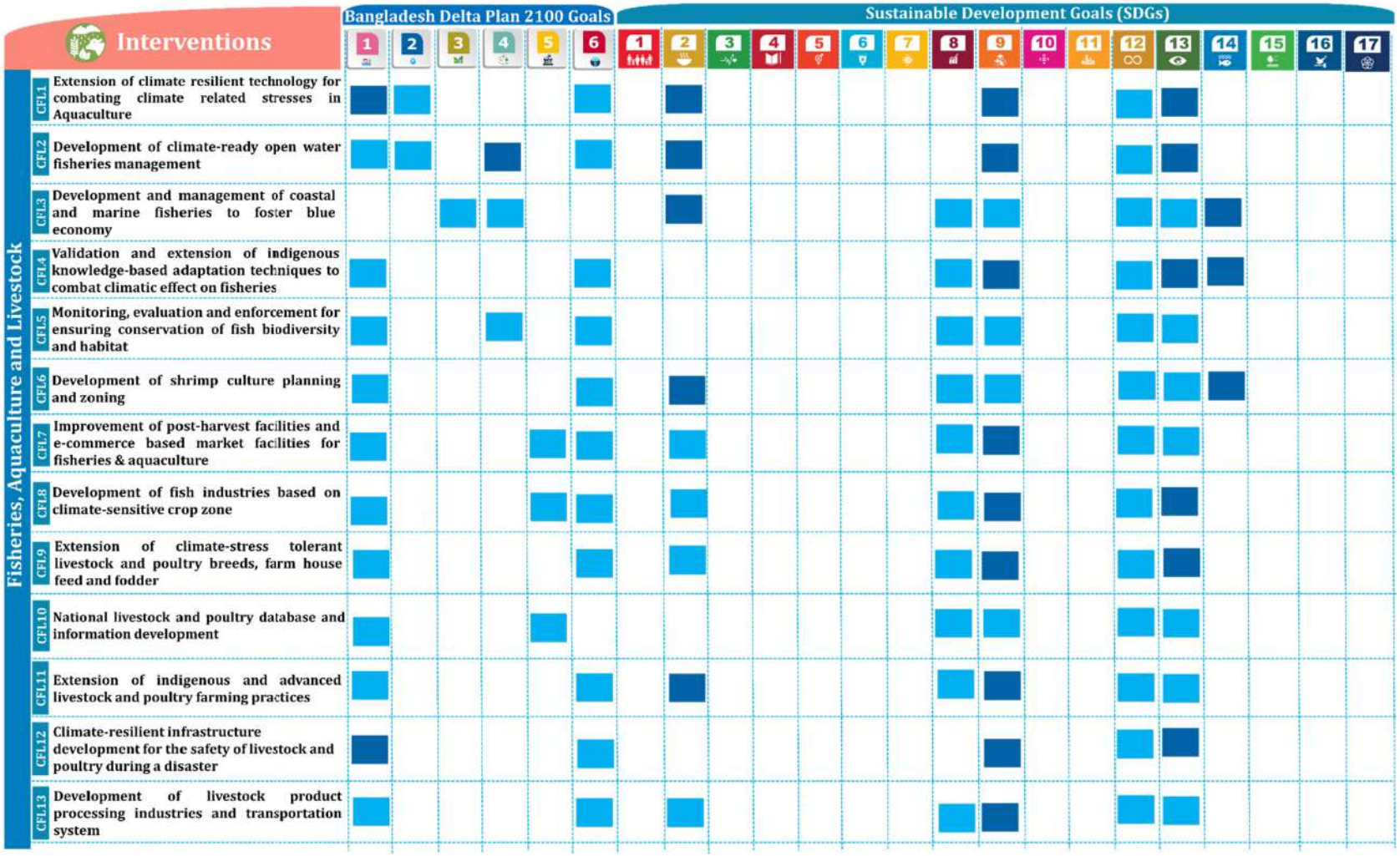
The following pages illustrate the alignment of NAP interventions with the BDP2100 and the SDGs.

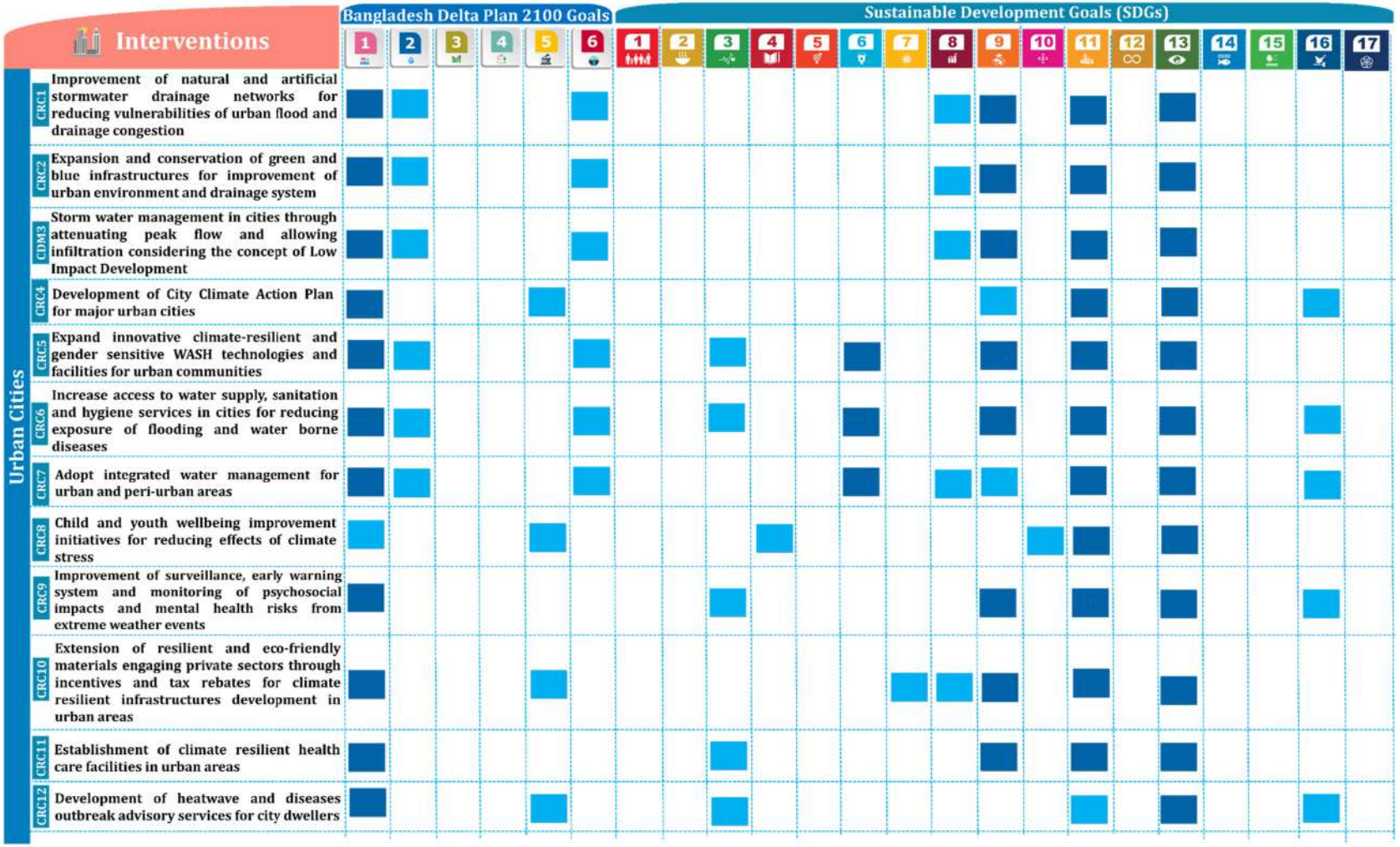

Interventions
Bangladesh Delta Plan 2100 Goals
Sustainable Development Goals (SDGs)
Water Resources
WRM1 Integrated management of coastal polders, sea dykes and cyclone shelters against sea level rise and storm surge
WRM2 Management of freshwater resources, and monitoring of salinity
WRM3 Protection and management of potential vulnerable areas due to SLR, extreme storm surge & flooding
WRM4 Strengthen early warning and dissemination services for climate change induced slow onset & sudden extreme water hazards using ICT & AI
WRM5 Community-based rainwater harvesting through indigenous techniques and conservation of wetlands, reservoirs and natural springs
WRM6 Dredging of all major and medium rivers for accommodating and smooth drainage of excess floods during climate induced extreme events
WRM7 Construction and rehabilitation of flood and drainage management measures with eco-engineering solutions
WRM8 Drainage management of economic/ industrial zones and critical infrastructures and reinforcing climate resilience through risk assessment
WRM9 Internal drainage management and climate resilient development of Char and Islands areas
WRM10 Protection against flash floods, wave action, erosion and sedimentation
WRM11 Erosion risk management through erosion prediction, improved early warning and dissemination

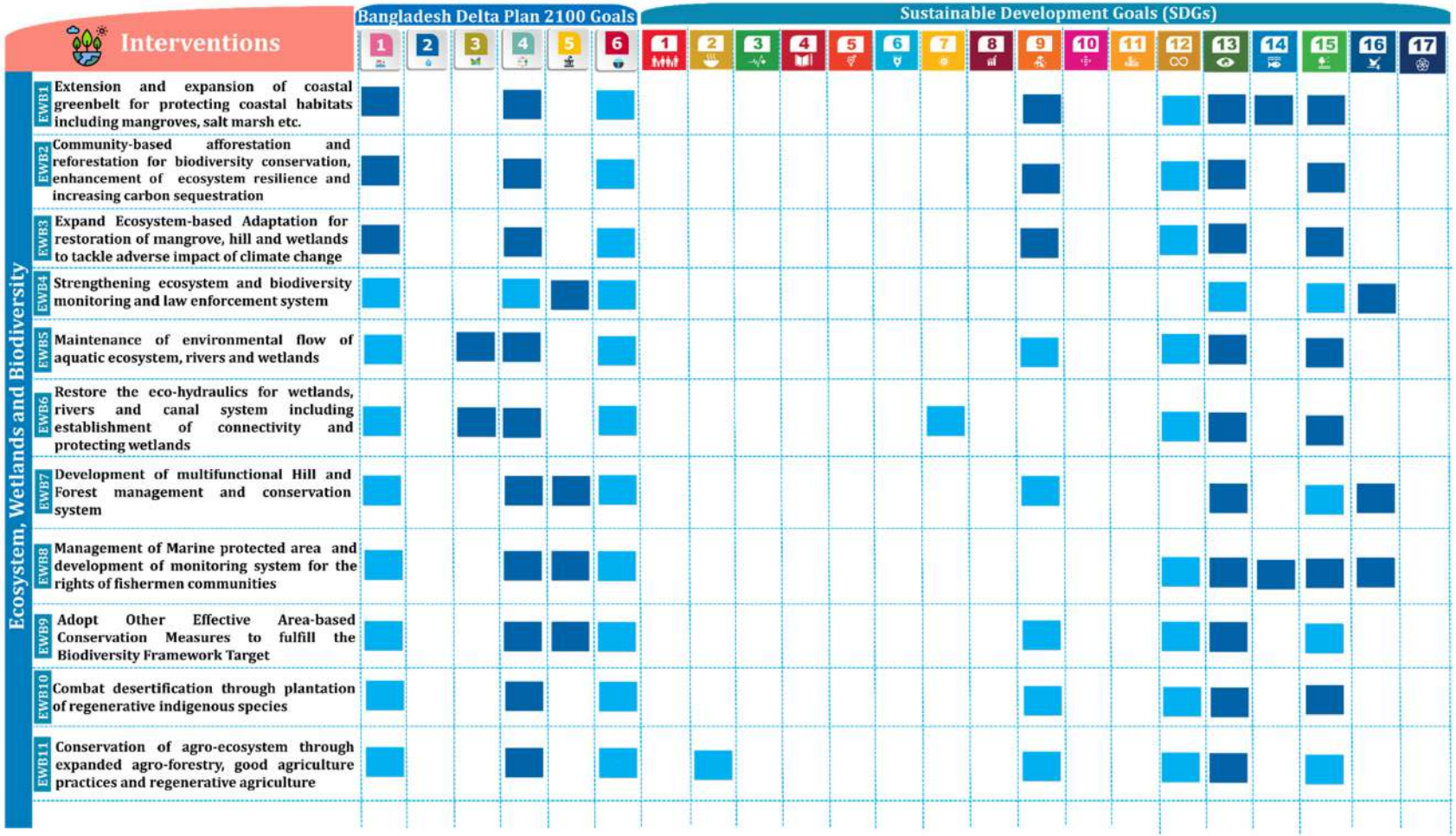

Interventions
Bangladesh Delta Plan 2100 Goals
Sustainable Development Goals (SDGs)
Water Resources
WRM12 Sustainable shoreline erosion management based on eco or bio-engineering measures
WRM13 Reclamation and development of lands for expansion of afforestation, agriculture, shrimp cultivation and settlements
WRM14 River management through bank stabilization and other ancillary works
WRM15 Ecosystem-based sediment management in coast and estuaries
WRM16 Drought management measures for enhanced groundwater recharge and increased soil moisture in water stress areas
WRM17 Development of National Drought Monitoring System
WRM18 Planned, participatory and coordinated land and water resources management
WRM19 Trans-boundary river basin management and basin level cooperation
WRM20 Development of basin wide and participatory watershed management framework to restore, harvest, and optimize use of water resources
WRM21 Remodeling of water regulating and cross drainage structures considering climate change scenarios

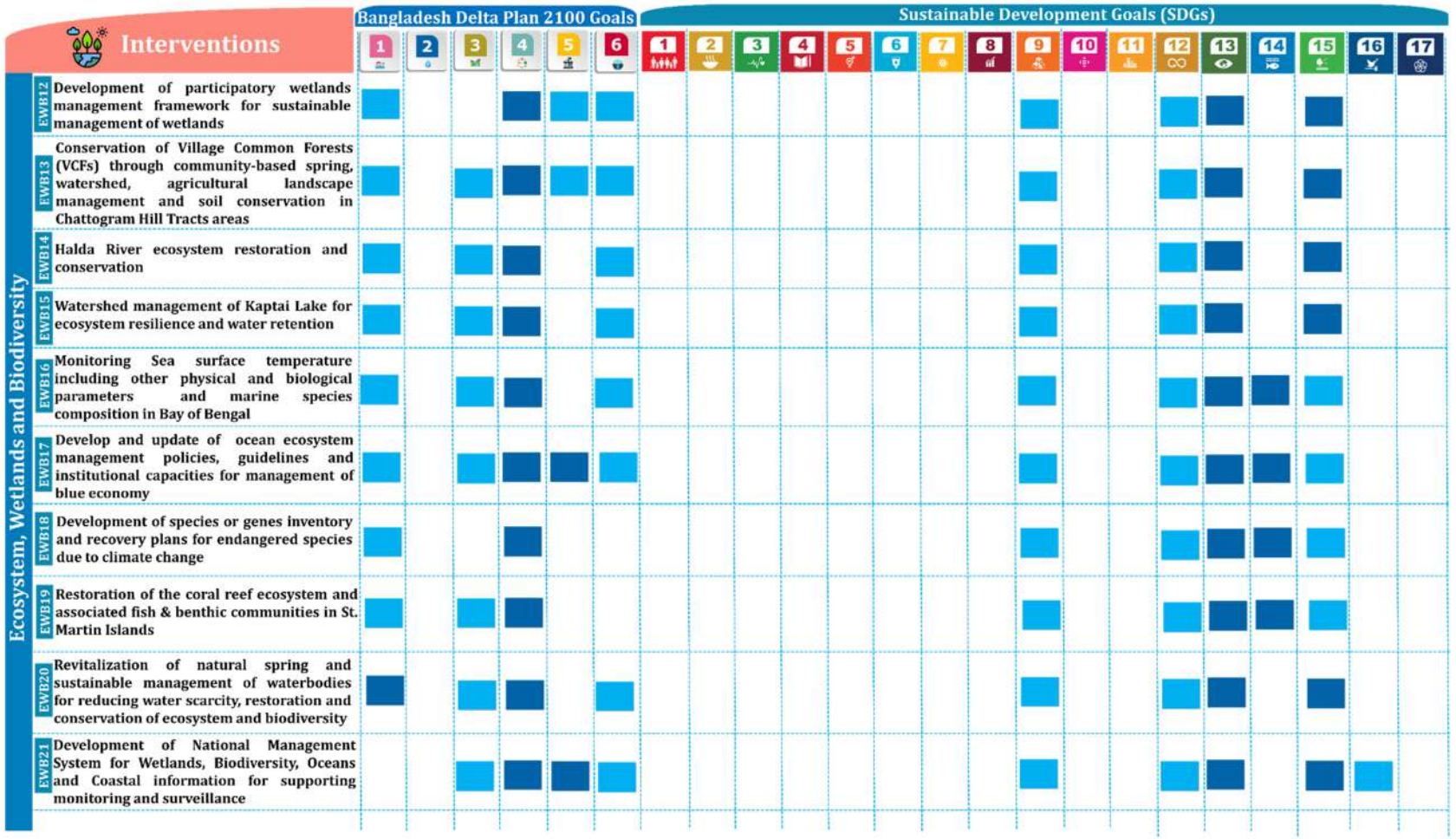

Interventions
Bangladesh Delta Plan 2100 Goals
Sustainable Development Goals (SDGs)
Disaster, Social Safety and Security
CDM1 Construction and rehabilitation of gender sensitive multi-purpose and climate resilient cyclone and flood shelters with safe drinking water, sanitation & livestock shelter facilities
CDM2 Landslide early warning system and risk management measures based on eco or bio-engineering measures
CDM3 Implementation of thunderstorm and lightning risk management measures in highly susceptible areas
CDM4 Protection and enhanced resilience against internal displacement for climate change with particular focus on gender
CDM5 Gender responsive and youth led disaster preparedness and emergency rescue and evacuation services
CDM6 Increase the resilience of vulnerable poor communities introducing gender responsive diversified livelihood, effective insurance mechanism and climate resilience fund
CDM7 Behavioral change and awareness development among vulnerable communities for emergency response and livelihood protection due to climate induced disasters
CDM8 Increase the coverage of social security /safety net programs for building community-based resilience & adaptive capacity
CDM9 Halt child abuse, early marriage and domestic violence triggered by climate induced disasters
CDM10 Development of women & young entrepreneurs for accelerated livelihood improvement through vocational training on adaptation practices and ICT
CDM11 Introduction of risk transfer and insurance mechanism for protection of critical and disaster protection infrastructures
CDM12 Building climate resilient houses and education infrastructures for high climate risk areas


Interventions
Bangladesh Delta Plan 2100 Goals
Sustainable Development Goals (SDGs)
Agriculture
CSA1 Extension of climate-smart technologies for increasing irrigation water use efficiency
CSA2 Augmentation of surface water for irrigation and multipurpose use
CSA3 Extension of stress tolerant, pest and diseases resistant rice and non-rice crops
CSA4 Introduction and up-scaling of innovative and indigenous agriculture
CSA5 Crop diversification/intensification for natural resources optimization and reducing climate stress
CSA6 Farm modernization/ mechanization to reduce climate vulnerability
CSA7 Increase fertilizer use efficiency for enhancing the production
CSA8 Extension of Good Agriculture Practices (GAP), Modern Agriculture Technology (MATH) and Sloping Agricultural Land Technology (SALT)
CSA9 Strengthening and development of impact based Early Warning System and Data Management
CSA10 Improvement of storage or post-harvest facilities, transport, communication and e-commerce based market facilities for agricultural product
CSA11 Development of agro-food processing industries based on climate-sensitive crop zoning
CSA12 Development of e-commerce and engagement of gender and youth for e-commerce based entrepreneurship


Interventions
Bangladesh Delta Plan 2100 Goals
Sustainable Development Goals (SDGs)
Fisheries, Aquaculture and Livestock
CFL1 Extension of climate resilient technology for combating climate related stresses in Aquaculture
CFL2 Development of climate-ready open water fisheries management
CFL3 Development and management of coastal and marine fisheries to foster blue economy
CFL4 Validation and extension of indigenous knowledge-based adaptation techniques to combat climatic effect on fisheries
CFL5 Monitoring, evaluation and enforcement for ensuring conservation of fish biodiversity and habitat
CFL6 Development of shrimp culture planning and zoning
CFL7 Improvement of post-harvest facilities and e-commerce based market facilities for fisheries & aquaculture
CFL8 Development of fish industries based on climate-sensitive crop zone
CFL9 Extension of climate-stress tolerant livestock and poultry breeds, farm house feed and fodder
CFL10 National livestock and poultry database and information development
CFL11 Extension of indigenous and advanced livestock and poultry farming practices
CFL12 Climate-resilient infrastructure development for the safety of livestock and poultry during a disaster
CFL13 Development of livestock product processing industries and transportation system


Interventions
Bangladesh Delta Plan 2100 Goals
Sustainable Development Goals (SDGs)
Urban Cities
CRC1 Improvement of natural and artificial stormwater drainage networks for reducing vulnerabilities of urban flood and drainage congestion
CRC2 Expansion and conservation of green and blue infrastructures for improvement of urban environment and drainage system
CDM3 Storm water management in cities through attenuating peak flow and allowing infiltration considering the concept of Low Impact Development
CRC4 Development of City Climate Action Plan for major urban cities
CRC5 Expand innovative climate-resilient and gender sensitive WASH technologies and facilities for urban communities
CRC6 Increase access to water supply, sanitation and hygiene services in cities for reducing exposure of flooding and water borne diseases
CRC7 Adopt integrated water management for urban and peri-urban areas
CRC8 Child and youth wellbeing improvement initiatives for reducing effects of climate stress
CRC9 Improvement of surveillance, early warning system and monitoring of psychosocial impacts and mental health risks from extreme weather events
CRC10 Extension of resilient and eco-friendly materials engaging private sectors through incentives and tax rebates for climate resilient infrastructures development in urban areas
CRC11 Establishment of climate resilient health care facilities in urban areas
CRC12 Development of heatwave and diseases outbreak advisory services for city dwellers


Interventions
Bangladesh Delta Plan 2100 Goals
Sustainable Development Goals (SDGs)
Ecosystem, Wetlands and Biodiversity
EWB1 Extension and expansion of coastal greenbelt for protecting coastal habitats including mangroves, salt marsh etc.
EWB2 Community-based afforestation and reforestation for biodiversity conservation, enhancement of ecosystem resilience and increasing carbon sequestration
EWB3 Expand Ecosystem-based Adaptation for restoration of mangrove, hill and wetlands to tackle adverse impact of climate change
EWB4 Strengthening ecosystem and biodiversity monitoring and law enforcement system
EWB5 Maintenance of environmental flow of aquatic ecosystem, rivers and wetlands
EWB6 Restore the eco-hydraulics for wetlands, rivers and canal system including establishment of connectivity and protecting wetlands
EWB7 Development of multifunctional Hill and Forest management and conservation system
EWB8 Management of Marine protected area and development of monitoring system for the rights of fishermen communities
EWB9 Adopt Other Effective Area-based Conservation Measures to fulfill the Biodiversity Framework Target
EWB10 Combat desertification through plantation of regenerative indigenous species
EWB11 Conservation of agro-ecosystem through expanded agro-forestry, good agriculture practices and regenerative agriculture


Interventions
Bangladesh Delta Plan 2100 Goals
Sustainable Development Goals (SDGs)
Ecosystem, Wetlands and Biodiversity
EWB12 Development of participatory wetlands management framework for sustainable management of wetlands
EWB13 Conservation of Village Common Forests (VCFs) through community-based spring, watershed, agricultural landscape management and soil conservation in Chattogram Hill Tracts areas
EWB14 Halda River ecosystem restoration and conservation
EWB15 Watershed management of Kaptai Lake for ecosystem resilience and water retention
EWB16 Monitoring Sea surface temperature including other physical and biological parameters and marine species composition in Bay of Bengal
EWB17 Develop and update of ocean ecosystem management policies, guidelines and institutional capacities for management of blue economy
EWB18 Development of species or genes inventory and recovery plans for endangered species due to climate change
EWB19 Restoration of the coral reef ecosystem and associated fish & benthic communities in St. Martin Islands
EWB20 Revitalization of natural spring and sustainable management of waterbodies for reducing water scarcity, restoration and conservation of ecosystem and biodiversity
EWB21 Development of National Management System for Wetlands, Biodiversity, Oceans and Coastal information for supporting monitoring and surveillance

Appendix II: Summary Portfolio of Adaptation Interventions

Table AII.1: Water Resources

Code	Interventions	Activity	Domain	BDP2100 CCAP	Cost (billion BDT)	Implementing entity	
						Lead	Supporting
WRM1	Integrated management of coastal polders, sea dikes and cyclone shelters against tropical cyclone, sea-level rise and storm surges	• Repair, construct and rehabilitate coastal polders, sea dikes or embankments considering sea-level rise and extreme storm surge height under varying climate change scenarios • Inside and outside polder management for proper drainage systems and sediment management through innovative and indigenous water resources management techniques such as tidal river management (TRM) • Repair, construct and rehabilitate cross drainage and water regulation structures considering extreme climate change scenarios and advanced technologies or construction materials • Regular and timely operation and maintenance (O&M) of coastal polders • Operationalize M&E system for polder/embankment management • Enhance functional participatory water management and effective co-management of water regulation structures • Integrated land-use management with supporting regulations in polder area to guide adaptive land-use practices • Encroachment-free *khals* in connection to polders for maintaining connectivity and uninterrupted drainage	SWM | SEE | CHI	CZ 1.8/1.21, CZ1.44, CZ1.40, CZ1.47	2212	BWDB	LGED, RHD, DoE, DAE, NARS institutes, BFD, DoF, BFRI, DDM, DLS, DPHE, BLRI, LGD, DYD, DSS, DWA, SRDI, BMD, SPARRSO, MoD, WARPO, DBHWD, MoL PPPA, private sector, NGOs

Code	Interventions	Activity	Domain	BDP2100 CCAP	Cost (billion BDT)	Implementing entity	
						Lead	Supporting
		• Allocate and mobilize adequate funds for emergency responses and recovery of damaged polders					
WRM2	Management of freshwater resources and monitoring of salinity for reducing vulnerabilities in existing and potential salinity-prone areas	• Monitoring and mapping of soil and water salinity through in situ low-cost testing instruments at the field level and GIS mapping at the planning level • Large-scale reservoir development and dredging of rivers for freshwater flow augmentation in coastal rivers • Excavation or re-excavation of *dighi,* pond, reservoir or construction relevant infrastructure for freshwater harvesting • Construct heightened dikes or freshwater retention ponds to halt salinity ingress due to storm surges • Community-based, youth-led and gender-inclusive freshwater pond management and rainwater harvesting • Demarcation of potential saline-prone areas, develop and implement freshwater management plan for smooth transition of freshwater ecosystem to saline water • Adjusted and adaptive land cover change • Expand use of deeper groundwater reserves through solar-powered water networks, advanced water storage through small-scale retention structures, and gender-sensitive drinking water points • Introduce community-based, low-cost desalination techniques and freshwater management for mass-level drinking water supplies	SWM | SEE | CHI		59	BWDB	LGED, RHD, DoE, DAE, NARS institutes, BFD, DoF, BFRI, DDM, DLS, DPHE, BLRI, LGD, DYD, DSS, DWA, SRDI, BMD, SPARRSO, WARPO, DBHWD, SoB, MoL, PPPA, private sector, NGOs
WRM3	Protection and management of potentially vulnerable areas due to tropical cyclone, sea-level rise, extreme storm surges and flooding	• Strategic climate risk assessment and climate risk-informed development planning for areas potentially vulnerable to sea-level rise, extreme storm surges and flooding • Construction of climate-induced disaster risk reduction infrastructures (polders, dikes or embankments, cross-drainage, water regulation, etc.) • Demarcate and keep enough 'room for river' during infrastructure development for accommodating excess floods • Maintain adequate freshwater flow in rivers and wetlands for slowing salinity intrusion	SWM | SEE | CHI	CZ1.47, MR 1.6	271	BWDB	LGED, RHD, DoE, DAE, NARS institutes, BFD, DoF, BFRI, DDM, DLS, DPHE, BLRI, LGD, DYD, DSS, DWA, SRDI, BMD, SPARRSO, WARPO, DBHWD, MoL, PPPA, SoB, private sector

Code	Interventions	Activity	Domain	BDP2100 CCAP	Cost (billion BDT)	Implementing entity	
						Lead	Supporting
WRM4	Strengthen early warning and dissemination services for climate change-induced slow-onset and sudden extreme water hazards using ICT and artificial intelligence	• Development of storm surge models and impact-based operational early warning and community-based dissemination systems for cyclonic storm surge to facilitate emergency responses • Develop and strengthen impact-based early warning, ICT and community-based dissemination systems for floods and flash floods • Expand hydrometeorological observation networks and strengthen forecast and climate information services through data acquisition and monitoring of local climate variables, sea surface temperature, sea-level rise, sediment, land subsidence and salinity intrusion • Invest in developing, updating, and strengthening climate products and services (data, forecast, analyses, etc.) for emerging climate extremes like heat waves, cold spells, hailstorms, salinity ingress, etc. • Develop space technology, artificial intelligence, crowdsourcing and big data-based climate change and impact monitoring tools • Develop and support a climate change vulnerability and early warning dissemination network with the involvement of relevant stakeholders • Installation of the mobile network-connected digital dashboard, voice SMS, mobile applications • Increase community volunteering or community-based risk flagging for emergency response.	Nationwide		91	BWDB, BMD	DoE, DAE, NARS institutes, BFD, DoF, BFRI, DDM, DLS, BLRI, SRDI, SPARRSO, CHTDB, BMDA, ICT, PPPA, private sector
WRM5	Community-based rainwater harvesting through indigenous techniques and conservation of wetlands, reservoirs and natural springs for drinking water supplies in hard-to-reach and water-stressed areas	• Identify and evaluate the effectiveness of community-based indigenous techniques for rainwater harvesting • Restoration and conservation of wetlands and reservoirs for rainwater harvesting • Identify and sensitize communities about the benefits of rainwater harvesting under climate stress condition • Implement community-based rainwater harvesting techniques inclusive of gender	SWM | SEE |CHT | DBA CBL| NNW| CHI | URB	CZ 1.8/1.21, CZ 1.26, CZ1.30	30	BWDB, BMDA, LGD, CHTDB	DoE, DDM, DLS, DPHE, BLRI, LGD, DYD, DSS, DWA, SRDI, BMD, SPARRSO, WARPO, DBHWD, PPPA, private sector, NGOs

Code	Interventions	Activity	Domain	BDP2100 CCAP	Cost (billion BDT)	Implementing entity	
						Lead	Supporting
WRM6	Dredging of all major and medium rivers for accommodating the smooth drainage of excess floods during climate-induced extreme events	• Planned capital and maintenance dredging of major and medium rivers for accommodating and smooth drainage of excess floods during climate-induced extreme events • Proper management and reuse of dredging materials • Regular monitoring of siltation and the connectivity of rivers with natural canals, wetlands or *haors* for planning dredging • Allocate and mobilize timely and adequate funds for capital and maintenance dredging	FPE | HFF	CZ4.1	1,501	BWDB	WARPO, BIWTA, DBHWD, RRI, DoE, RHD, LGED, SoB, MoD, LGD, BFD, NRCC, DoF, BADC, MoL, PPPA, private sector
WRM7	Construction and rehabilitation of flood and drainage management measures with eco-engineering solutions	• Investigate and pilot eco-engineering solutions (slope protection with vetiver grass or stress-tolerant plants or native species, fish pass, elevated roads or causeway avoiding crossing waterbodies, restoration of the connectivity of rivers and khals, earthen embankments, etc.) as flood and drainage management measures • Implement eco-engineering solutions for flood and drainage management measures	FPE | HFF		754	BWDB	LGED, RHD, WARPO, DoE, DBHWD, BFD, DoF, BADC, BIWTA, NRCC, PPPA, private sector
WRM8	Drainage management of economic/industrial zones and critical infrastructure, and reinforced climate resilience through risk assessment	• Comprehensive climate risk assessment of planned or implemented economic/industrial zones and critical infrastructure • Preparation and implementation of inside and outside drainage management plans and creation of appropriate drainage mitigation measures considering extreme climate change scenarios, surrounding hydrological system and settlements • Maintain adequate opening and operational modalities for water regulation and cross-drainage structures based on climate change scenario modelling • Re-excavation, restoration and conservation of natural canals, wetlands or hydrological systems for proper drainage • Awareness-raising for climate risk-informed development	SWM | SEE | FPE | HFF |URB	CZ 1.11, CZ 1.4, MR 3.1	326	BEZA	LGED, RHD, BWDB, WARPO, PPPA, private sector
WRM9	Internal drainage management and climate-resilient development of	• Assessment of climate risk for the *char* and islands areas for risk-informed development planning • Preparation and implementation of inside and outside drainage management plan and the creation of appropriate drainage mitigation measures considering extreme climate change scenarios, surrounding hydrological system and settlements	CHI	CZ 1.11	461	BWDB	LGED, DoE, BFD, DDM, DLS, DYD,WARPO, DBHWD, MoD, MoL, PPPA, private sector, NGOs

Code	Interventions	Activity	Domain	BDP2100 CCAP	Cost (billion BDT)	Implementing entity	
						Lead	Supporting
	the *char* and islands areas	• Maintain adequate opening and operational modalities for water regulation and cross-drainage structures based on climate change scenario modelling of sea-level rise, extreme storm surges, etc. • Re-excavation and conservation of natural canals, wetlands or hydrological systems for proper drainage					
WRM10	Protection against flash floods, wave action, erosion and sedimentation	• Ensure regular and timely O&M of water management and drainage (regulators, culverts, etc.) structures, embankments and submersible embankments • Develop design guidelines and monitoring tools for construction and regular O&M of embankments • Participatory conservation of wetlands ecosystems through promoting submersible embankments and elevated roads with adequate opening for cross drainage • Development of the *karach/hijol* belt along the periphery of *haor* settlements to reduce wave action, erosion and consequent land degradation • Construction of guide walls for protection from wave action or flash floods in *haor* areas • Provisioning of causeways in *haor* areas for facilitating agricultural and fisheries production • Adopt experimental bioengineering and eco-engineering techniques for slope stabilization of embankments or banks of canals, reducing erosion risk • Construction, rehabilitation and maintenance of erosion protection structures along erosion-prone rivers • Indigenous or native vegetation or tree plantation along hill slopes to reduce soil erosion during excessive rain and flash floods • Maintaining connectivity of rivers or *khals* with perennial *beels*, seasonal wetlands in *haor* areas and *charas* or *jhiris* in the CHT area • Development of awareness at the planning and local levels of the principles of 'living with floods' in deeply flooded *haor* areas ensuring the conservation of rich ecosystems • Ensure hassle-free land rights to entitled holders after the reemergence of eroded land • Development of *haor,* wetland, *char*-specific WASH technologies focusing on serving the needs of people living on Aati (in *haor*) and *char*	FPE | HFF | CHI		1,909	BWDB	DBHWD, WARPO, LGED, RHD, CHTDB, DoE, DoF, DAE, BMD, SPARRSO, DDM, MoD, BIWTA, BN, BA, MoL, PPPA, private sector, NGOs
WRM11	Erosion risk management through erosion prediction, improved early	• Improvement of the existing erosion prediction model using artificial intelligence for predicting riverbank erosion risks under long-term future climate change scenarios • Development of an erosion risk management tool using the state-of-the-art Erosion Prediction Model for Bangladesh • Increase community volunteering or community-based risk flagging for warning dissemination and evacuation	FPE | HFF	CC18.5	7	BWDB	WARPO, CEGIS, FFWC, ICT, LGED, RHD, LGIs, BMD, SPARRSO, DDM, BFD, PPPA, private sector

Code	Interventions	Activity	Domain	BDP2100 CCAP	Cost (billion BDT)	Implementing entity	
						Lead	Supporting
	warning and its dissemination	• Increase access of communities to disseminated early warning information through the use of ICT					
WRM12	Sustainable shoreline erosion management based on eco- or bioengineering measures	• Innovation and investigation and piloting of bioengineering shoreline protection measures • Prediction of shoreline erosion using the erosion prediction model under climate change scenarios • Design and implement eco- or bioengineering shoreline protection measures such as oyster reef, vetiver grass or mangrove plants like *Golpata,* etc. • Regular O&M of protection measures for ensuring durability and sustainability	SWM | SEE |CHT | HFF | NNW	CZ 1.3, CC9.17	755	BWDB	WARPO, CEGIS, LGED, RHD, LGIs, BMD, SPARRSO, DDM, DoE, MoD, BFD, BN, BA, BCG, MoL, PPPA, private sector
WRM13	Reclamation and development of lands for the expansion of afforestation, agriculture, shrimp cultivation and settlements	• Identify suitable areas for reclamation and development of lands through erosion and accretion analysis • Land acquisition and stress-tolerant species plantation • Community-based afforestation and social forestry engaging communities • Conservation of forestry, wetlands and internal drainage channels • Strategic environmental and climate risk assessments for agriculture, shrimp cultivation and climate-proofed settlements and communication facilities development • Internal drainage management and climate proofing of water management and disaster protection infrastructures • Expansion of settlements and increased opportunities for livelihood generation activities	SEE |CHI	HR2.1/2.2, HR2.4	490	BWDB	BFD, DoE, MoL, DAE, DoF, BIWTA, WARPO, RRI, MoD, private sector
WRM14	River management through bank stabilization and other ancillary works	• Assess erosion risk-prone areas through analysis of historical river morphology and bank line shifting • Design riverbank stabilization and training on related structural and non-structural measures considering the hydromorphological characteristics of rivers and climate change • Implement river stabilization and training works to provide erosion protection and management of rivers • Introduce eco-engineering measures for riverbank stabilization and ancillary works • Ensure regular and timely O&M of protection measures	FPE | HFF	MR 1.1, MR 1.46,DP 1.3	587	BWDB	WARPO, BIWTA, DBHWD, RRI, DoE, RHD, LGED, LGD, BFD, NRCC, DoF, MoD, MoL, BADC, PPPA, private sector
WRM15	Ecosystem-based sediment management along coasts and in estuaries	• Measure sediment loads and assess sediment budget • Identification of approaches for ecosystem-based sediment management such as tidal river management • Piloting and evaluation of lessons learned from ecosystem-based sediment management approaches • Implementation of ecosystem-based sediment management on coasts and in estuaries	SWM | SEE | CHI		83	BWDB	BIWTA, DoE, BFD, DDM, LGED, DYD, DSS, DWA, SRDI, WARPO, BN, BA, BCG, MoL

Code	Interventions	Activity	Domain	BDP2100 CCAP	Cost (billion BDT)	Implementing entity	
						Lead	Supporting
WRM16	Drought management measures for enhanced groundwater recharge and increased soil moisture in water-stressed areas	• Development of a national drought management master plan • Groundwater resources mapping, and ensure efficient and conjunctive use of water based on groundwater availability assessment • Restrict groundwater abstraction in depleted areas by introducing water pricing policies • Formulate strategies, and explore and implement managed aquifer recharge and rainwater harvesting • Implementation of Bangladesh Water Rule 2018 for conserving water bodies and ensuring wise use of water • Coordinated and community-based rainwater harvesting through indigenous techniques and conservation of springs in CHT • Introduce and implement shadow water pricing to increase water use efficiency and ensure conjunctive use of water • Digging of reservoirs, *dighis* or mini-ponds for surface water harvesting	DBA|NNW| CBL|CHT|SWM	CZ 1.3, CZ 1.6	99	BADC, BMDA, CHTDB	BWDB, LGED, WARPO, SRDI, DPHE, DBHWD, DDM
WRM17	Development of a national drought monitoring system	• Assess meteorological, hydrological and agricultural drought for establishing co-relation based on seasonal variability • Establish memorandums of understanding and data-sharing protocols with relevant agencies and knowledge institutes for drought-related data collection, drought assessment and monitoring framework development • Develop and launch a national drought monitoring system and operationalize climate information services for planning and farm-level early warning dissemination	Nationwide	MR 1.2	6	BADC	BMDA, CHTDB, BMD, SPARRSO, BWDB, LGED, WARPO, SRDI, DPHE, DBHWD, CEGIS, DDM, PPPA, private sector
WRM18	Planned, participatory and coordinated land and water resources management	• Implement integrated water resources management for climate change adaptation through optimized use of scarce freshwater resources • Community-based climate change risk, vulnerability and adaptation need mapping for supporting locally led adaptation • Climate-sensitive land zoning • Development of gender-inclusive and youth-led functional participatory water and disaster management groups • Effective co-management of watersheds and water regulation • Maintain coordination between participatory water management committees (e.g., water management groups) and disaster management committees	SWM | SEE |CHT | FPE | HFF | DBA CBL| NNW| CHI |URB		170	BWDB	LGED, RHD, MoL, DoE, DAE, BFD, DoF, DDM, DLS, DPHE, LGD, DYD, DSS, DWA, SRDI, BIWTA, WARPO, DBHWD, NGOs
WRM19	Transboundary river basin management and basin-level cooperation	• Strengthen bilateral and multilateral water diplomacies with transboundary countries for enhanced cooperation in basinwide management • Knowledge and information exchange from similar transboundary basin countries • Development of negotiation skills among young water professionals	Nationwide		9	JRC	BWDB, NRCC, DBHWD, BIWTA, MoFA, PMO

Code	Interventions	Activity	Domain	BDP2100 CCAP	Cost (billion BDT)	Implementing entity	
						Lead	Supporting
WRM20	Development of a basinwide and participatory watershed management framework to restore, harvest and optimize the use of water resources	• Development of an institutional framework for effective basinwide management within and among transboundary countries • Knowledge-sharing on basinwide management with other similar countries • Update the participatory water management framework for supporting participatory basinwide management • Develop and implement guidelines to restore, harvest and optimize use of water resources	SWM | CHT | FPE | HFF | DBA CBL| NNW		21	BWDB	LGED, RHD, MoL, DoE, DAE, BFD, DoF,DDM, DLS, DPHE, LGD, DYD, DSS, DWA, WARPO, DBHWD, CHTDB, BMDA
WRM21	Remodelling of water-regulating and cross-drainage structures considering climate change scenarios	• Climate data downscaling, assessment of anomalies and future climate scenarios development • Conduct hydrodynamic and hydrological modelling and assess the adequacy of existing water regulation and cross-drainage structures under climate change scenarios • Redesign and implement remodelled water regulation and cross-drainage structures to be adequate under future scenarios • Introduce eco-friendly and composite materials for remodelling water management structures	Nationwide		542	BWDB	LGED, RHD, BIWTA, FFWC, WARPO, DBHWD, MoL, LGD, DDM, DoF, PPPA, private sector
Grand total for water resources (billion BDT)					**10,383**		

Table AII.2: Disaster, social safety and security

Code	Interventions	Activity	Domain	BDP2100 CCAP	Cost (billion BDT)	Implementing entity	
						Lead	Supporting
CDM1	Construction and rehabilitation of gender-, age- and disability-sensitive multipurpose, climate-resilient and accessible cyclone and flood shelters with safe drinking water, sanitation and livestock shelter facilities	• Rehabilitation of existing cyclone shelters to make the gender- and disability-friendly and to serve multiple purposes • Construction of gender- and disability-friendly, multipurpose and climate-resilient cyclone and flood shelters meeting the desired level of shelter density in disaster-prone vulnerable areas • Provision of safe drinking water, lactation and maternity facilities, gender- and disability-sensitive sanitation, disability accessibility, livestock shelters, solar energy, etc. • Connecting emergency response services through boat ambulances, boat schools, potable drinking water, medication and sanitation facilities, etc. • Repair, rehabilitate or construct access roads to cyclone shelters that are gender- and disability-responsive	SWM|SEE|CHI|FPE|HFF	CC1.4	592	DDM, LGED	EED, BWDB, RHD, DoE, ICT, HBRI, PWD, DWA, DSS, DPHE, DAE, WARPO, DBHWD, PPPA, MoD, private sector, NGOs
CDM2	Landslide early warning systems and risk management measures based on eco- or bioengineering measures	• Landslide susceptibility mapping and risk assessment through comprehensive inventory development, monitoring and updating on a regular basis • Landslide risk management in CHT and other hilly areas following government-approved scientific guidelines and with a proper geotechnical investigation • Knowledge exchange on landslide risk management using bioengineering measures with similar disaster-prone countries • Introduce bioengineering measures for landslides, evaluate their effectiveness and implement them accordingly • Early warning system, ICT and community-based dissemination system developed for landslides	CHT|HFF|NNW		19	DDM	CHTDB, RHD, LGED, DoE, BFD, BRB, BMD, SPARRSO, DBHWD, PPPA, MoD, private sector
CDM3	Implementation of thunderstorm and lightning risk management measures in highly susceptible areas	• Study on understanding the relationship of climate change and lightning trends in Bangladesh • Plantation of palm trees and installation of lightning arresters at the household level in *haor* and other open areas to protect against frequent lightning and thunderstorms • Construction of farmers sheds or pedestrian sheds near open areas for protection against frequent thunderstorms and lightning • Development of early warning systems, ICT and community-based dissemination systems for lightning and thunderstorms	Nationwide		14	DDM	LGD, LGED, RHD, DBHWD, PWD, BMDA, DAE, CHTDB, MoD, PPPA, private sector
CDM4	Protection and enhanced resilience of climate migrants with a particular	• Development of an inventory of existing and potential climate migrants, and strengthening response and recovery mechanisms • Alternative livelihoods, job creation and income-generation activities • Planned internal climate migrant management in urban areas • In-situ adaptation training for livelihoods to discourage mobility	Nationwide		124	DDM	DSS, DWA, DYD, LGD, MoL, BBS, BWDB, MoA, MoFL, MoEFCC, LGED, RHD, CHTDB, PMO, MoF, PPPA, MoD,

Code	Interventions	Activity	Domain	BDP2100 CCAP	Cost (billion BDT)	Implementing entity	
						Lead	Supporting
	focus on gender and disability	• Ex-situ capacity development training for coping with new environments and livelihood opportunities • Development of index-based insurance mechanisms (such as weather-based crop insurance) for potential climate migrants and their livelihoods • Improve the financial condition of climate migrants • Planned relocation of settlements at high risk of potential cyclonic storm surges, floods and erosion					private sector, NGOs
CDM5	Gender-, age- and disability-responsive, youth-led disaster preparedness and emergency rescue and evacuation services	• Development of youth-led volunteer groups for emergency response, rescue and evacuation during disasters • Gender- and disability-responsive emergency response services through boat ambulances, boat schools, potable drinking water, medication, maternity and lactation facilities, hygiene and floating or portable sanitation facilities, etc. • Regular drills for emergency response, rescue and evacuation	SWM | SEE |CHT | FPE | HFF | CBL| NNW| CHI | URB		20	DDM	DSS, DWA, DYD, LGD, BWDB, MoEFCC, LGED, RHD, BMD, SPARRSO, CHTDB, PPPA, MoD, private sector, NGOs
CDM6	Increase the resilience of vulnerable poor communities by introducing gender-, age- and disability-responsive diversified livelihoods, effective insurance mechanisms and climate resilience funds	• Build alternative livelihoods and income-generation opportunities for vulnerable people inclusive of gender, ethnic communities, persons with disabilities and other socially disadvantaged groups • Climate insurance for small shrimp cultivators, forest resource users, slum dwellers, farmers and women • Financial incentives and livelihood promotion for women, ethnic communities, persons with disabilities and socially disadvantaged groups • Financial subsidies to capture fishers to avoid local moneylending for purchasing fishing gear and equipment • Training for livelihood diversification for *jhum* cultivators, dry fish industries, fishers, farmers, labourers, shrimp cultivators, forest resource users (FRU), women • Provide production inputs (seeds, fishing gear, etc.)	Nationwide		535	DDM, LGD	MoF, DSS, DWA, DYD, LGD, BWDB, MoEFCC, LGED, DAE, BMDA, DoF, DLS, RHD, BMD, SPARRSO, MoD, BIDA, CHTDB, ICT, PPPA, private sector, NGOs
CDM7	Behavioural change and development of awareness among vulnerable communities for emergency responses and livelihood protection from climate-induced disasters	• Knowledge dissemination and sensitize communities about localized impacts of climate change through community-based and participatory risk assessment and mapping of social resources, infrastructure and adaptation techniques • Awareness-raising and behavioural change programmes for accessing cyclone or flood or other disaster shelters and facilities • Raise awareness and encourage social forestry and tree plantation for forest-dependent livelihood generation and nature-based adaptation • Awareness programme for emergency response, evacuation and disaster preparedness • Behavioural change program for enhancing proactive adaptation practices based on indigenous knowledge	Nationwide		3	DDM	LGD, ICT, MoEFCC, DSS, DWA, DYD, CHTDB, MoD, PPPA, private sector, NGOs

Code	Interventions	Activity	Domain	BDP2100 CCAP	Cost (billion BDT)	Implementing entity	
						Lead	Supporting
		• Development of knowledge and communications hub, e-learning modules, posters, apps, flyers, animated videos or documentaries, websites, ICT based digital facilities, electronic and print media, community announcements, etc. for awareness-raising and behaviour change • Preparation of gender-sensitive communications materials for awareness-building and knowledge enhancement					
CDM8	Increase the coverage of social security/social safety net programmes for building community-based resilience and adaptive capacity	• Initiate climate change allowances and insurance under social security/social safety net programmes • Increase the amount/number of beneficiaries considering the vulnerability growth rate • Provision of income security for the elderly, widows and persons with disabilities • Generating temporary employment for working-age men and women and supporting the healthy development of young mothers and children • Livelihood protection and improvement for communities of the *char* and islands areas	Nationwide		625	DDM, DSS, DWA	LGD, MoF, PMO, DYD, BWDB, LGED, DAE, BMDA, DoF, DLS, RHD, MoD, BMD, SPARRSO, ICT, CHTDB, NGOs
CDM9	Halt child abuse, early marriage and domestic violence triggered by climate-induced disasters	• Awareness-raising among communities and children regarding the effects of climate change on abuse, early marriage or domestic violence • Sensitize community representatives for regular grooming of vulnerable families • Inclusion of domestic violence-prone vulnerable families or marginal families in social safety net programmes • Update education curriculum for knowledge and awareness-building among children • Stringent enforcement of laws against domestic violence and child abuse	Nationwide		7	DDM, DSS, DWA	LGD, DYD, ICT, CHTDB, MoD, MoLJPA, private sector
CDM10	Accelerated livelihood improvements for women, people with disabilities and young entrepreneurs through vocational training on adaptation practices and ICT	• Expand CMSME programmes for women and youth • Extension of easy access to microcredit support or start-up loans • Entrepreneurial training for local resources use (in market promotion) • Revetment from taxes and levies • Promote community-based farming (CBF) (agriculture, fishery, livestock) • Capacity development through vocational training on adaptation and ICT	Nationwide		230	DWA, ICT, DYD, PPPA	MoF, DSS, LGD, DAE, BMDA, DoF, DLS, BIDA, MoD, CHTDB, private sector, NGOs
CDM11	Introduction of risk transfer and insurance mechanisms for protection of critical and	• Inventory of critical and disaster protection structures • Develop a framework for the financial protection of critical coastal infrastructure through risk transfer or insurance mechanisms based on discussion with banks, financial institutions, NBR and PPPA • Popularize and implement risk transfer or insurance facilities	Nationwide		23	DDM, MoF	DSS, DWA, DYD, LGD, BWDB, MoEFCC, WARPO, LGED, DAE, BMDA, DoF, DLS, RHD, BMD, SPARRSO,

Code	Interventions	Activity	Domain	BDP2100 CCAP	Cost (billion BDT)	Implementing entity	
						Lead	Supporting
	disaster protection infrastructure, vulnerable MSMEs and farmers	• Encourage private sector investors to build adaptation or disaster risk reduction infrastructure using risk transfer tools					BIDA, CHTDB, MoD, ICT, MoP, PPPA, private sector, insurance companies, NGOs
CDM12	Building climate-resilient houses, education & communication infrastructure in areas with high climate risk	• Establishment of low-cost and sustainable climate-resilient houses (such as elevated, portable, solar energy-based cookstoves, rainwater harvesting, sanitation facilities, etc.) for marginal communities following the guidelines of House Building Research Institute. • Building research institutes and other piloted initiatives • Establishment of climate-resilient education facilities (such as floating or dismantlable schools, boat schools, elevated schools with digital multimedia facilities, home-based digital schools, etc.) for reducing risks to education during disasters • Development of climate resilient rural and urban communication infrastructures • Gender and disability inclusion in developing climate-resilient shelters, houses and educational facilities	Nationwide		160	DDM, LGED, EED, RHD	LGD, PWD, HBRI, UDD, MoEdu, MoEFCC, CHTDB, WARPO, MoD, DBHWD, PPPA, private sector, NGOs
Grand total for disaster, social safety and security (billion BDT)					**2,352**		

Table AII.3: Agriculture

Code	Interventions	Activity	Domain	BDP2100 CCAP	Cost (billion BDT)	Implementing Entity	
						Lead	Supporting
CSA1	Extension of climate-smart technologies for increasing irrigation water use efficiency	• Improve irrigation water conveyance efficiency through buried pipes, hose pipes, canal lining, etc. • Improve on-farm water use efficiency through bund management, leaser levelling, volumetric water pricing (prepaid metering), etc. • Extension of alternate wetting and drying (AWD) in HYV boro rice cultivation system for improving on-farm water use efficiency • Introducing micro-irrigation systems (sprinkler and drip) for increasing water use efficiency • Practicing agronomic management (reduce tillage, direct wet seeded rice using drum seeder, mulching, etc.) for minimizing water loss. • Training and demonstration of different water saving technologies	SWM | SEE | CHT | FPE | HFF | DBA CBL | NNW | CHI | URB		313	BADC and BMDA	DAE, LGED, RDA, BWDB, CHTDB, DoF, LGD, PPPA, WARPO, private sector

Code	Interventions	Activity	Domain	BDP2100 CCAP	Cost (billion BDT)	Implementing Entity	
						Lead	Supporting
CSA2	Augmentation of surface water for irrigation and multipurpose use	• Rehabilitation of existing surface water irrigation projects particularly in Muhuri, Manu, Bhola, Barisal, Chandpur, Meghna-Dhonogoda, Testa and the Ganges-Kobadak (GK) Irrigation Project. • Implementation of the Padma Barrage Project • Implementation of the North Rajshahi Irrigation Project • Rainwater harvesting through periodic re-excavation of perennial water bodies (ponds, *beels,* canals, rivers, etc.) for year-round surface water availability • Rainwater harvesting and storing treated wastewater for watering rooftop gardens	SWM | SEE | CHT | FPE | HFF | DBA CBL | NNW | CHI	DP1.1, DP1.2, DP1.4	846	BWDB, BADC and BMDA	DAE, LGED, RDA, CHTDB, DoF, LGED, NRCC, JRC, WARPO, RRI, DBHWD, PPPA, private sector
CSA3	Extension of stress-tolerant, pest and disease-resistant rice and non-rice crops	• Extension of different stress-tolerant varieties (salinity, heat, cold, flood, lodging, etc.) through training, field-level demonstrations and input supplies • Extension of pest- and disease-resistant varieties through training, field-level demonstrations and input supplies. • Extension of biofortified (zinc, iron, protein, etc.) crop varieties through training, field-level demonstrations and input supplies. • Ensure the availability of seeds of different stress-tolerant rice and non-rice crops	SWM | SEE | CHT | FPE | HFF | DBA CBL | NNW | CHI | URB	MR12.1, CC12.37	20	DAE	RDA, NARS institutes, BADC, BMDA, CHTDB, DoF, SRDI, DoE, PPPA, DoFood, private sector
CSA4	Introduction and scaling up of innovative and indigenous agriculture	• Alternate use of saline and non-saline water in maize, sunflower and wheat cultivation in the saline zone • Upscaling of floating agriculture for the southern, *haor* and *beel* areas • Upscaling of coffee, cashew nut, mixed fruit and other high-value crop cultivation in the hill and terrace region • Extension of the Sorjan method in the southern region • Upscaling of sack gardening in the *char* island and southern region • Extension of community seedbeds in *haor, beel* and floodplain areas • Promotion of sandbar agriculture in *char* areas • Introduction of hydroponic farming and upscaling of rooftop gardening in urban areas • Extension of high-value fruit and vegetable cultivation in the *barind* and north-western region	Nationwide		15	DAE	RDA, NARS institutes, BADC, BMDA, DoF, NGOs, CHTDB, BIDA, PPPA, private sector
CSA5	Crop diversification/intensification for natural resources optimization and reduction	• Extension of family nutrition gardens in homestead and uncultivated fallow land • Introduction of BARI, BRRI and other agricultural universities and private organizations to develop a quadruple cropping pattern • Extension of relay and mixed cropping in all regions • Strengthen vegetable cultivation in peri-urban areas	SWM | SEE | CHT | FPE | HFF | DBA CBL | NNW | CHI		15	DAE	BADC, BMDA, NARS institutes, BADC, DoF, DBHWD, MoL, NGOs, CHTDB, PPPA, DoFood, private sector

Code	Interventions	Activity	Domain	BDP2100 CCAP	Cost (billion BDT)	Implementing Entity	
						Lead	Supporting
	of climate stress						
CSA6	Farm modernization/mechanization to reduce climate vulnerability	• Extension of auto transplanter/seed drill use to minimize the time gap between two seasons and labour costs • Expansion of mechanical weeders and threshers to reduce the labour crisis and minimize cost • Expansion of combine harvesters/reapers for quick harvesting during disaster periods and to reduce the time gap between two seasons • Introduction of mechanical grain dryer for *haor*, *chalan beel* and low-lying areas • Promotion of jute ribbon retting to minimize the quantity of water for rotting and environmental pollution • Expansion of solar irrigation pumps for reducing biofossil energy sources • Promotion of small tool packages (foot pump and hand sprayer, budding knife, bush cutter, etc.) in hilly regions • Crop insurance for climatic stress-prone areas • Introduction of UAV technologies for precision use of agrochemicals	SWM | SEE | CHT | FPE | HFF | DBA CBL | NNW | CHI		106	BADC, BMDA, DAE	RDA, NARS institutes, NGOs, CHTDB, BIDA, PPPA, private sector
CSA7	Increased fertilizer use efficiency for enhancing production	• Establishment of mobile soil testing labs at the union level • Increase fertilizer use efficiency by using fertilizer deep placement technology • Subsidy for urea super granule and nitrogen, phosphorus and potassium (NPK) Guti briquette machines and fertilizer deep placement (FDP) applicator • Extension of the use of the leaf colour chart (LCC) for optimizing urea fertilizer use and minimizing the cost of production • Fertilizer application based on prior soil testing for minimizing the use of chemical fertilizers • Combined application of organic and inorganic fertilizers considering the integrated plant nutrient system (IPNS) • Application of biochar for crop production and soil health improvement • Application of nano fertilizer/pesticides for the effective use of fertilizers • Awareness development for the application of an optimum dose of organic fertilizer for increasing soil water-holding capacity • Development of fertilizer storage facilities to maintain the quality and ingredients of respective fertilizes (e.g., quality can degrade due to high temperatures) • Mouza/blockwise fertilizer dose recommendations should be prepared for optimum use of chemical fertilizers	SWM | SEE | CHT | FPE | HFF | DBA CBL | NNW | CHI		103	BADC, SRDI	DAE, BMDA, NARS institutes, NGOs, CHTDB, DoE, BFD, DoF, PPPA, private sector
CSA8	Extension of good	• Good agricultural practices (GAP) for all regions	SWM | SEE | CHT | FPE | HFF | DBA		25	DAE, CHTDB	RDA, NARS institutes, BMDA,

Code	Interventions	Activity	Domain	BDP2100 CCAP	Cost (billion BDT)	Implementing Entity	
						Lead	Supporting
	agricultural practices, modern agricultural technology and sloping agricultural land technology	• Modern agricultural technology for hills (MATH) and sloping agricultural land technology (SALT) for the hilly regions	CBL | NNW | CHI				DoE, NGOs, PPPA, private sector
CSA9	Strengthening and development of impact-based early warning systems and data management for agriculture	• Location-specific pest and disease outbreak alerts • AEZ based Real-time agro-met services • AEZ specific crop modelling for CC stress management based on agroecological zones • Benchmark survey and mapping on GHG emissions and climate-induced hazards (salinity, droughts, floods, storm surges, etc.) • Database generation of micro-level data on soil and crops for better management of CC impacts • Land zoning and land-use planning database development	Nationwide		15	DAE	ICT, BMD, SPARRSO, BADC, DoF, FFWC, BWDB, DDM, BMDA, CHTDB, DoE, PPPA, private sector
CSA10	Improvement of storage or post-harvest facilities, transport, communications and e-commerce-based market facilities for agricultural products	• Establishment of regulated markets, provision for grading and standardization of produce, standardization of weights and measures, and daily broadcasting of market prices of agricultural products • Construction of community seed storage, cold storage, godown and food silos in different climatic stress zones • Freezing vans, extra compartments attached to passenger trains for carrying vegetables and fruits • Construction of farm-level roads particularly in *haor* and low-lying areas • Adaptation policy for market price support for producers and consumers	Nationwide		145	BADC, DAM, DAE	RHD, LGED, LGD, BRTA, BIWTA, MoS, ICT, CHTDB, BIDA, PPPA, private sector
CSA11	Development of agrofood processing industries based on climate-	• Development/promotion of agro-processing industries (fruits, vegetables, cereals and pulses, etc.) in rural areas/CHT • Industrialization based on different crop zones and production (e.g., mango in Rajshahi, litchi in Dinajpur, etc.) • Household-based mini-processing factories developed (jam, jelly, etc.)	Nationwide		52	BADC, DAM, DAE	BSCIC, NGOs, CHTDB, BIDA, MoI, PPPA, private sector

Code	Interventions	Activity	Domain	BDP2100 CCAP	Cost (billion BDT)	Implementing Entity	
						Lead	Supporting
	sensitive crop zoning						
CSA12	Development of e-commerce and engagement of women, people with disabilities and youth in e-commerce-based entrepreneurship	• Development of e-commerce facilities • Engagement of women, people with disabilities and youth in online/offline agriculture marketing system • Engagement of women, people with disabilities and youth in different value chain systems as value chain actors	Nationwide		11	DAM, DAE, ICT	DWA, DSS, DSW, MoWCA, DYD, CHTDB, BIDA, BADC, BMDA, PPPA, private sector, NGOs
Grand total for agriculture (billion BDT)					**1,666**		

Table AII.4: Fisheries, aquaculture and livestock

Code	Interventions	Activity	Domain	BDP2100 CCAP	Cost (billion BDT)	Implementing Entity	
						Lead	Supporting
CFL1	Extension of climate-resilient technology for combating climate-related stresses in aquaculture	• Identify and select simultaneous culture of fish or shellfish along with other culture systems in light of integrated fish farming (IFF) • Identify and demonstrate suitable state-of-the-art aquaculture technology • Facilitate mangrove ecosystem-friendly aquaculture (i.e., silvofishery) in existing coastal farms • Maintain sufficient water in ponds • Species diversification in coastal aquaculture • Select and develop stress-tolerant species of commercially important fish for extension • Facilitate in developing and extension of stress-tolerant functional aqua-feed • Emphasize and facilitate mechanization, automation and technology (e.g., Fourth Industrial Revolution, sensors, IOT, etc.) to combat climate-related stresses in aquaculture • Introduce IMTA (integrated multi-trophic aquaculture in suitable areas	SWM | SEE | CHT | FPE | HFF | DBA CBL | NNW | CHI | URB		162	DoF	BFRI, BFDC, MoA, LGD, BMDA, CHTDB, MoWR, MoEFCC, MoI, MoS, NGOs, PPPA, private sector

Code	Interventions	Activity	Domain	BDP2100 CCAP	Cost (billion BDT)	Implementing Entity	
						Lead	Supporting
		• Utilize solar energy for avoiding GHG .					
CFL2	Development of climate-ready open water fisheries management	• Develop and disseminate stressor-based early warning systems for fisheries • Restore connectivity between habitats and increase room for water • Restore habitats for the conservation of aquatic resources under conservation programmes (e.g., sanctuaries, marine protected areas (MPA), ecosystem-based fisheries management) to enhance productivity • Stock enhancement of threatened fish species • Climate-responsive hilsa fishery management • Open water fisheries resource mapping	SWM | SEE | HFF | DBA CBL | NNW | CHI | BoB | URB		88	DoF	BFRI, BFDC, LGD, MoA, MoWR, MoEFCC, BMDA, CHTDB, MoI, MoS, NGOs, PPPA, private sector
CFL3	Development and management of coastal and marine fisheries to foster the blue economy	• Identify and select mariculture species and their extension • Develop a leapfrogging approach for coastal fisheries management • Develop an integrated approach for mangrove fisheries management • Seaweed farming as a sustainable blue food and the pathway to carbon neutrality.	SWM | SEE | BoB		45	DoF	BFRI, BORI, BFDC, BCG, BMA, BN, MoS, MoI, MoEFCC, MoFA, MoA, BWDB, CHTDB, NGOs, private sector
CFL4	Validation and extension of indigenous knowledge-based adaptation techniques to combat climatic effects on fisheries	• Identify the selected indigenous technologies practising currently • Conduct stakeholder surveys and accumulate information by stress area • Upscale selected indigenous technologies for battling climatic stress	SWM | SEE | CHT | HFF | DBA CBL | NNW		14	DoF	BFRI, BFDC, BORI, DAE, LGD, DSS, DWA, DYD, CHTDB, BMDA, DBHWD, MoEFCC, private sector, NGOs

Code	Interventions	Activity	Domain	BDP2100 CCAP	Cost (billion BDT)	Implementing Entity	
						Lead	Supporting
CFL5	Monitoring, evaluation and enforcement to ensure the conservation of fish biodiversity and habitat	• Develop a Fourth Industrial Revolution (4th IR) and Internet of things (IOT) based monitoring tool for monitoring and surveillance of illegal and indiscriminate fishing activities • Identification of monitoring parameters/indicators by consulting line agencies • Determination of monitoring locations and frequency of monitoring	SWM | SEE | CHT| DBA CBL | NNW | CHI | BoB | URB		246	DoF	BFRI, BFDC, DoE, BFD, BCG, BN, Port Authority, BIWTA, BWDB, MoA, CHTDB, NGOs
CFL6	Development of shrimp culture planning and zoning	• Identify suitable area for shrimp zoning in the reclaimed land of the coastal region with befitting planning • Identification of criteria for delineating the shrimp zone with a multicriteria analysis (MCA) • Engagement of different relevant stakeholders from farmers to line and research agencies	SWM | SEE | BoB		7	DoF	BFRI, BFDC, LGD, MoL, MoA, MoS, BORI, BMA, NGOs, WARPO, DBHWD, CHTDB, BMDA, MoI, MoEFCC
CFL7	Improvement of post-harvest facilities and e-commerce-based market facilities for fisheries and aquaculture	• Establish fish storage facilities • Develop e-commerce-based fish market facilities • Create fish transport with freezing facilities	Nationwide		288	BFDC, DoF	ICT, RHD, LGED, LGD, BRTA, BIWTA, MoS, DSS, DWA, DYS, CHTDB, BMDA, BIDA, PPPA, private sector
CFL8	Development of fish industries based on climate-sensitive crop zones	• Make arrangement for value addition to fisheries products • Identify the components of the value chain and their functions • Identify the actors of the value chain and their roles and responsibilities • Engage relevant stakeholders and interact with them for stocktaking of relevant information	Nationwide		46	BFDC	DoF, BFRI, NGOs, BIDA, PPPA, private sector, MoL, MoEFCC, BWDB, WARPO, DBHWD, CHTDB, BMDA, MoS, BIWTA, ICT, BIDA, MoI, PPPA, private sector
CFL9	Extension of climate-stress-tolerant	• Extension of stress-tolerant livestock and poultry breeds • Extension of climate-smart farmhouses (heat/cold minimization with local and low-cost technology) in rural areas • Extension of stress-tolerant high-yielding fodder cultivation in climate-stressed regions	Nationwide		41	DLS	BLRI, LGD, BADC, DAE, DoF, BMDA, CHTDB, knowledge institutes, academia and

Code	Interventions	Activity	Domain	BDP2100 CCAP	Cost (billion BDT)	Implementing Entity	
						Lead	Supporting
	livestock and poultry breeds, farms, feed and fodder	• Promotion and extension of hydroponic fodder cultivation for meeting fodder demand during disasters • Development and extension of dietary feed manipulation • Extension of community-based livestock and poultry farm management systems to minimize climate hazard impacts					universities, NGOs, LGED, PWD, HBRI, PPPA, private sector
CFL10	Development of a national livestock and poultry database and information	• Location-specific pest and disease outbreak alerts • Livestock and poultry census by upazilla and update it • Livestock and poultry pest and diseases database development • National livestock and poultry demand analysis based on population growth	Nationwide		11	DLS	ICT, BMD, SPARRSO, BLRI, LGD, BADC, DAE, DoF, BMDA, CHTDB, MoEFCC, PPPA, private sector
CFL11	Extension of indigenous and advanced livestock and poultry farming practices	• Extension of country-hen rearing at the household level for meeting family demand as well as economic return • Extension of local promising cattle breeds in all suitable areas • Extension of buffalo farming in different climate-stressed areas • Extension of advanced livestock farming for combating climatic stresses • Engagement of youth and women in advanced livestock and poultry farm management • Awareness-building on livestock and poultry deworming and vaccination • Application of Internet of things-based farm management systems • Extension of climate-smart poultry hatchery management • Resilience-building through feed intake (vitamin C during cold weather and saline during hot weather) • Promotion and extension of green feed additives for climate resilience and sustainable livestock production • Application of climate-smart biotechnological tools • Extension of silage preparation technology to farmers • Use of AI techniques to develop climate stress-tolerant breeds • Establishment of silo pits under every *upazilla* livestock office to provide silage to local farmers	Nationwide		120	DLS	BLRI, LGD, BADC, DAE, DoF, BMDA, CHTDB, MoL, MoEFCC, knowledge institutes, academia and universities, NGOs, private sector
CFL12	Climate-resilient infrastructure development for the safety of livestock	• Construction of *killas* for livestock shelter during natural disasters (cyclone, floods, etc.) • Community-based shelter management for livestock • Feed/fodder storage capacity-building in disaster-prone areas to support disaster responses • Infrastructure for rapid-response mobile veterinary services during disasters	Nationwide		207	DLS	LGED, BLRI, DDM, PWD, HBRI, DAE, BADC, MoEFCC, CHTDB, RHD, PPPA, private sector, NGOs

Code	Interventions	Activity	Domain	BDP2100 CCAP	Cost (billion BDT)	Implementing Entity	
						Lead	Supporting
	and poultry during disasters						
CFL13	Development of livestock product processing industries and transportation systems	• Development of livestock product processing and storage industries to reduce loss from climatic or any other hazards (e.g., COVID-19) • Development of a livestock product transportation system (e,g., freezing van, road communication system, etc.) • Development of e-commerce-based livestock and poultry products marketing systems • Development of household-based mini milk- and meat-processing industries led by youth and women • Private sector investment in livestock and poultry product marketing systems and processing industries • Development of milk-processing factories (cheese, UHT, chocolate, etc.) in the milk production zone • Awareness-building programme to popularize processed milk products (e.g., cheese can be included in school feeding programmes) • Development of community-based livestock product marketing systems	Nationwide		135	DLS	LGD, BLRI, BSCIC, DDM, PWD, HBRI, DAE, BADC, BFDC, MoEFCC, BIDA, CHTDB, PPPA, BIWTA, private sector, NGOs
Grand total for fisheries, aquaculture and livestock (billion BDT)					**1,410**		

Table AII.5: Urban areas

Code	Interventions	Activity	Domain	BDP2100 CCAP	Cost (billion BDT)	Implementing Entity	
						Lead	Supporting
CRC1	Improvement of natural and artificial stormwater drainage networks for reducing vulnerabilities to urban flooding and	• Construct and rehabilitate adequate coverage of artificial drainage networks in all major cities through water modelling under extreme climate change scenarios • Maintain enough room for rivers flowing through cities for accommodating excess flood volume during an extreme event • Revitalization of rivers or wetlands flowing inside or surrounding any city through regular dredging or re-excavation • Integrated solid waste and urban drainage management for sustainable drainage system development following 3R (reduce, recycle, recovery) principles • Awareness raising and citizen behaviour change to avoid illegal waste dumping into drains or *khals*	URB	UA 1.3, UA10.3, UA11.1,UA 3.1,UA 23.1,CC9.18	1,914	LGD	UDD, PWD, BIWTA, LGED, RHD, BWDB, DBHWD, WARPO, MoL, DoE, PPA, private sector

Code	Interventions	Activity	Domain	BDP2100 CCAP	Cost (billion BDT)	Implementing Entity	
						Lead	Supporting
	drainage congestion	• Regular cleaning of *khals* or canals inside the city to maintain adequate drainage capacity, navigability and connectivity with rivers (where appropriate) • IT-based monitoring mechanisms for urban drainage clogging, reporting, evaluation and rehabilitation • Improvement of storm water drainage system using smart warnings and pumping stations • Climate-proofing of water management infrastructure supporting improved drainage • Develop required infrastructures and purchase machineries for garbage cleaning on a regular basis and during extreme rainfall events					
CRC2	Expansion and conservation of green and blue infrastructure for improvement of urban environments and drainage systems	• Conservation of urban wetlands or *khals*; develop walkway and recreational facilities along the banks of *khals* or wetlands • Urban landscaping through green and blue infrastructure to reduce the heat island effect, pollution, human health discomfort, etc. • Expansion of green building and green roofs to reduce the urban heat island effect and enhance cooling, carbon sequestration and energy efficiency • Support rooftop gardening or plantations, installation of solar energy, and biodiversity conservation through tax instruments • Design smart villages and smart cities with a 10 percent provision for protected areas • Community conservation area or OECM and 25 percent of area as green space (rooftop garden, hanging garden, greening office and academic compounds, greening military compounds, urban green parks or garden development, etc.) along with water-sensitive planning • Plant suitable species of trees or grass on roadsides or road islands • Promote environmentally friendly vehicles and mass transport to reduce emissions and pollution • Expansion and commercialization of urban agriculture through rainfed rooftop and vertical farming for boosting leafy vegetable production and food security • Development of climate-smart solar energy-based utilities and installation of lightning arresters in residential and commercial buildings • Strict monitoring and enforcement of land cover change per DAP or structural plan to reduce encroachment on permeable open land, *khash* lands or green areas	URB	UA 9.1, UA 1.1	189	LGD	UDD, PWD, BWDB, DBHWD, WARPO, DoE, BFD, LGED, RHD, MoL, DYD, DWA, DSS, BA, BAF, BN, BCG, PPA, private sector

Code	Interventions	Activity	Domain	BDP2100 CCAP	Cost (billion BDT)	Implementing Entity	
						Lead	Supporting
CRC3	Stormwater management in cities through attenuating peak flow and allowing infiltration in line with the concept of low-impact development	• Preparation of stormwater management guidelines based on low-impact development concepts and operationalization • Feasibility study and implement different low-impact development (LID) measures such as permeable pavement, rooftop rainwater harvesting and use for households, disconnecting direct runoff, green parks or playgrounds, bioswale or bioretention cells, reservoirs, green rooftops, etc. • Develop the capacity of city managers to understand low-impact development and its operation	URB		37	LGD	UDD, PWD, BIWTA, LGED, RHD, BWDB, DBHWD, WARPO, MoL, DoE, PPA, private sector
CRC4	Development of city climate action plans for major urban and peri-urban areas emphasizing the resilience of urban-poor communities and climate migrants	• Take stock of baseline information and needs of city dwellers in all 43 major urban areas for preparing city climate action plans • Develop climate action plans for municipalities • Climate risk and vulnerability assessments and mappings for cities • Stocktaking of resilient Infrastructure and other adaptation need from the urban areas • Integrate water and climate-smart city development concepts into DAP or other required urban development policy • Adopt climate and disaster risk recovery mechanisms for urban slum dwellers, the urban poor and climate migrants • Adopt low-impact development principles, 3R principles, and urban green and blue conservation and expansion • Develop implementable actions for the short, medium and long term for climate-resilient city development that enhances the resilience of the urban poor and climate migrants along with implementation mechanisms and financing modalities	URB		4	LGD	UDD, PWD, BIWTA, LGED, RHD, BWDB, DBHWD, WARPO, MoL, DoE, PPA, private sector
CRC5	Expand innovative climate-resilient, gender-, age- and disability-sensitive WASH technologies and facilities	• Expand the use of deeper groundwater reserves through solar-powered water networks, advanced water storage through small-scale retention structures and rainwater harvesting, climate-resilient latrines, and gender-sensitive drinking water points for marginal urban communities to reduce the health risks of climate change • Establish sheds with improved gender- and disability-sensitive WASH facilities for reducing heat stress and lightning risk and supporting physical well-being • Introduce community-based low-cost desalination techniques and freshwater management for mass drinking water supplies among coastal city communities	URB		65	LGD	DSW, Mow CA, BIWTA, LGED, RHD, BWDB, DBHWD, WARPO, Moll, DoE, BIDA, UDD, PPA, private sector

Code	Interventions	Activity	Domain	BDP2100 CCAP	Cost (billion BDT)	Implementing Entity	
						Lead	Supporting
	for urban communities						
CRC6	Increase access to water supply, sanitation and hygiene services in cities for reducing exposure to flooding and waterborne diseases during or after extreme weather events	• Operationalize new WASAs for climate-sensitive water supply services • Development of climate-smart WASH (Water, Sanitation and Hygiene) technologies and infrastructure to increase the resilience of urban citizens • Expand coverage of piped water supplies and improved sanitation in all major cities • Develop smart metering systems for water services through assessments of shadow water prices • Managed aquifer recharge (MAR) and rainwater harvesting for artificial groundwater recharge in urban areas • Ensure implementation/enforcement of the Bangladesh National Building Code (BNBC) and MAR strategy • Establishment of dense pedestrian sheds in urban areas with improved gender-sensitive WASH facilities for reducing heat stress and lightning risk and supporting physical well-being • Increase the efficiency of water use through sustainable management of water resources and locally led adaptation practices • Reduce leakage, repair and provide O&M regularly to halt outbreaks of waterborne diseases from WASH-related service infrastructure • Develop climate-resilient and portable public sanitation facilities for marginal people and slum communities • Encourage the private sector to invest in expansion of the city water supply and sanitation services through PPP modalities • Gender- and disability-responsive WASH service expansion	URB		593	LGD	DSW, MoWCA, BIWTA, LGED, RHD, BWDB, DBHWD, WARPO, MoL, DoE, BIDA, UDD, PPA, private sector
CRC7	Adopt integrated water management for urban and peri-urban areas	• Impact assessments of climate change and interventions in water and hydrological systems in the upstream and downstream of urban and peri-urban areas to avoid any consequences downstream • Maintain coordination and collaboration among development initiatives in urban and peri-urban areas • Decentralize management adaptation by LGIs	URB	UA 9.3, UA 1.2	13	LGD	UDD, PWD, BIWTA, LGED, RHD, BWDB, DBHWD, WARPO, MoL, DoE, private sector

Code	Interventions	Activity	Domain	BDP2100 CCAP	Cost (billion BDT)	Implementing Entity	
						Lead	Supporting
		• Management of water resources, urban drainage system and waste in an integrated fashion • Raising awareness among city dwellers and other relevant stakeholders regarding the importance of integrated water and urban development plans					
CRC8	Carry out initiatives to improve the well-being of children and youth and reduce the effects of climate stress	• Assess impacts of climate change on the well-being of children and youth • Expansion of green area, biodiversity or green parks, walkways or bicycling facilities with separate lanes, sports playground and recreational facilities for improvement in the physical health of children and youth • Update education for children to understand climate change and adaptations for building proactive coping mechanisms • Initiatives for children and youth in sports, cycling, swimming and other physical exercise • Expand development programmes for children and youth • Expand youth entrepreneurship programmes and innovation labs • Youth leadership development programmes • Engage youth in the nursery development programme	URB		138	LGD, DYD	DWD, DSS, MoYS, DoE, BFD, UDD, PWD, PPPA, private sector
CRC9	Improvement of surveillance, early warning systems and monitoring of psychosocial impacts and mental health risks from extreme weather events	• Understand and regularly assess the adverse impacts of extreme climate events on mental health inclusive of gender and disability issues • Development of advanced and web-based surveillance and early warning systems and monitoring of psychosocial impacts and mental health risks under extreme climatic event • Extension of telehealth services for accessing health services • Mental health-boosting programme through the development of pollution-free cities and expanding green and blue infrastructure	URB		52	DGHS	ICCDRB, IEDCR, BMD, SPARRSO, WARPO, DWA, DYD, DSS, CEGIS, LGD, DoE, BIDA, PPPA, ICT, private sector
CRC10	Extension of resilient and eco-friendly materials and engagement of the private	• Implementation of feasibility assessments of eco-engineering and environmentally friendly measures for infrastructure and communication • Preparation of guidelines for implementing eco-engineering measures and updating relevant building code like BNBC • Implement the eco-engineering measures as per developed guidelines	URB		58	LGD	DoE, HBRI, City Development Authority, NBR, IRD

Code	Interventions	Activity	Domain	BDP2100 CCAP	Cost (billion BDT)	Implementing Entity	
						Lead	Supporting
	sector through incentives and tax rebates for climate-resilient infrastructure development in urban areas	• Develop proper policy support for producing resilient and eco-friendly brick and other construction materials • Preparation of guidelines for use of eco-friendly materials • Introduce incentives and tax rebate mechanisms to develop investment ecosystems for the private sector • Popularize and extend eco-friendly materials for climate-resilient infrastructure development					
CRC11	Establishment of climate-resilient health-care facilities in urban areas	• Operational framework development for building climate-resilient health-care facilities (HCFs) as per WHO guidelines and ensuring the inclusion of women, people with diverse gender identities, children, the elderly and persons with disabilities • Establish climate-resilient Health Care Facilities (HCFs), including infection prevention and control (ipc) • Scenario-based stress test assessments for the health-care system, including in light of the COVID-19 pandemic or sudden shocks, to formulate adaptations • Develop and plan a one health approach to address emerging and re-emerging diseases and infections (COVID-19, SARS, zika, etc.) due to climate calamities • Identify and initiate climate-smart approaches including WASH interventions to combat cholera and other neglected diseases (filaria, kalazar, etc.) and to minimize risks from antimicrobial resistance (AMR) • Develop special arrangements for emergency neonatal and post-neonatal services • Initiatives for dense community clinics with local health workers helping women, children, the physically challenged and pregnant women during climatic hazards • Expand renewable energy-based power supplies and green buildings for hospitals or clinics through the private sector	URB		214	HED	DPHE, ICDDRB, IECDR, SREDA, MoPEMR, LGD, LGED, RHD, DoE, ICT, BFD, BIDA, PPPA, private sector, MoI, DSW, MoWCA
CRC12	Development of heatwave and disease outbreak advisory services for city dwellers	• Develop specific emergency health-care facilities and infrastructure based on spatial vulnerability • Improve accessibility and communication facilities to obtain emergency services from health-care facilities • Establish a correlation between heatwaves and disease outbreaks through extensive research • Develop climate and health data sharing protocols and MoUs with relevant agencies, research and knowledge institutes	URB		30	DGHS	ICCDRB, IEDCR, BMD, SPARRSO, WARPO, CEGIS, LGD, DoE, BIDA, PPPA, ICT, private sector, DSW, MoWCA

Code	Interventions	Activity	Domain	BDP2100 CCAP	Cost (billion BDT)	Implementing Entity	
						Lead	Supporting
		• Review existing health-related advisory services and develop a framework for heatwave and disease outbreak advisory services with health improvement guidelines • Establish ICT-based dynamic heatwave and disease outbreak advisory services with PPP modalities • Popularize and extend advisory services to citizens					
Grand total for urban areas (billion BDT)					**3,307**		

Table AII.6: Ecosystems, wetlands and biodiversity

Code	Interventions	Activity	Domain	BDP2100 CCAP	Cost (billion BDT)	Implementing Entity	
						Lead	Supporting
EWB1	Extension and expansion of the coastal greenbelt for protecting coastal habitats, including the Sundarbans, mangroves, salt marshes, etc.	• Mangrove plantation at possible foreshore mudflats areas along the tidal rivers • Mangrove plantation at foreshores of stable *char* lands and mudflats of newly accreted *char* lands • Conservation and restoration of the Sundarbans ecosystem and biodiversity • Expand mangrove plantation along embankments of large aquaculture dike toes • Assessment of annual accretion rate along the coastline for new mangrove plantation • Enforcement of laws to protect artisanal areas of the coastline from fishing and thereby improve flora and fauna (by the Navy, Coast Guard, fisheries officers, mobile courts) • Identify biologically important *char* lands • Restrict human interventions and perform biological health monitoring of identified important biodiversity-enriched *char* lands	SWM | SEE | CHI		32	BFD	BFRI, BNH, BWDB, LGD, LGED, RHD, DSS, DWA, DYD, BPC, MoL, MoDMR, MoA, MoFL, MoI, MoS, PPPA, private sector, NGOs
EWB2	Community-based afforestation and reforestation for biodiversity conservation, enhancement of ecosystem resilience and increased	• Low-carbon farming through reducing tilling, planting longer-rooted crops and incorporating organic materials into the soil • Suitable mangrove plantations at possible spaces in homesteads and along pond banks in polder areas • Ornamental and fruit plantations in all institutional yards • Timber and fuel-yielding plantations on hill slopes and in valleys • Swamp plantations in all institutional small village platform ridges • Bamboo and areca plantations in fallow lands and along village roadsides	Nationwide		32	BFD	BFRI, BNH, CHTDB, DBHWD, WARPO, BWDB, LGD, LGED, RHD, DSS, DWA, DYD, BMDA, MoL, MoDMR, MoA, MoFL, MoI, MoS, PPPA, private sector, NGOs

Code	Interventions	Activity	Domain	BDP2100 CCAP	Cost (billion BDT)	Implementing Entity	
						Lead	Supporting
	carbon sequestration						
EWB3	Expand ecosystem-based adaptation for the restoration of mangroves, hill areas and wetlands to tackle the adverse impacts of climate change	• Introduce a nominal payment for ecosystem services (PES) for all tourists and industries in and around the Sundarbans, beach areas, hill areas and wetlands • Expand agroforestry practices in all homesteads and aquaculture area and mangrove plantation in coastal belt • Retain rainwater in deep parts of large wetlands through restoration and bank stabilization • Retain rainwater through excavation of ponds and trenches alongside cultivable land and ponds • Provision of rainwater harvesting in all buildings in urban areas and incentives offered (for example, a reduced holding tax) by municipal authorities	Nationwide		53	BFD	BFRI, BNH, CHTDB, DBHWD, BWDB, LGD, LGED, RHD, DSS, DWA, DYD, BMDA, BPC, MoL, MoDMR, MoA, MoFL, MoI, MoS, PPPA, private sector, NGOs
EWB4	Extension and expansion of the coastal greenbelt for protecting coastal habitats, including the Sundarbans, mangroves, salt marshes, etc.	• Identify law enforcement challenges, responses and collaboration concerning environmental crimes • Links to national and regional forestry, biodiversity and land-use policies • Expand required manpower and equipment support to the DoE and BFD to enforce environmental regulations and monitoring • Establishment of permanent sample plots in different hotspots for periodically monitoring biodiversity • Establishment of a biodiversity monitoring network and demonstration projects • Development of strategies for the conservation and management of private forests through government legislation and support • Development of awareness-building programmes for stakeholders to reduce environmental crimes • Develop a separate environmental policing system to stop smuggling or trafficking to overseas markets • Establish environmental courts in every district and organize specialist knowledge and training for judicial officials	Nationwide		57	DoE	BFD, BNH, BFRI, CHTDB, BMDA, DBHWD, WARPO, LGIs, MoLJPA, private sector, NGOs

Code	Interventions	Activity	Domain	BDP2100 CCAP	Cost (billion BDT)	Implementing Entity	
						Lead	Supporting
EWB5	Community-based afforestation and reforestation for biodiversity conservation, enhancement of ecosystem resilience and increased carbon sequestration	• Policy for water diplomacy and transboundary negotiation for the use of upstream water with equal rights • Create inland water sources for major rivers through re-excavation of large *beels, baors* and canals • Participatory watershed management through step farming and terrace plantations for increasing stream water in hilly areas • Develop ecological hydrographs for all large floodplains • Intensive community consultation and involvement of local knowledge to enhance and maintain floodplain ecosystems	Nationwide		16	BWDB, WARPO	RRI, JRC, BFD, CHTDB, DBHWD, LGD, BMDA, LGIs, MoA, MoFL, MoI, MoS, NRCC
EWB6	Restore eco-hydraulics for wetlands, rivers and canal systems, including through the establishment of connectivity and protection of wetlands	• Delineation and mapping of small-scale catchment areas in major watersheds • Trend analysis of the spatial and temporal connectivity of wetlands with other waterbodies for the last 30 years • Policy upgradation and enforcement for ensuring upstream fresh water e-flow over the year • Collection and monitoring of regular data on key parameters of a watershed such as: water availability and discharge volume; annual precipitation surplus (precipitation minus evapotranspiration); annual runoff; timing (seasonality) of water surplus during the year and precipitation intensity for future planning and management • Evaluation of the functionality and rehabilitation of old hydraulic structures within the polder area to raise the freshwater table • Removal of infilled debris (garbage and construction site infill) and illegal encroachments from wetlands by restoration of lateral connectivity between the river and floodplain wetlands for increasing floodplain productivity, nutrient exchange and dispersal of biota • Implementation of EbA for restore water in feasible wetlands • Wetlands and rivers should be promoted by recognized scientists and academia for protection and 'eco-development' • Regular monitoring of water quality and nutrition for protecting wetland ecosystems and biodiversity • Development of pollution control and prevention tools and technologies from agriculture, industry and the urban sector	Nationwide		42	BWDB	DoE, BFRI, BNH, CHTDB, DBHWD, WARPO, BWDB, LGD, LGED, RHD, BMDA, NRCC, MoA, MoFL, MoI, MoS, PPPA, private sector

Code	Interventions	Activity	Domain	BDP2100 CCAP	Cost (billion BDT)	Implementing Entity	
						Lead	Supporting
		• Promote scientific research to enhance wetland resource value, improve benefits to neighbouring communities and strengthen the capacity of the wetland to play ecological, socioeconomic and hydrological functions					
EWB7	Development of multifunctional hill and forest management and conservation system	• Development of MIS including historical land use and land cover maps of forest area • Development of a future land-use plan for hill and forest management planning • Development of a management programme related to controlling soil erosion, overexploitation and the loss of soil fertility, and improving soil & water quality • Introduce multilayer agroforestry involving local communities, including women • Introduce combined cultivation of swamp tree and cereal/vegetable crops and duck rearing at possible *kandas* within the *haor* areas • Restoration of degraded hills by the historical management system of village common forests (VCF)	SEE | CHT | HFF | NNW		19	CHTDB, BFD	DoE, BFRI, BNH, DBHWD, LGD, LGED, RHD, DSS, DWA, DYD, BMDA, MoL, MoA, MoI, PPPA, private sector, NGOs
EWB8	Management of marine protected areas and development of a monitoring system to protect the rights of fishing communities	• Expansion of marine protected area (MPAs) in the Bay of Bengal by at least 20 percent • Control fishing and other extractive activities in MPAs considering the major fish species' breeding seasons • Introduce registration and tracking systems for all fishing boats using modern technology • Promotion of sustainable marine ecosystem management through incorporation of decisions and recommendation by different international conferences and conventions	BoB		16	DoE, DoF	BFRI, DBHWD, BWDB, LGD, DSS, DWA, DYD, MoI, MoS, BN, BCG, BMA, BORI, PPPA, private sector, NGOs
EWB9	Adopt other effective area-based conservation measures to fulfil the biodiversity framework target	• Strengthen the existing biodiversity conservation programme for the Sundarbans and other coastal areas • Assimilation of 20 percent of mangrove plantations (except in the Sundarbans) as reserve forest • Create an artificial mangrove forest to expand the Sundarbans for high ecosystem services value, such as water provision and carbon sequestration • Special conservation program for conserving flora and fauna within declared protected areas and other biodiversity hotspots • Plantation in the hilly areas to protect topsoil erosion from the hills • Declare *char* lands with high biodiversity significance as protected areas and deploy required human resources to conserve them • Establish at least one botanical garden in each district town	SWM | CHT | HFF | CHI | URB		13	BFD	DoE, BFRI, BNH, CHTDB, DBHWD, BWDB, LGD, LGED, RHD, DSS, DWA, DYD, BMDA, MoL, MoDMR, MoA, MoFL, MoI, MoS, PPPA, private sector, NGOs

Code	Interventions	Activity	Domain	BDP2100 CCAP	Cost (billion BDT)	Implementing Entity	
						Lead	Supporting
		• Development of the National Land Use Plan and Land Use Plan Act					
EWB10	Combat desertification through planting regenerative indigenous species	• Demarcation and monitoring of degraded areas using remote sensing • Bamboo plantation along allow lands and hill toes • Declare Ratargul Forest and other prominent swamp forests as protected areas and deploy required human resources to conserve them • Plant neem, babla and bamboo along fallow lands and terraces • Promotion of government, NGO and local people working together to achieve self-reliance in forest products and maintenance of the ecological balance	CHT | HFF | DBA		5	BFD	DoE, BFRI, BNH, CHTDB, DBHWD, LGD, DSS, DWA, DYD, BMDA, MoL, MoA, PPPA, private sector, NGOs
EWB11	Conservation of agroecosystems through expanded agroforestry, good agricultural practices and regenerative agriculture	• Expand agroforestry practices in all homesteads and aquaculture areas • Introduce innovative agricultural practices to support agroecosystems • Establishment of a monitoring and warning system for agricultural wild plant conservation sites • Strengthening the social forestry system • Introduce floating garden in wetlands for commercial cultivation	SWM | SEE | CHT | FPE | HFF CBL | NNW | CHI		13	DAE	BFD, BFRI, BNH, DoE, RDA, CHTDB, DBHWD, LGD, DSS, DWA, DYD, BMDA, MoFL, PPPA, private sector, NGOs
EWB12	Development of a participatory wetlands management framework for the sustainable management of wetlands	• Development of national guidelines for wetland management following the RAMSAR guidelines • Conduct ecological and socioeconomic baseline surveys for developing systematic planning for sustainable wetland resource off-take and effective monitoring systems • Recognize the condition of wetlands prior to disturbance, importance to fish and aquatic functions, crucial to degradation, pressures on the ecological services and related physical, chemical and biological characteristics. • Assessment of wetland vulnerability, sensitivity and adaptive capacity to provide vital information for determining wetland resource off-take and designing appropriate interventions • Formulate water and wetland management committees consisting of different livelihood groups at the union level across the country with the support of local administrations • Development of a participatory wetlands management framework that will provide guidance to stakeholders on how human activities within the wetland system will be regulated, threats to the conservation of the wetland could minimized, and local people empowered to actively participate in the management, monitoring and use of wetland resources	SWM | SEE | CHT | HFF | CBL | URB		8	DBHWD	DoE, BFD, BFRI, BNH, CHTDB, DBHWD, WARPO, BWDB, LGD, LGED, RHD, DSS, DWA, DYD, BMDA, MoL, MoDMR, MoA, MoFL, MoI, MoS, PPPA, private sector, NGOs

Code	Interventions	Activity	Domain	BDP2100 CCAP	Cost (billion BDT)	Implementing Entity	
						Lead	Supporting
EWB13	Conservation of village common forests through community-based spring, watershed and agricultural landscape management, and soil conservation in the Chattogram Hill Tracts	• Promote participatory forestry through cash for work systems or financial incentives • Enhancement of forest-dependent jobs by reforesting vacant local lands and enhancing tree cover, inside and outside village areas • Organize training, provide modern technologies and IT infrastructure to young community members for proper conservation, monitoring and evaluation of village common forests • Assessment of local needs and indigenous knowledge-based resource conservation techniques for intensifying planting to avoid depleting the natural resources of watersheds • Promote VCF programmes in national or regional plans to increase the area without interfering with the physical and environmental characteristics of reservoirs • Development of a constant regional funding mechanism and capitalization of traditional local institutions to increase the total number of VCF • Develop a crop calendar for harvesting and new plantation/farming times by the executive committee every year before starting extraction and commercial selling	CHT	HR14.3	38	CHTDB	DoE, BFD, BFRI, BNH, CHTDB, LGD, LGED, RHD, DSS, DWA, DYD, MoL, MoA, MoFL, PPPA, private sector, NGOs
EWB14	Halda River ecosystem restoration and conservation	• Assessment of the baseline status of the Halda River through identification, categorization and valuation of ecosystem services (ESs) (provisioning, cultural, regulating and support services) • Restore and protect the connectivity of four surrounding rivers (Sangu, Chandkhali, Sikalbaha and Karnaphulli) with Halda River for facilitating the migration of carp fish to the Halda River for breeding • Assess the water availability of the Halda River for future e-flow calculation inventories of pollution sources, loads and anthropogenic pressures • Control of pollution using treatment plants and regular monitoring of water quality and fish and benthic biodiversity • Promote and provide financial support for annual fingerlings stocking programmes • Inventories of commercial endangered species for awareness-building and undertaking stocking programmes • Redesigning of the hydraulic structures following NbS	SEE | CHT		52	BWDB	MoFL, DoE, BFRI, BNH, CHTDB, DBHWD, NRCC, LGD, LGED, RHD, DSS, DWA, DYD, MoL, MoA,, MoI, MoS, PPPA, private sector, NGOs
EWB15	Watershed management of Kaptai Lake for ecosystem resilience and	• Assessment of the baseline status of Kaptai Lake including an inventory of resources and identification of threats and challenges • Multilayer plantation/reforestation with indigenous trees within the catchment area of major streams to reduce soil erosion • Establish vegetative barriers by building contour bunds along contours for erosion and planting horticultural contour species on bunds	CHT | SEE		24	BWDB	BFRI, BNH, BPC, CHTDB, DBHWD, BWDB, LGD, LGED, RHD, DSS, DWA, DYD, BMDA, MoL, MoDMR, MoA,

Code	Interventions	Activity	Domain	BDP2100 CCAP	Cost (billion BDT)	Implementing Entity	
						Lead	Supporting
	water retention	• Irrigation water management through drip and sprinkler methods • Survey, mapping and cataloguing of aquatic biological resources					MoFL, MoI, MoS, NGOs
EWB16	Monitoring of sea surface temperature and other physical and biological parameters and the marine species composition in the Bay of Bengal	• Monitoring of physical and biological parameters at marine-protected areas, St. Martins Island and surrounding areas on a half-yearly basis in collaboration with neighbouring countries where applicable • Demonstration projects on typical coastal and offshore marine ecosystems conservation and restoration and establishment of a system for monitoring • Establishment of a national biodiversity information management system	BoB		8	DoE	DoF, BFRI, BNH, BWDB, WARPO, MoS, MoI, BN, BCG, BMA, BORI, BMD, SPARRSO, PPPA, private sector
EWB17	Develop and update ocean ecosystem management policies, guidelines and institutional capacities for management of the blue economy	• Development of ocean ecosystem management policies, guidelines and institutional capacities • At an initial stage, formulate a three to five year plan for a blue economy project involving the Ministry of Fisheries and Livestock, Ministry of Finance, Ministry of Shipping, Ministry of Water Resources, Ministry of Planning and Ministry of ICT for technological support • Formulate a panel of experts from diversified fields (marine biologists, ecologists, fisheries and aquaculture specialists, marine trade experts, economists [nature and resources], macroeconomists) for monitoring and evaluating the sustainable blue economy project. No policy/action should be taken without the approval of the expert panel	BoB		9	DoE, BORI	DoF, BFRI, BNH, BWDB, WARPO, MoS, MoI, BN, BCG, BMA, BORI, maritime universities
EWB18	Development of species or gene inventories and recovery plans for endangered species due to climate change	• Develop a Sundarbans gene bank with the support of IUCN • Allocate the required budget for BFRI to research gene pool development and gene conservation • Captive breeding and reintroduction of endangered animal species • Designate experimental populations of listed species to further the conservation and recovery of those species	Nationwide		37	BFRI	DoE, BNH, CHTDB, DBHWD, BWDB, WARPO, BORI, LGD, BMDA, MoL, MoDMR, MoA, MoFL, MoI, MoS, BMD, SPARRSO, PPPA, private sector, NGOs, maritime universities

Code	Interventions	Activity	Domain	BDP2100 CCAP	Cost (billion BDT)	Implementing Entity	
						Lead	Supporting
EWB19	Restoration of the coral reef ecosystem and associated fish and benthic communities in the St. Martin Islands	• Biodiversity conservation programme for St. Martins Island • Use proper management to protect coral reefs from abiotic stresses, such as low or high temperatures, deficient or excessive water, high salinity, heavy metals and ultraviolet radiation • Coral plantation at different suitable places of St. Martin Island • Conservation of coral-dependent flora and fauna in the inshore habitats of the island. • Monitoring of coral diversity and habitats and the abundance of coral-dependent flora and fauna and benthic communities	CHI | BoB		21	DoE, BFD	BFRI, BNH, BPC, LGD, DSS, DWA, DYD, MoL, MoA, MoFL, MoI, MoS, PPPA, private sector, NGOs
EWB20	Revitalization of natural springs and sustainable management of waterbodies for reducing water scarcity, and the restoration and conservation of ecosystems and biodiversity	• Identification and mapping of natural springs and waterbodies and their status, characteristics and connectivity, considering different hydrological regions • Restoration of surface freshwater sources through identification of new interventions considering nature-based solutions • Establishment of water treatment and effluent treatment plants where required to maintain water quality • Development of nature-based small- and medium-scale river basin/watershed management programmes considering the challenges of climate change for the restoration and conservation of ecosystems and biodiversity • Integration of ecology with hydrology for improvement of predictive abilities for large-scale, long-term processes as a background for sustainable management	CHT |DBA		13	BMDA, CHTDB, LGD	DoE, BFRI, CHTDB, BWDB, WARPO, NRCC, LGED, RHD, MoA, MoFL, PPPA, private sector, NGOs
EWB21	Development of a national management system for wetlands, biodiversity, oceans and coastal information	• Development of a national database/management information system through collecting baseline information about the biodiversity of wetlands, oceans and coastal areas • Preparation of biodiversity and habitat maps under different ecosystems considering the detailed description and status of species • Identification and application of traditional and modern tools for monitoring the status of wetlands, oceans and coastal biodiversity	Nationwide		7	DoE	ICT, BMD, SPARRSO, BFRI, BNH, CHTDB, DBHWD, BWDB, WARPO, BORI, LGD, BMDA, MoDMR, MoA, MoFL, MoI, MoS, CEGIS, PPPA, private sector,

Code	Interventions	Activity	Domain	BDP2100 CCAP	Cost (billion BDT)	Implementing Entity	
						Lead	Supporting
	for supporting monitoring and surveillance						NGOs, maritime universities
Grand total for ecosystems, wetlands and biodiversity (billion BDT)					**515**		

Table AII.7: Policies and institutions

Code	Interventions	Activity	Domain	BDP2100 CCAP	Cost (billion BDT)	Implementing Entity	
						Lead	Supporting
PIN1	Preparation of a roadmap for implementing the NAP	• Comprehensive assessment of dynamic adaptive pathway to identify tipping points and assess the effectiveness of adaptation • Development of sector-specific implementation guidelines for the approved NAP • Development of the three-tier M&E framework as proposed in the NAP based on SMART indicators and a development results framework based on a theory of change	Nationwide		2.2	MoEFCC, MoP, MoF	Cabinet Division, PMO
PIN2	Development of a regulatory and institutional framework for advancing the NAP	• Development of the Climate Change Policy Regime and make it operational • Formation of the proposed institutional arrangement for the NAP, appointing the respective chairperson, member secretary and members from sector ministries, departments and line agencies, the private sector, youth, women, CBOs, NGOs, academia, universities, prominent experts, knowledge institutes, development partners, media, CSOs, etc. as mandated by the proposed policy regime • Update the 'allocation of business' of the MoEFCC for the smooth implementation of the NAP and NDC in a coordinated way with IMED, MoP, GED and other sector ministries and departments • Ensure landownership rights and planned urbanization in CHT • Update the National Environment Policy (2018) as an umbrella policy document for updating oversight of the NAP implementation • Update the Bangladesh Climate Change Trust Act (2010) to widen the scope for harnessing international climate fund for the BCCTF • Expand collaboration and networking with the MoEFCC, MoP, MoF and other sector ministries and line agencies, knowledge and research institutes from the public and private sectors, LGIs, CSOs, CBOs, development partners, NGOs, women, youth, academia, universities and media • Ease collaborative climate change research and innovation project formulation and operation with national and transnational partners • Development of a youth-led climate negotiator pool for COP and international outreach, communication and negotiation • Increased collaboration with the Global Center on Adaptation (GCA), CVF, GWP, and another international global adaptation forums • Empower LGIs for local-level climate change adaptation implementation • Devise strategies, dedicated funds and a task force to ensure enhanced financing for smooth implementation of the NAP	Nationwide		9	MoEFCC	MoP, MoLJPA, MoWCA, MoCHTA, MoLGRDC, MoWR, MoA, MoFL,MoWCA, MoYS, MoDMR, Cabinet Division, PMO and other relevant ministries, private sector, NGOs, CBOs, CSOs
PIN3	Update and reform policies and plans for	• Introduce a climate change impact and risk assessment framework (CCIRAF) into the existing disaster impact assessment (DIA) framework to enable a comprehensive assessment of climate change impacts and risks through pre-feasibility and feasibility	Nationwide		6.85	MoEFCC, MoP	MoLJPA, MoWCA, MoCHTA, MoLGRDC, MoWR, MoA, MoFL,MoWCA,

Code	Interventions	Activity	Domain	BDP2100 CCAP	Cost (billion BDT)	Implementing Entity	
						Lead	Supporting
	mainstreaming climate change adaptation	studies as obligatory risk screening tools for project appraisal and mainstreaming into DPP formulation • Develop a method and mainstream climate change risk adjusted economic and financial analysis (NPV, IRR and BCR) analysis and costing for DPP formulation • Develop an integrated agriculture development plan for adaptive farming practices in areas potentially affected by saltwater intrusion and/or climate stress • Update the log frame in light of the theory of change • Mainstream the Climate and Environmental Fiscal Framework into the budgeting system • Mainstream and implement the updated Climate Change Gender Action Plan (ccGAP) • Development of a gender-responsive budgeting system • Develop and implement the Youth-Led Adaptation Plan (YLAP) • Develop and implement the Chattogram Hill Tracts Climate Action Plan (CHT-CAP) to facilitate adaptation for ethnic communities • Climate Adaptation Plan for Persons with Disabilities • Mainstream the City Climate Action Plan (City CAP) • Develop separate sectoral NAPs for WASH and infrastructure • Update BCCSAP as the sector action plan on climate change adaptation and mitigation to support ADP • Inclusion of green growth strategies into sectoral development and action plans • Development or updating of agriculture policy conducive to crop diversification and intensification in fallow land in the dry season in climate-stressed areas (due to saline, drought, irrigation) • Integration of climate-smart agricultural practices into the development planning process • Development of an updated *jalmohal* policy or leasing system management policy and ensure its effective implementation in restricting leaseholders from drying *beels* for overfishing • Banning the use of illegal fishing nets or fishing with poison • Ensure the coordination of the Department of Fisheries and Department of Agriculture • Extension of proper land management for fisheries and agriculture • Promote rainwater harvesting systems at the building design level • Mainstream climate change issues into city development plans or local city development practices • Mainstream OECM policies to make green spaces a mandatory 25 percent of urban areas for smart city development					MoYS, MoDMR, Cabinet Division, PMO and other relevant ministries, private sectors, NGOs, CBOs, CSOs

Code	Interventions	Activity	Domain	BDP2100 CCAP	Cost (billion BDT)	Implementing Entity	
						Lead	Supporting
		• Transform/reform local disaster management coordination and decision-making mechanisms through decentralization and co-management, enforcing the standing order on disasters (SOD), establishing a digital disaster information centre in each union, capacity-building for disaster management committees, enhancing humanitarian coordination, etc. • Update the Standing Order on Disasters (2019), integrating emerging threats from lightning • Development of appropriate policies for the conservation of ocean ecosystems and fostering the blue economy in the Bay of Bengal • Improve policy, legal, regulatory and institutional frameworks to increase the resilience of essential ecosystems • Establish synergies with the health NAP and other aligned policies and plans					
PIN4	Operationalize the NAP monitoring, evaluation and learning framework based on a theory of change.	• Develop and operationalize the proposed M&E framework of the NAP at the national level (Tier 1), planning level (Tier 2), and programme or project level (Tier 3) in collaboration with IMED and sector ministries • Action research and development of dynamic M&E indicators and tools for data collection, processing, uploading, updating and report generation (based on a weighted aggregation of indicator data) per the prescribed process and outcome-based reporting framework • Collect, update and report sex-, age- and disability-disaggregated data and information on selected SMART indicators to facilitate the M&E process based on a given frequency • Development of a NAP M&E dynamic web-based portal and Android-based apps to support M&E operational processes • Building capacity among officials of the MoEFCC and other relevant sector ministries, departments or divisions and IMED to understand the 'theory of change' and the NAP M&E framework • Develop an internal and external auditory mechanism for M&E verification, climate investment allocation and utilization, maintaining transparency • Ascertain roles and responsibilities for M&E among key stakeholders, and develop data sharing, updating, access protocols and coordination mechanisms among all data-generating agencies or key implementers of NAP • Capacity-building for responsible agencies, ministries and officials for involvement in operational NAP M&E	Nationwide		6.5	MoEFCC, IMED	MoP, Cabinet Division, PMO, all relevant ministries and line agencies, PPPA, private sector
PIN5	Reform local government institutes towards the inclusion of community-	• Engagement of women, youth, people with diverse gender identities, persons with disabilities and CBOs in identifying, planning and designing adaptation activities and their implementation • Development of WASAs in all divisional cities and city corporations/municipal water supply authorities as subordinate bodies of divisional WASAs	Nationwide		34.3	LGD, MoP	MoEFCC, DSW, MoWCA, Cabinet Division, PMO, all relevant ministries and line agencies, PPPA, private sector

Code	Interventions	Activity	Domain	BDP2100 CCAP	Cost (billion BDT)	Implementing Entity	
						Lead	Supporting
	based organizations, women, people with disabilities and youth in the implementation of locally led adaptation	• Development of a water supply, sanitation and regulatory authority to develop and implement volumetric pricing and sanitation policy • Encourage a decentralized environment and climate change management system through developing capacities among local government officials, community representatives, NGOs and private sector actors • Establish a gender-responsive community resilience fund (GrCRF) for mobilization and utilization of resources for implementing locally led adaptation through LGIs, CBOs, NGOs and private actors • Support co-management and participatory resource management committees/associations or groups (on agriculture, fisheries, livestock, ecosystems, water, disasters, etc.) for effective climate risk management • Assess locally led adaptation needs, and develop and implement the Local Adaptation Programme of Action (LAPA) • Local-level youth leadership programme engaging LGIs, CBOs and NGOs • Encourage and ensure the participation of local-level stakeholders and vulnerable/voiceless people including women, persons with disabilities and youth in policy dialogues and needs assessment consultation processes					
PIN6	Innovative, appropriate and enhanced financial instruments for supporting climate change adaptation	• Introduce index-based insurance mechanisms (such as crop insurance) for recovery of losses and damages due to a sudden extreme shock or disaster • Develop policy and incentive tools to popularize urban nature-based solutions and green infrastructure at the community level • Introduce and enforce seasonal and annual ban periods for fishery locations or habitat-specific conservation and provide incentives/subsidies to fishers following payment for ecosystem services (PES) or beneficiary pay principles • Provide subsidies to fishers for promoting the use of aerators to maintain oxygen levels in depleted ponds or *gher* • Provide incentives to farmers for adoption of new stress-tolerant varieties or breeds • Gender-responsive and inclusive index-based insurance mechanisms • Develop VAT and other tax instruments, green or climate bonds and/or suitable risk transfer tools through collaboration with NBR, MoF, Bangladesh Bank and the private sectors for CCA implementation • Provide a 'climate resilience allowance' for vulnerable communities for emergency response and recovery, and adoption of adaptation technologies	Nationwide		72.4	MoF	NBR, BB, MoEFCC, Cabinet Division, PMO, PPPA, private sector
PIN7	Private sector finance in leading the implementation of climate	• Popularize incentives and modalities for private sector engagement (PSE) in adaptation through PPPA, development cooperation and innovative tax or VAT instruments • Engage the private sector in the supply of modern fishing nets, technologies, quality fish seed and fish feed to marginal fishers through innovative mechanisms like development cooperation as per the Kampala Principles	Nationwide		8.5	MoF	NBR, BB, MoEFCC, Cabinet Division, PMO, PPPA, private sector

Code	Interventions	Activity	Domain	BDP2100 CCAP	Cost (billion BDT)	Implementing Entity	
						Lead	Supporting
	change adaptation	• Introduce incentive mechanisms, risk transfer mechanisms, innovative taxes or financing instruments for encouraging private sector engagement (PSE) in the expansion of climate-smart agricultural practices, agricultural mechanization, agrofood product generation, marketing and distribution, block production, climate advisory services, reused materials for product generation, etc. • Climate-resilient construction materials and infrastructure development, launching green product, etc. • Introduce no-cost agricultural inputs (quality seed, fertilizers, insecticides) to marginal farmers, and popularize e-commerce-based entrepreneurship, floating agriculture, etc. • Awareness-raising of PSE for climate change adaptation through PPP modalities • Promote private sector contributions to climate financing, banking on development cooperation or SDG achievement • Update and advertise PPP guidelines among private sector stakeholders to build awareness and subsequently select potential investors • Explore and collaborate with countries like Turkey or Japan with significant experience of PPPs project implementation for knowledge exchange on PPPs for adaptation initiatives • Encourage the private sector to participate in a voluntary carbon market to support the PES mechanism for communities to conserve forests, mangroves, etc. • Introduce resilience, debt swap, green bonds, etc. for private sector involvement • Invest in extensive research for inventing advanced technologies, bankable products, and new goods and services • Provide skills development and alternative livelihood generation for people in the informal sectors and/or CMSMEs • Ease lending policy and improve access to credit facilities					
Grand total for policies and institutions (billion BDT)					**140**		

Table AII.8: Capacity development, research and innovation

Code	Interventions	Activity	Domain	BDP2100 CCAP	Cost (billion BDT)	Implementing Entity	
						Lead	Supporting
CDR1	Transformative capacity development and knowledge management for integrating climate change adaptation into planning processes and climate financing	• Integrate CCA into the development planning process, the M&E of different sectoral projects, meeting agendas, annual reporting, etc. • Develop the institutional adaptive capacity of sector departments, agencies and research institutes for implementing CCA and its M&E • Develop a system-level transformative capacity development regime through mainstreaming CCA learning and effective practices into day-to-day activities & enhanced climate financing • Establish transformative 'learning and practice spheres' and 'self-assessment and evaluation mechanisms' to enable proactive learning of CCA knowledge, assess individual skills, utilize skills efficiently for climate actions and integrate them into office responsibilities • Include climate change-related courses in education or training curriculum from the elementary level, and in recruitment exams and foundational training for public administrative services • Monitor and evaluate skills, knowledge and behavioural changes among concerned officials from the public and private sectors as an integral part of system-level planning and capacity building • Develop e-learning modules for CCA and integrate them into the training courses of different government, vocational and private training institutes • Deploy a dedicated multidisciplinary and multilevel expert pool, engaging experts from different thematic sectors, to support the MoEFCC in NAP implementation, which may undergo reform at regular intervals • Develop a regular capacity-building programme for national and local CCA project focal of NAP in regular frequency • Capacity development of local government institutions (union *parishad, paurashava*, and city	Nationwide		12.5	MoEFCC, MoP, MoF	Cabinet Division, PMO, government and non-governmental knowledge and training institutes like CreLIC, CECCR, NILG, BPATC, CEGIS, etc., MoPA, private sector, universities, academia

Code	Interventions	Activity	Domain	BDP2100 CCAP	Cost (billion BDT)	Implementing Entity	
						Lead	Supporting
		corporation) on designing, operating and managing locally led adaptation • Strengthen the institutional capacity of finance institutes and potential private sector financial services institutes for enhanced climate financing, and access to, mobilization and utilization of national and international funds for supporting the smooth implementation of the NAP • Capacity development program for enhanced financing • Encourage gender-responsive and youth-led adaptation and emergency disaster response mechanisms • Support proactive adaptation practices through developing strategies to promote behaviour change among citizens • Arrange and disburse enhanced financing provisions for research and innovation for up-to-date CCA related data, knowledge, innovative adaptation techniques, and information generation • Develop adequate staffing at the planning and field levels for CCA implementation, extension and mainstreaming • Develop special programmes at schools, colleges and universities for conducting research and awareness-raising on CCA and subsequent knowledge management • Increase coordination and collaboration among sector ministries, departments or line agencies, research and knowledge institutes, private sector firms, NGOs, development partners, etc. regarding CCA related research, planning, design, implementation and monitoring • Capacity development of MoEFCC officials, especially for implementing monitoring of the NAP and climate negotiations • Support the development of a youth-led negotiator pool for communicating and leadership in CCA related negotiation processes					

Code	Interventions	Activity	Domain	BDP2100 CCAP	Cost (billion BDT)	Implementing Entity	
						Lead	Supporting
		• Support national- and local-level gender inclusion and a youth leadership programme • Generate advanced and innovative knowledge, and collect data on indigenous adaptation practices (such as local varieties); store, process and disseminate or otherwise extend knowledge widely • Develop different climate products and information services (EWS for climate hazards) using AI, ICT, space technology and/or big data so that climate risks inform decision-making, field-level adaptation and emergency responses • Institutional capacity-building for extensive research on the Bay of Bengal and its ocean ecosystem and dynamics in a collaborative and coordinated manner with other relevant knowledge institutes • Implement a transformative capacity-building action plan and knowledge management plan at the MoEFCC					
CDR2	Awareness-raising, training on skills for enhanced adaptive capacities and improved diversified livelihoods at the community level	• Capacity development of officials from the public and private sectors to access, mobilize and use climate finance • Strengthen extension services for the field-level demonstration of innovative adaptation practices, use of ICT or mechanization, and ensure easy access to field-level officers for emergency advisory services • Field-level demonstrations or hands-on training on agriculture, fisheries, livestock, water management-related advanced and climate-smart technology, and use of mechanization • Training and awareness-raising on EbA, homestead gardening, social forestry and/or community-based afforestation and ecosystem conservation • Training on alternative income generation activities for forest-dependent communities • Arrange training/capacity-building on understanding climate financing for local	Nationwide		7.2	LGD, DSS, DWA, DYD	MoEFCC, BWDB, DAE, BFDC, DoF, DLS, ICT, LGED, RHD, CHTDB, BMDA, PPPA, private sector

Code	Interventions	Activity	Domain	BDP2100 CCAP	Cost (billion BDT)	Implementing Entity	
						Lead	Supporting

		people/communities, persons with disabilities, women and people with diverse gender identities
		• Arrange regular capacity-building training on climate change and adaptation for officials in the public and private sectors
		• Arrange regular CCA events/seminars/awareness-raising programmes at the local/community level for raising awareness on CCA;
		• Capacity-building or skills development training engaging LGIs, CBOs and NGOs, farmers, fishers, women, people with diverse gender identities, youth and ethnic communities on:
		  • Advanced agriculture, livestock and aquaculture technology
		  • Using stress-tolerant varieties or breeds
		  • Climate-smart agricultural practices
		  • Mechanized agriculture
		  • Crop diversification or mixed farming
		  • Organic farming or hydroponic agriculture
		  • Floating agriculture or vegetable cultivation
		  • Homestead vegetable farming
		  • Livestock rearing and feeding
		  • Homestead or HYV fodder cultivation
		  • Fish feeding and dry fish processing
		  • Net, trap-making and fish-processing techniques
		  • Pearl harvesting and mariculture
		  • Alternative income generation activities like handicrafts, CMSMEs, shopkeeping, flower gardening, garland preparation, sewing, rickshaw pulling, crop harvesting, etc.
		• Arrange community-based alternative livelihoods training for people affected by floods, erosion and droughts
		• Gender mainstreaming and skills development programme					

Code	Interventions	Activity	Domain	BDP2100 CCAP	Cost (billion BDT)	Implementing Entity	
						Lead	Supporting
		• Participation of youth and ethnic communities in awareness programmes with special attention to local knowledge and culture					
CDR3	Coordinated research, field-level demonstrations, knowledge management and communication of adaptation at the local level	• Undertake nationwide climate change-related knowledge demand assessment at the system, institutional and individual/community levels through regular surveys • A central knowledge hub on climate change (CKHCC) or a climate change information and knowledge management (CCIKM) portal with easy accessibility at both the national and local levels • Initiatives for preparing a central database on losses and damages due to climate-induced disasters • Encourage interactions, transfers of innovative technology and knowledge, learning from indigenous know-how, and the development of skills and awareness • Promote collaborative and individual research and innovative studies, publications on climate-smart technologies, and priority research areas for different sectors, making provision for increased opportunities through scholarships, grants or fellowships • Capacity-building and technology transfer through establishing the Bangladesh Climate Change Knowledge and Technology Network, (B-CCKTN) collaborating with the UNFCCC's Climate Change Knowledge and Technology Network (CCKTN) • Establishment of the Climate Change Research and Innovation Fund (CCRIF) to emphasize climate change-related research initiatives • Increase coordination and strengthen local government institutes (LGIs), local government administrations, MoEFCC and other key stakeholders in maintaining climate change adaptation-specific knowledge and communications, and sustainable knowledge management • Develop a communications strategy and action plan for adaptation to support effective adaptation	Nationwide	CC1.3	44.5	Government and non-governmental research and knowledge institutes	All relevant ministries, line agencies dedicated to service extension, the private sector, academia, universities

Code	Interventions	Activity	Domain	BDP2100 CCAP	Cost (billion BDT)	Implementing Entity	
						Lead	Supporting
		communication on local, regional, national and international platforms.					
CDR4	Capacity development for the implementation of nature-based solutions and locally led adaptation	• Raising awareness among city dwellers about climate change impacts, low-impact development, expansion of green coverage and household-level waste management • Capacity development of local government institutions for supporting implementation of LLA and NbS • Training on understanding and sensitizing NbS and LLA Mobilize resources for implementation of NbS and LLA	Nationwide		4.5	MoEFCC	All relevant ministries, line agencies dedicated to service extension, the private sector, academia, universities, government and non-governmental research and knowledge institutes
CDR5	Generation of national, regional and local-level evidence and scenario-based climate information through climate downscaling and publication of a national climate outlook, risk and vulnerability atlas	• Establish and strengthen a climate simulation lab for data storage, processing, modelling, downscaling and analysis • Publish the national climate outlook report every year, including a mapping of spatial and temporally variable historical climate and climate change trends (diurnal variations, month, season, annual, extremities), evidence, variability and future projections • Nationwide sector-specific local-level climate change risk and vulnerability mapping for multihazards with regular updating	Nationwide		5	MoEFCC	BMD, SPARRSO, ICT, CEGIS, knowledge institutes, academia, universities, BFD, SoB, MoA, MoFL, MoLGRDC, MoI, MoS, CHTDB, BMDA, DBHWD, WARPO, BWDB, FFWC
CDR6	Research on the impact of climate change on land and water resources	• Development of a regional climate model (RCM) for understanding the interactions of land, water, the ocean and atmosphere with higher confidence and generating future climate anomalies under different scenarios • Research on composite materials for construction of water management structures	Nationwide		3.5	BWDB	MoEFCC, BMD, SPARRSO, ICT, CEGIS, knowledge institutes, academia, universities, BFD, MoL, MoA, MoFL, MoLGRDC, MoI, SoB, MoS, CHTDB, BMDA, WARPO, DBHWD

Code	Interventions	Activity	Domain	BDP2100 CCAP	Cost (billion BDT)	Implementing Entity	
						Lead	Supporting
		• Research on the effective of community-based rainwater-harvesting technology • Research on low-cost desalinization tools for supplying drinking water to coastal households • Comprehensive research and investigation to understand ocean dynamics in the Bay of Bengal (ocean circulation, marine meteorology, chemical and physical oceanography, marine observations) to explore opportunities for the blue economy • Research on promoting the cultivation of oyster reefs to combat erosion in coastal areas as the first line of defense • Study on hydrometeorology, sedimentology, geology and geomorphology to assess current and predict future absolute and relative sea-level rise • Research on eco-engineering or bioengineering measures for facilitating flood and erosion protection • Field-based research on managed aquifer recharge (MAR) and potential contaminant filtration technology • Study on sediment dynamics, delta formation and progradation for the Bengal Delta • Study on climate change impact assessments on land & water for supporting sectoral climate change risk assessment • Develop a business model to use abundant water during the monsoon, engaging the private sector • Development of an Earth observatory, Bangabandhu Satellite, artificial intelligence (AI), crowdsourcing and a big data-based climate monitoring tool					
CDR7	Action research and field demonstrations on climate-smart agriculture	• Research on managed aquifer recharge for artificial storage of water to improve the groundwater table • Research on developing stress-tolerant (salinity, water stagnant, heat, cold, lodging) crop varieties (rice and non-rice) • Research on agronomic practices to reduce stress (salinity, submergence, drought, stagnant water,	Nationwide		60	BARC	RDA, NARS institutes, academia, universities, knowledge institutes, CHTDB, BMDA, WARPO, DBHWD, SRDI, BMD, SPARRSO, private sector

Code	Interventions	Activity	Domain	BDP2100 CCAP	Cost (billion BDT)	Implementing Entity	
						Lead	Supporting
		heat, cold, lodging) on crop phenology and production • Research on pest-/disease-resistant varieties to cope with the coming adverse situation • Crop zoning research on climate-stressed regions to increase cropping intensity • Research on developing short-duration HYV rice and non-rice crops considering climatic variability • Research on sowing/transplanting times to escape climatic stress • Strengthen research facilities to reduce the gap between research outcomes and field-level yields • Research on farm mechanization using renewable energy (solar, wind, etc.) • Research on the pull-push pest infestation management system • Research on fall army worm management for sustainable maize production • Research on soil nutrient management for sustainable crop production • Research on existing cropping patterns to introduce new or incorporate short-duration leafy vegetables for increasing system productivity • Research on sustainable soil health management and crop production • Research on management approaches for reducing climate stress effects on crops • Adoption of the 4Rs approach for fertilizer application (right time, right place, right rates and right source) to reduce climate risks • Research on soil–crop–water management to reduce greenhouse gas emissions • Research on land use and agroforestry for sustainable production • Strengthening research on precision agriculture using GIS, RS and UAV technology to face the 4IR challenges					

Code	Interventions	Activity	Domain	BDP2100 CCAP	Cost (billion BDT)	Implementing Entity	
						Lead	Supporting
		• Research on indigenous technologies to improve and expand in other areas					
CDR8	Research and innovation related to climate-resilient fisheries and aquaculture	• Assess climate change impacts on food nutrients, biological process, habitat and fish migration, and crop and fish production • Research on developing stress-tolerant fish varieties with high-yielding genotypes • Develop biological corridors for fish movement • Research on population dynamics and the migratory routes of climate-sensitive fish species • Research on climate-sensitive feed management practices • Develop early warning and dissemination systems and climate information services • Research on the natural *kuchia* breeding sites • Research on socioeconomic suitability and acceptability of climate-smart technologies • Research on identifying intersaline convergent zones	Nationwide		15	BFRI	DoF, BFDC, BWDB, WARPO, DBHWD, BoRI, maritime institutes, BIWTA, MoI, MoA, MoEFCC, SPARRSO, BMD, PPPA, private sector, academia, universities, knowledge institute
CDR9	Research and innovation related to climate-smart livestock and poultry	• Research on the development of climate-stress-tolerant livestock and poultry breeds • Research on the development of climate-smart livestock and poultry fodder and feed • Research on community-based cooperative livestock and poultry farming practices to reduce climate risks • Research on converting manure into renewable energy and biofertilizer and its impact on animal-derived products • Research on CC induced/ emerging and re-emerging livestock and poultry pest and diseases (including zoonotic disease) and climate-smart management of these pests and diseases • Research on CC impact on livestock and poultry production and reproductive systems of livestock and poultry • Research on subsistence livestock and poultry farming systems to meet household level nutritional uptake	Nationwide		54	BLRI	DLS, NARS institutes, other livestock and poultry research institutes, MoA, MoWR, LGD, CHTDB, BMDA, MoEFCC, BMD, SPARRSO, PPPA, private sector, academia, universities, knowledge institutes

Code	Interventions	Activity	Domain	BDP2100 CCAP	Cost (billion BDT)	Implementing Entity	
						Lead	Supporting
		• Research on the immunological status and vaccine scheduling of livestock and poultry • Research on the immunological status and vaccine scheduling of livestock and poultry • Research on natural feed additives derived from bioactive components (secondary metabolites) combating CC impacts • Research on feed intake to adapt to the CC effect • Study on livestock and poultry disease surveillance • Study on roof sprinklers for heat mitigation in livestock and poultry farmhouses • Research on climate change impacts on the nutritional aspects of feed and fodder • Research on genotypes for livestock and poultry to adapt to adverse climatic conditions • Develop a heat-/cold-tolerant housing system for livestock and poultry • Research on indigenous/local adaptation technology to develop and extend in other areas • Research on livestock rearing times (brooding in the case of poultry, etc.) to reduce livestock and poultry production loss due to excess heat or cold • Research on local livestock breeds (meerkadim cows, sheep, goats, etc.) to increase milk and meat production • Study on herd health management for disease-free livestock and poultry production(milk, meat and eggs) • Study on climate-induced pests and diseases and management systems to reduce climate risks • Capacity-building on disease outbreaks among livestock and poultry					
CDR10	Action research for locally led and indigenous climate change adaptation	• Intensive research on the sensitivity of different construction materials to different climate stresses and to identify climate-stress-resistant options • Research on ecosystem-based shoreline protection (oyster reefs, vetiver grass or other native plants)	Nationwide		4.5	MoEFCC	Research centres, all relevant ministries and line agencies, knowledge institutes like CEGIS, academia, universities

Code	Interventions	Activity	Domain	BDP2100 CCAP	Cost (billion BDT)	Implementing Entity	
						Lead	Supporting
		• Research on nutritional benefits from seaweed • Research on locally available indigenous plant species to assess water- and soil-holding capacity for seed storage and reforestation • Study to create an inventory of locally led and indigenous adaptation practices in CHT, coastal areas, *haors* and the *barind* area					
CDR11	Action research for developing and exploring the potential use of ecosystem-based adaptation and nature- based solutions	• Identify the gaps, possibilities and challenges in potential application of EbA and NbS. • Development of a national framework for effective implementation of EbA and NbS in different sectors • Assess and develop a valuation of ecosystem services in ecologically important areas to identify EbA and NbS. • Assess and identify new interventions considering nature-based solutions • Development and implementation of an integrated plan for green growth strategies	Nationwide		8	MoEFCC	Research centres, all relevant ministries and line agencies, knowledge institutes like CEGIS, academia, universities, private sector
CDR12	Research on climate change impacts on land, water and ocean ecosystems	• Determination of the distribution of biodiversity in the past and future • Assessment of adverse impacts on coral reef ecosystems and reef fish biodiversity due to the increasing temperature and acidity of the ocean • Identify the vulnerability of freshwater ecosystems to climate change and promote long-term increases in fish-production through EbA and NbS • Analysis of the economic crisis of fish farmers due to climate change • Integration of climate-proof agriculture and aquaculture with other sectors to support ecosystems and biodiversity • Proper and accurate risk assessments considering local-level ecosystems • Exploration of the carbon sequestration process in terrestrial and aquatic ecosystems • Analysis of climate change impacts on the phenological behavior of indigenous plant species	Nationwide		15	BWDB, BORI, BFRI	WARPO, BMD, SPARRSO, MoL, CEGIS, IWM, DBHWD, RRI, MoS, MoI, maritime institutes, MoA, BFD, DoF, CHTDB, BMDA, other knowledge institutes, academia, universities

Code	Interventions	Activity	Domain	BDP2100 CCAP	Cost (billion BDT)	Implementing Entity	
						Lead	Supporting
		• Advances in biotechnological tools for improving the abiotic stress tolerance of ecosystems					
CDR13	Research and popularize climate-stress-tolerant plant species	• Identify major constraints/limitations and assess needs for scientific research on climate-stress-tolerant plant species • Analysis of current scenarios, progress and prospects of developing technologies for combating climate stress on ecosystems in Bangladesh • Construction of a plant stress research centre or laboratories considering the service area of major ecosystems • Analysis of the ecophysiology of abiotic and biotic stress on pollination and fertilization of major plant species through scientific research • Popularization of newly developed climate-stress-tolerant plant species through proper training for environmental and social acceptance	Nationwide		21	BFRI	BNH, BFD, BRB, BJRI, SCA, BSRI, BTRI, CHTDB, BMDA, DBHWD, BMD, SPARRSO, LGD, DDM, DoE, knowledge institutes, academia, universities, private sector
CDR14	Research on and piloting of climate-resilient infrastructure, improved health measures and WASH technologies	• Action research for innovating climate-resilient and eco-friendly construction materials for climate-resilient infrastructure • Research and piloting of eco-engineering measures (such as plantation of vetiver grass or native species, use of biodegradable geo-textiles, oyster reef cultivation, golapata plantation, eco-friendly bricks or construction materials, etc.) to develop climate-resilient infrastructure • Research on identifying and driving design parameters for making different infrastructure climate-resilient and updating design guidelines for them • Study the impact of climate change on malnutrition, premature child death, heat stress or increased heatstroke, mental health or trauma and links to adaptation • Investigate human health and comfort during extreme changes in climate (e.g., sudden significant variations in diurnal temperature or sudden cold or heatwaves, etc.) and potential adaptation	Nationwide		6	LGD	BFD, DoE, UDD, PWD, LGED, RHD, BWDB, WARPO, BMD, SPARRSO, DBHWD, MoDMR, knowledge institutes, academia, universities, private sector

Code	Interventions	Activity	Domain	BDP2100 CCAP	Cost (billion BDT)	Implementing Entity	
						Lead	Supporting
		• Research the sensitivity of changes in climatic parameters and the effect on pathogens and contaminants of drinking water • Research climate-adaptive, resilient, potable safe drinking water technologies, safely managed sanitation technologies and hygiene technologies that could be initiated for locally led adaptation					

CDR15	Action research for low-impact development techniques, green infrastructure and integrated drainage management for smart city development	• Research on:
		  • Sustainable drainage systems (SUDS) for rural and urban areas
		  • Smart residential and commercial building
		  • Sustainable climate-resilient house for coastal, floodplain and hilly areas
		  • Climate and environmentally friendly vehicles
		  • Development of stormwater drainage and management models for all major cities considering future climate scenarios, and formulate mitigation measures for urban drainage problems
		  • Low-impact development techniques (green roofs, rainwater harvesting, bioswale, permeable pavement or foot paths, etc.) and their efficacy for reducing urban drainage problems in different cities
		  • Impact of green and blue infrastructure in improving the urban environment and biodiversity
		  • Integrated waste and drainage management
			Nationwide		4	LGD	BFD, DoE, UDD, HBRI, PWD, LGED, RHD, BWDB, WARPO, DBHWD, BMD, knowledge institutes, academia, universities, private sector

Grand total for capacity development, research and innovation (billion BDT)					**265**		

Appendix III: Planning Level M&E Framework for NAP

Strategic focus	Strategic actions	Outcome	Potential indicators
Sectoral	**Goal 1: Ensure protection against climate change variability and induced natural disasters**		
	S 1.1: Combat cyclonic storm surges, sea-level rise and salinity intrusion	**Outcome 1:** Increased adaptive capacity of human, natural and economic systems to reduce risks and vulnerabilities and ensure protection against climate change-induced disasters in coastal areas	1. Affected areas or exposure to different climate change-induced hazards (storm surges, sea-level rise, salinity intrusion) 2. Measurement of discharges, water levels, salinity in designated locations 3. Measures regarding infrastructure development (embankment height, number of regulator, access by disability, etc.) 4. Vulnerable population by sex, age and disability 5. Losses and damages due to climate change-induced slow-onset and extreme events (coastal areas) 6. Household-level potable drinking water facilities 7. Per capita freshwater availability in salinity-prone areas 8. Loss of food (crops, fish, meat and eggs) production 9. Number of gender- and disability-inclusive and co-management initiatives for CCA 10. Income from alternative sources
	S 1.2: Manage floods, erosion and drought risks	**Outcome 2:** Increased adaptive capacity of human, natural and economic systems to reduce risks and vulnerabilities and ensure protection against climate change-induced disasters in the floodplain or drought areas	1. Affected areas or exposure to different climate change-induced hazards (floods, erosion and droughts) 2. Losses and damages due to climate change-induced slow-onset and extreme events (floodplain and drought-prone areas) 3. Loss of food (crops, fish, meat and eggs) production 4. Soil moisture content 5. Groundwater depth

Strategic focus	Strategic actions	Outcome	Potential indicators
			6. Number of gender-inclusive and co-managed initiatives for CCA 7. Income from alternative sources
	S 1.3: Protect life, livelihoods, infrastructures and ecosystems against slow-onset and other climate extremities	**Outcome 3:** Enhanced adaptive capacity and protection of life, livelihoods and ecosystems against slow-onset and other extreme events of climate change	1. Affected areas or exposure to different climate change-induced hazards 2. Losses and damages due to climate change-induced slow-onset and extreme events (land, coast, hills, ocean and islands) 3. Human health (medical expenses, diseases occurrences, mortality rate, risk of disability, etc.) 4. Ecosystem (water quality, land degradation, soil nutrient, native species, etc.) health 5. The environmental flow of rivers and ecosystems during the dry season 6. Death or injuries and damages due to lightning and landslides 7. Heatstroke rate during the summer 8. Pre-mature childbirth and high blood pressure or other comorbidity rates in coastal areas 9. Sea surface temperature and pH level of the ocean 10. Density and diversity of coral reefs 11. Marine stocks
	Goal 2: Develop climate-resilient agriculture for food, nutrition and livelihood security		
	S 2.1: Promote extension of climate-smart agriculture	**Outcome 1:** Increased agricultural productivity and resilience, and reduced emissions from the adoption of climate-smart agriculture (CSA) practices	1. Food and nutrition security 2. Irrigation water use efficiency 3. Irrigation from surface water and groundwater sources 4. Contribution of agriculture sectors to the national economy 5. Pest and disease outbreak occurrences 6. Number of organic farms 7. Degree of adoption of climate-smart agricultural practices 8. Yield reduction due to crop loss 9. Crop production and demand 10. Malnutrition of children 11. Women engaged in agricultural practices 12. Poverty incidence or dynamics of farmers 13. Functional early warning system (EWS) and climate information services (CIS) for agriculture

Strategic focus	Strategic actions	Outcome	Potential indicators
			14. Farming income from alternative sources 15. Agricultural emissions 16. Crop variety 17. Surface to groundwater usage ratio 18. Crop diversification 19. Tools and technologies
	S 2.2: Develop climate-resilient fisheries, aquaculture and livestock	**Outcome 2:** Enhanced climate resilience in aquaculture, fisheries and livestock	1. Food and nutrition security 2. Contribution of aquaculture, fisheries and livestock sectors to the national economy 3. Condition of agricultural input supplies (feed, medicine, vitamins, etc.) during and after disasters 4. Pest and disease outbreak occurrences 5. Degree of adoption of climate-smart practices for fisheries, aquaculture and livestock 6. Number of climate-resilient poultry or livestock sheds 7. Production of fisheries, aquaculture, livestock and poultry 8. Production loss in fisheries, aquaculture, livestock and poultry 9. Malnutrition of children 10. Protein deficiency 11. Use of modern technologies for fisheries, aquaculture and livestock 12. Women's engagement in fisheries and livestock 13. Number of vaccination or deworming programmes 14. Number of fry release programmes 15. Number of crossbreeds 16. Number of native fish species and mother fisheries 17. Number of *beel* sanctuaries 18. Shrimp and marine production 19. Contribution of F&A to the blue economy 20. Poverty incidence or dynamics of farmers and fishers 21. Functional early warning systems (EWS) and climate information services (CIS) for fisheries and livestock 22. Income of livestock farmers and fishers from alternative sources

Strategic focus	Strategic actions	Outcome	Potential indicators
	S 2.3: Manage sustainable agro-inputs and transformative value chains	**Outcome 3:** Abundance of quality inputs for agriculture, fisheries and livestock, and transformed value chains	1. Contributions of the agriculture, livestock and fisheries sectors to the national economy 2. Registered farmers and fishers in e-commerce services 3. Number of SMEs, CMSMEs related to agriculture and fisheries 4. Number of vegetable, fish and poultry farms 5. Number of hatcheries 6. Supply of agricultural inputs (feed, medicine, fertilizer, pesticides, etc.) during and after disasters 7. Pest and disease outbreak occurrences 8. The density of climate-resilient road and communications networks 9. Poverty incidence or dynamics of farmers and fishers 10. Functional early warning dissemination systems (EWDS) and climate information services (CIS) for agriculture, fisheries and livestock 11. Income of farmers and fishers from alternative sources 12. Income of farmers and fishers from e-commerce 13. Production price and market price
	S 2.4: Strengthen extension services for agriculture, fisheries and livestock	**Outcome 4:** Improved extension services related to agriculture, fisheries and livestock	1. Number of stress-tolerant crop varieties, breeds and fish species 2. Degree of adoption of stress-tolerant crop varieties, breeds and fish species 3. Number of extension officials per farmer or fisher 4. Number of climate-resilient poultry or livestock sheds 5. Yield gap in climate stress areas 6. Poverty incidence or dynamics among farmers and fishers 7. Functional early warning systems (EWS) and climate information services (CIS) for agriculture, fisheries and livestock 8. Income of farmers and fishers from alternative sources 9. Number of cases of conflict resolution among farmers and fishers 10. Net cultivable area for agriculture, fisheries and livestock 11. Awareness of farmers, fishers, women, people with diverse gender identities, people with disabilities and communities regarding modern and advanced technologies

Strategic focus	Strategic actions	Outcome	Potential indicators
			12. Mechanization status 13. Number of research and capacity-building initiatives 14. Number of field-level research studies
	Goal 3: Develop climate-smart cities for an improved urban environment and well-being		
	S 3.1: Promote green and blue infrastructure for urban environmental management and conservation	**Outcome 1:** Improved urban environment and resilient urban infrastructure	1. Number of climate-resilient road and infrastructure design guidelines 2. Number of climate-proofed road and communications facilities 3. Number of climate-resilient cross-drainage infrastructures 4. Length of environment-proofed flood and coastal embankments or polders 5. Rainwater harvesting coverage 6. Length of excavation or re-excavation of local canals to maintain connectivity with rivers 7. Number of reservoirs 8. Length of green belts 9. Use of vetiver grass or plants for embankment protection 10. Number of climate-resilient water and flood management structures 11. Number of green buildings or LEED-certified buildings 12. Coverage of climate-resilient WASH facilities for the urban poor 13. Number of rooftop gardens 14. Green GDP 15. Losses and damages to roads and infrastructure due to climate hazards
	S 3.2: Develop climate-smart cities to increase urban resilience	**Outcome 2:** Enhanced urban resilience and improved standard of living	1. Losses and damages due to urban floods 2. Coverage of climate-resilient urban drainage or stormwater management facilities 3. Urban green areas 4. Number of green building or LEED-certified buildings 5. Number of cities or municipalities under dedicated solid, liquid and e-waste management 6. Contributions of the urban economy to the national economy 7. Living standards, public and mental health 8. Occurrence of vector or waterborne diseases 9. Coverage of metropolitan slum area 10. Coverage of climate-resilient WASH facilities for the urban poor

Strategic focus	Strategic actions	Outcome	Potential indicators
			11. Cities or municipalities have stormwater management guidelines considering climate change 12. Urban population 13. Number of rooftop gardens 14. Green GDP 15. Emissions and pollution in cities 16. Retention times 17. Renewable energy contribution 18. Rainwater harvesting facilities 19. Flood zoning coverage 20. Water supply and sewerage system coverage 21. Heat island/temperature monitoring 22. Population density 23. Traffic delays 24. Solid waste management
	S 3.3: Develop climate-resilient health care and WASH facilities for improved human well-being and livability in cities	**Outcome 3:** Improved human health, livability and well-being	1. Living standards, public and mental health 2. Coverage of climate-resilient WASH facilities for the urban poor 3. Number of cancer patients 4. Number of blood pressure and diabetic patients 5. Number of organic farms 6. Number of floating vegetable gardens 7. Number of youth-led nurseries or horticultural initiatives 8. Occurrence of vector or waterborne diseases 9. Coverage of climate-resilient health-care facilities 10. Mortality rate 11. Premature childbirth rate 12. Number of cases of resolved social conflicts 13. Human Development Index 14. Health-care digitalization coverage 15. Health-care facilities count (hospitals, health complexes, satellite clinics, etc.) 16. Awareness campaigns
	Goal 4: Promotion of nature-based solutions for the conservation of forestry, biodiversity and the well-being of communities		
	S 4.1: Scale up ecosystem-based adaptation for wetlands conservation	**Outcome 1:** Increased use of nature-based solutions and conservation of biodiversity ensured **Outcome 2:** Increased practice of ecosystem-based adaptation for	1. Forest coverage 2. Coverage of hill forest and social forestry 3. Number of EbA initiatives 4. Length and width of green belts along the coastal belt 5. Number of migratory birds, Gangetic dolphins and tigers

Strategic focus	Strategic actions	Outcome	Potential indicators
		reducing climate change risks	6. The abundance of native flora and fauna 7. The density and composition of climate-sensitive trees 8. Carbon sequestration from mangroves and forests 9. Valuation of ecosystem services 10. Areas of permanent water bodies 11. The abundance of native fish and aquatic species 12. Terrestrial and aquatic habitat condition 13. Wetland coverage 14. Macrofauna and microfauna count
	S 4.2: Restore and conserve habitat, ecosystems and biodiversity	**Outcome 3:** Critical and fragile ecosystems restored and conserved	1. Forest coverage 2. Ecologically reserved areas and wetlands 3. Number of migratory birds, Gangetic dolphins and tigers 4. The abundance of native flora and fauna 5. Density and composition of climate-sensitive trees 6. Air, water, and soil nutrient quality 7. Marine stocks, coral reefs and benthic community status in ocean 8. Monitoring and enforcement report for eco-tourism 9. Carbon sequestration from mangroves and forests 10. Valuation of ecosystem services 11. Contribution of the blue economy to the national economy 12. Number of industries with functional ETPs installed 13. Areas of permanent water bodies 14. The abundance of native fish and aquatic species 15. Terrestrial and aquatic habitat condition
	S 4.3: Expand community-based afforestation and/or reforestation	**Outcome 4:** Expansion of forest coverage, mangroves and biodiversity **Outcome 5:** Community and youth-led conservation of nature for improved well being	1. Forest coverage 2. Coverage of hill forests and social forestry 3. Number of EbA initiatives 4. Encouragement of entrepreneurship for women and youth through organic farming, nursery, etc. 5. Length and width of green belts along the coastal belt 6. Number of migratory birds, Gangetic dolphins and tigers 7. An abundance of native flora and fauna

Strategic focus	Strategic actions	Outcome	Potential indicators
			8. Density and composition of climate-sensitive trees 9. Air, water and soil nutrient quality 10. Income from alternative sources 11. Marine stock, coral reefs and benthic community status in the ocean 12. Carbon sequestration from mangroves and forests 13. Valuation of ecosystem services 14. Contribution of the blue economy to the national economy 15. Terrestrial habitat condition 16. Encouragement of entrepreneurship for women and youth through organic farming, nurseries, etc. 17. Air, water, and soil nutrient quality 18. Number of urban farms, vertical garden, and rooftop garden 19. Human health index 20. Environment pollution 21. Waste management 22. Clean *khal* length 23. Mental health index/mental patient density 24. Youth engaged in sports 25. Number of urban parks or playgrounds 26. Addiction rates 27. Substance use: smoking, alcohol, drugs
Institution	**Goal 5:** Impart good governance through the integration of adaptation into the planning process		
	S 5.1: Reform policies for mainstreaming adaptation	**Outcome 1:** New or updated policies, plans, regulations and institutions developed or reformed to support mainstreaming of the NAP into government risk-informed planning and implementation processes	1. Approved and operational policy and institutional framework 2. Mandatory climate impact and risk assessment framework (CIRAF) developed and integrated into the DPP process for project appraisal 3. Number of climate risk-informed updated policies and planning initiatives 4. Number of private sectors led adaptation initiatives for CCA 5. Number of youth-led CCA initiatives 6. Participation of women and people with diverse gender identities in CCA initiatives 7. Number of co-management initiatives for CCA 8. Reformed and operational institutional arrangements for the NAP 9. Value added or other tax instruments
	S 5.2: Develop a framework for	**Outcome 2:** Effective and robust M&E for climate change	1. Regular M&E reports at the national, planning and project levels

Strategic focus	Strategic actions	Outcome	Potential indicators
	adaptation monitoring, evaluation and learning	adaptation developed to support the national monitoring, reporting and verification system	
	S 5.3: Engage the private sector in adaptation implementation	**Outcome 3:** Private sector-led CCA initiatives implemented	1. Number of private sector-led adaptation initiatives 2. Private sector financing 3. Awareness of private sector stakeholders 4. Updated CSR policies 5. VAT or other tax instruments
	S 5.4: Empower local government institutes, community-based organizations, women, people with disabilities and youth for locally led adaptation	**Outcome 4:** Decentralized environmental and climate change management ensured **Outcome 5:** Locally led, gender-, disability- and youth-inclusive adaptation initiatives increased	1. LGI-led CCA initiatives 2. Development and implementation of LAPA 3. WASAs in all divisional cities 4. Number of private sector-led adaptation initiatives 5. Number of youth-led CCA initiatives 6. Development and implementation of YLAP-CC 7. Participation of women, people with diverse gender identities and people with disabilities in CCA initiatives 8. Number of co-management initiatives for CCA 9. Engagement of NSOs and CBOs in CCA
	S 5.5: Enhance climate financing for adaptation	**Outcome-6:** Adaptation investment gap declines	1. Available risk transfer tools 2. Green bonds or resilience bonds 3. Contributions from domestic sources 4. Private sector investment in adaptation 5. Contributions of development partners and international funds 6. Rate of access to readiness support
	Goal 6: Ensure transformative capacity-building and innovation for climate change adaptation		
	S 6.1: Develop transformative capacities and management of knowledge	**Outcome 1:** A paradigm shift in capacity development and behavioural change happens and persists over time **Outcome 2:** Sustainable CCA knowledge management ensured **Outcome 3:** Capacity development at the individual, institutional and process levels	1. National climate status report published and communicated annually 2. Collaboration and networking among the public and private sector, NGOs, civil society and academia 3. Knowledge exchanges and technology transfer programmes through transitional cooperation 4. Number of CCA related training between involving government and private sector officials 5. related knowledge demand, supply, and communication 6. National adaptation communication to the UNFCCC

Strategic focus	Strategic actions	Outcome	Potential indicators
			7. Inclusion of CCA in the elementary level syllabus, public service recruitment exams, foundation courses, training institutes, etc. 8. Inclusion of CCA in vocational education 9. CCA communication through digital, print and electronic media 10. Number of peer-reviewed CCA related research papers and journals 11. Number of field-level demonstrations to farmers, fishers, marginal people, women and people with diverse gender identities, people with disabilities and youth 12. Number of capacity-building initiatives or hands-on training on alternative income generation activities 13. Number of system-level transformative capacity-building initiatives
	S 6.2: Introduce innovation in reducing climate change and disaster risks and consequent losses and damages	**Outcome 4:** Development of innovative technologies and adaptation practices to support risk-informed planning and damage mitigation	1. Number of peer-reviewed research papers or journals related to CCA 2. Tools/methodologies 3. Risk reduction 4. Damage mitigation 5. Number of local, national and international seminars, workshops, trainings or conferences 6. Number of climate-resilient guidelines 7. Number of climate change risk-informed planning and implementation initiatives 8. Awareness of communities, marginalized people, women, people with diverse gender identities, youth and ethnic groups
	S 6.3: Research and innovation for agriculture, fisheries and livestock	**Outcome 5:** Development of tools and methodologies, and increased capacities of actors to improve research and extension services related to agriculture, fisheries and livestock	1. Number of stress-tolerant crop varieties, breeds and fish species 2. Degree of adoption of stress-tolerant crop varieties, breeds and fish species 3. Number of extension officials per farmer or fisher 4. Number of climate-resilient poultry or livestock sheds 5. Yield gap in climate stress areas 6. Poverty incidence or dynamics among farmers and fishers 7. Functional early warning systems (EWS) and climate information services (CIS) for agriculture, fisheries and livestock 8. Income of farmers and fishers from alternative sources 9. Number of cases of conflict resolution among farmers and fishers

Strategic focus	Strategic actions	Outcome	Potential indicators
			10. Net cultivable area for agriculture, fisheries and livestock 11. Awareness of farmers, fishers, women, people with diverse gender identities, people with disabilities and communities regarding modern and advanced technologies 12. Mechanization status 13. Number of research and capacity-building initiatives 14. Number of field-level research studies
	S 6.4: Advanced research on climate change impacts on ecosystems and application of ecosystem-based adaptation	**Outcome 6:** Knowledge generated on ecosystem sensitivity to climate change and its impacts	1. Terrestrial and aquatic habitat condition 2. Sensitivity of different flora and fauna to climate-related changes to land, wetlands and the ocean 3. Number of peer-review publications related to climate change impacts on ecosystems 4. Increased institutional capacity of BFD, BFRI, etc. 5. Developed EbA options 6. Ecosystem resilience 7. Species suitability of plants 8. Threatened species of flora and fauna 9. Well-managed marine or ocean ecosystems
	S 6.5: Action research for innovation in climate-resilient infrastructure, improved health and WASH technologies	**Outcome 7:** Scientific knowledge and guidelines for climate-resilient health, adaptive rural and urban WASH infrastructure, and urban development	1. Coverage of climate-resilient urban drainage or stormwater management facilities 2. Coverage of climate-resilient WASH facilities for rural areas and the urban poor, women, people with diverse gender identities and people with disabilities 3. Climate-resilient health-care facilities 4. Cities or municipalities having stormwater management guidelines that consider climate change 5. Number of climate-resilient LID design guidelines 6. Reports or peer-reviewed publications on climate-resilient infrastructure development 7. Number of climate-resilient infrastructures 8. Innovative tools and methodologies 9. Research budgets

Appendix IV: Portrait of Adaptation Initiatives

Shelter for Landless, Homeless and Displaced People under Ashrayan Project at Langolerhat, Rangpur

Inclusion of Autism & Disability for Climate Adaptation and Resilience Building by Mrs Saima Wazed

Specially Designed Machang House, Bandarban Hill District

Buildings with Modern Facilities for Climate Refugees under Ashrayan Khurushkul Special Project, Cox's Bazar

Mujib Killa in Raised Land of Northeastern Haor Areas for Crop Storage & Giving Shelter to Livestock

Earthen Embankment of Coastal Polder for Protecting Agriculture Lands

Gender Inclusive Social Safety Net Program for Improved Livelihoods and Resilience

Year Round Vegetable Farming with Stress Tolerant Seeds

School cum Multi-purpose Cyclone Shelter at Putiakhali, Jhalakathi

Floating Agriculture as Nature based Solutions in Southwestern Part of Bangladesh

Coastal Embankment Improvement for Combating Sea Level Rise, Storm Surge and Salinity Intrusion

Friendship Multi-purpose Cyclone Shelter in the Coastal Belt

Community based Coastal Afforestation and Greenbelt Development

Appendix V: Glimpses of Stakeholder Consultation for NAP Formulation

Community Consultation at Satkhira

Stakeholder Consultation at Ashuganj, Brahmanbaria

Community Consultation at Patharghata, Barguna

Stakeholder Consultation at Bandarban

Community Consultation at Char Fassion, Bhola

Consultation with Youth at Shymnagar, Satkhira

Stakeholder Consultation at Lalmonirhat

Stakeholder Consultation at Kurigram

Consultation with Persons with Disabilities

Consultation with Development Partner

Stakeholder Consultation at Gopalganj

Inter-ministerial Steering Committee Meeting for NAP

Consultation with Private Sector

Consultation with MoEFCC Officials

Final Dissemination and Validation Workshop

Pre-validation Workshop of NAP

National Mainstreaming Dialogue for NAP

National Mainstreaming Dialogue for NAP

Validation with Water Resources Sector

Validation with Agriculture Sector

Consultation for Gender Mainstreaming in NAP

References

Adnan, M.S.G., Dewan, A., Zannat, K., Abdullah, A. Y. M. (2019). The use of watershed geomorphic data in flash flood susceptibility zoning: a case study of the Karnaphuli and Sangu river basins of Bangladesh. Natural Hazards. 99. 425–448. 10.1007/s11069-019-03749-3.

Ahmed, A.U., Alam, M., Rahman, A.A. (1999). Adaptation to Climate Change in Bangladesh: Future Outlook. Springer, Dordrecht. https://doi.org/10.1007/978-94-015-9325-0_9

Ahmed, Mahfuz; Suphachalasai, Suphachol. 2014. Assessing the Costs of Climate Change and Adaptation in South Asia. © Asian Development Bank

ASC. (2015). Progress in Preparing for Climate Change: 2015 Report to Parliament. United Kingdom

BBS. (2016). Bangladesh Disaster-related Statistics 2015: Climate Change and Natural Disaster Perspectives. Bangladesh Bureau of Statistics, Statistics and Informatics Division, Ministry of Planning, Government of the People's Republic of Bangladesh, Dhaka Bangladesh

BBS. (2017). Bangladesh Statistics, Bangladesh Bureau of Statistics, Dhaka Bangladesh

BBS (2022a). Key findings and detailed tables on Bangladesh Disaster-related Statistics 2021: Climate Change and Natural Disaster Perspectives. Bangladesh Bureau of Statistics, Statistics and Informatics Division, Ministry of Planning, Government of the People's Republic of Bangladesh, Dhaka, Bangladesh.

BBS, (2022b). Statistical Yearbook Bangladesh 2021, Statistics and Informatics Division (SID), Ministry of Planning, Dhaka, Bangladesh.

BHWDB. (2012). Master Plan of Haor Area: Volume I Summary Report, Ministry of Water Resources, Government of the People's Republic of Bangladesh, Dhaka, Bangladesh

BWDB. (2014). Annual Flood Report 2014, Flood Forecasting and Warning Center, BWDB, Dhaka, Bangladesh

Brammer H (1996) The geography of the soils of Bangladesh. University Press Limited, Dhaka

Caesar, J., Janes, T. (2018). Regional Climate Change over South Asia. In: Nicholls R., Hutton C., Adger W., Hanson S., Rahman M., Salehin M. (eds) Ecosystem Services for Well-Being in Deltas. Palgrave Macmillan, Cham. https://doi.org/10.1007/978-3-319-71093-8_11

CEGIS (2010). Final Report on Impacts of Climate Change on the Morphological Process of the Main Rivers and Meghna Estuary of Bangladesh. Asian Development Bank, Pilot and Demonstration Activities (PDA) Programme.

CEGIS. (2013). Assessing the Economic Impact Of Climate Change On Agriculture, Water Resources And Food Security And Adaptation Measures Using 5 Seasonal And Medium Range Of Forecasts. Dhaka.

CEGIS (2021). CEGIS Technical Note: Impacts of projected Sea Level Rise on coastal embankments, CEGIS, Dhaka, Bangladesh.

CEGIS (2022a). CEGIS Technical Note: Recent Climatic Trend in Bangladesh, CEGIS, Dhaka, Bangladesh.

CEGIS (2022b), Climate Change Vulnerabilities Assessment for 9 LIUPC Cities and Infrastructure Assessment (Draft) for United Nations Development programme, Dhaka.

Dewan, A., Kiselev, G. et. al. (2021). Surface Urban Heat Island Intensity In Five Major Cities of Bangladesh: Patterns, drivers and trends. Sustainable Cities and Society 71(1)

Dewan A, Hossain MF, Rahman MM, Yamane Y, Holle RL (2017) Recent Lightning-Related Fatalities and injuries in Bangladesh. Weather Clim Soc 9(3):575–589

DoE. (2020). Impacts of Projected Sea Level Rise on Water, Agriculture and Infrastructure Sectors of the Coastal Region. Draft Final Report

DoF. 2020. Yearbook of Fisheries Statistics of Bangladesh, Department of Fisheries, Dhaka, Bangladesh

DoF. 2021. Yearbook of Fisheries Statistics of Bangladesh, Department of Fisheries, Dhaka, Bangladesh

DBHWD. (2012). Master Plan of Haor Area, Volume I, CEGIS/Bangladesh Haor and Wetland Development Board

DMIC, 2013. Situation Report on Tornado in Brahmanbaria, DMIC, Ministry of Disaster Management and Relief, Dhaka.

EACC. 2010. Economics of Adaptation to Climate Change, World Bank Study

Ezaz, T.G., Zhang, K., et. al. (2021). Spatiotemporal Changes of Precipitation Extremes in Bangladesh During 1987–2017 and Their Connections with Climate Changes, Climate Oscillations, and Monsoon Dynamics.
Global and Planetary Change, Volume 208, 2022, 103712, ISSN 0921-8181. https://doi.org/10.1016/j.gloplacha.2021.103712.

Fernandes, J., Kay, S., Hossain, M., Ahmed, M., Cheung, W., Lazar, A., Barange, M. (2015). Projecting marine fish production and catch potential in Bangladesh in the 21st century under long-term environmental change and management scenarios. ICES Journal of Marine Science. 73. 10.1093/icesjms/fsv217.

Finch JD, Dewan AM. (2003). Tornadoes in Bangladesh and East India. Available from: http://bangladeshtornadoes.org/climo/btorcli0.htm.

Fox-Kemper, B., H. T. Hewitt, C. Xiao, G. Aðalgeirsdóttir, S. S. Drijfhout, T. L. Edwards, N. R. Golledge, M. Hemer, R. E. Kopp, G. Krinner, A. Mix, D. Notz, S. Nowicki, I. S. Nurhati, L. Ruiz, J-B. Sallée, A. B. A.

Slangen, Y. Yu, 2021, Ocean, Cryosphere and Sea Level Change. In: Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Masson-Delmotte, V., P. Zhai, A. Pirani, S. L. Connors, C. Péan, S. Berger, N. Caud, Y. Chen, L. Goldfarb, M. I. Gomis, M. Huang, K. Leitzell, E. Lonnoy, J. B. R. Matthews, T. K. Maycock, T. Waterfield, O. Yelekçi, R. Yu and B. Zhou (eds.)]. Cambridge University Press.

GED. (2012). Bangladesh Climate Public Expenditure and Institutional Review. Dhaka: General Economics Division (GED), Planning Commission, Government of the People's Republic of Bangladesh.

GED, 2014. Towards Resilient Development: Scope for Mainstreaming Poverty, Environment, Climate Change and Disaster in Development Projects, General Economic Division (GED), Planning Commission, Ministry of Planning, Government of the People's Republic of Bangladesh, Dhaka, p. 130

GED. (2018a). Bangladesh Delta Plan 2100. Dhaka: General Economics Division (GED), Planning Commission, Government of the People's Republic of Bangladesh.

GED. (2018b), Bangladesh Delta Plan 2100: Baseline Studies; Volume 2: Disaster and Environmental Management. Dhaka: General Economics Division (GED), Planning Commission, Government of the People's Republic of Bangladesh.

GED. (2020a). Second Perspective Plan of Bangladesh, 2021-2041. Dhaka: General Economics Division (GED), Planning Commission, Government of the People's Republic of Bangladesh.

GED. (2020b). Sector Action Plan on Environment and Climate Change. Dhaka: General Economics Division (GED), Planning Commission, Government of the People's Republic of Bangladesh.

GoB. (2010). Climate Change Trust Act, 2010 (Act No. 57 of 2010).

Holle, R. L., Dewan, A., Said, R., Brooks, W. A., Hossain, M. F., & Rafiuddin, M. (2019). Fatalities related to lightning occurrence and agriculture in Bangladesh. International Journal of Disaster Risk Reduction, 41, 101264

Hossain PR, Amjath-Babu TS, Krupnik TJ, Braun M, Mohammed EY and Phillips M (2021) Developing Climate Information Services for Aquaculture in Bangladesh: A Decision Framework for Managing Temperature and Rainfall Variability-Induced Risks. Front. Sustain. Food Syst. 5:677069

IFRC. 2021. Final Report, Bangladesh: Cyclone Amphan. International Federation of Red Cross and Red Crescent Societies.

IPCC. (2014). Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, R.K. Pachauri and L.A. Meyer (eds.)]. IPCC, Geneva, Switzerland, 151 pp.

IPCC. (2021). Climate Change 2021: The Physical Science Basis. Contribution of the Working Group I to the Sixth Assessment Report.

IPCC (2022). Climate Change 2022: Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [H.-O. Pörtner, D.C. Roberts, M. Tignor, E.S. Poloczanska, K. Mintenbeck, A. Alegría, M. Craig, S. Langsdorf, S. Löschke, V. Möller, A. Okem, B. Rama (eds.)]. Cambridge University Press. In Press.

Islam, S. A., Mohammed, K .et. al. (2018). Future Floods in Bangladesh under 1.5°C, 2°C, and 4°C Global Warming Scenarios. Journal of Hydrologic Engineering 23(12):04018050. DOI: 10.1061/(ASCE)HE.1943-5584.0001705

Islam, S., Murshed, S.B, et. al. (2014). Impact of Climate Change on Heavy Rainfall in Bangladesh. Institute of Water and Flood Management (IWFM), BUET.

Islam, Shafi & Gnauck, Albrecht. (2009). Threats to the Sundarbans Mangrove Wetland Ecosystems from Transboundary Water Allocation in the Ganges Basin: A Preliminary Problem Analysis. International Journal of Ecological Economics and Statistics (IJEES). 13. 64-78.

IUCN (2021). Nature-based Recovery Initiative. Technical Paper No. 2. Nature-based Solutions for recovery – Opportunities, policies and measures

Karmakar, Samarendra & Das, Mohan. (2019). Study on Heat Waves and Associated Large-scale Circulations in Bangladesh. 10.13140/RG.2.2.13090.86720.

Karim, M.F. and Mimura, N. (2008) Impacts of Climate Change and Sea-Level Rise on Cyclonic Storm Surge Floods in Bangladesh. Global Environmental Change, 18, 490-500.

Khan, A. E., Scheelbeek, P. F., Shilpi, A. B., Chan, Q., Mojumder, S. K., Rahman, A., Haines, A., & Vineis, P. (2014). Salinity in drinking water and the risk of (pre)eclampsia and gestational hypertension in coastal Bangladesh: a case-control study. PloS one, 9(9), e108715. https://doi.org/10.1371/journal.pone.0108715

LEG. (2012a). National Adaptation Plans: Technical Guidelines for the National Adaptation Plan Process.

LEG. (2012b). The National Adaptation Plan Process: A Brief Overview.

Mazumder, Arnab & Sikder, Md & Islam, Md. Saiful & Mohon, Munjurul & Talukder, Sajid. (2021). Lightning in Northeast Bangladesh: Relation with Climatic Variables, Consequences And Adaptation. 10.47253/jtrss.v9i2.

MCPP. 2021. draft Mujib Climate Prosperity Plan, Bangladesh Secretariat, Dhaka Bangladesh

Ministry of Economy. (2017). Fiji's National Adaptation Plan Framework. Government of Fiji. https://cop23.com.fj/wp-content/uploads/2018/03/NAP-Framework-Fiji.pdf

Ministry of Economy. (2018). Republic of Fiji National Adaptation Plan: A Pathway Towards Climate Resilience. Suva, Fiji: Government of Fiji. https://www4.unfccc.int/sites/NAPC/Documents/Parties/National%20Adaptation%20Plan_Fiji.pdf

Mitchell, T., Tanner, T. and Lussier, K. 2007. We Know What We Need: South Asian Women Speak Out On Climate Change Adaptation. Institute of Development Studies, University of Sussex, UK.

MoDMR. (2020). National Plan for Disaster Management (2021-2025). Action for Disaster Risk Management Towards Resilient Nation, Ministry of Disaster Management and Relief.

MoEF. (2005). National Adaptation Programme of Action (NAPA). Dhaka: Ministry of Environment, Forest, Government of the People's Republic of Bangladesh. https://unfccc.int/resource/docs/napa/ban01.pdf

MoEF. (2009). Bangladesh Climate Change Strategy and Action Plan 2009. Dhaka: Ministry of Environment, Forest, Government of the People's Republic of Bangladesh. https://moef.gov.bd/site/page/97b0ae61-b74e-421b-9cae-f119f3913b5b/BCCSAP-2009

MoEF. (2013). Climate Change Gender Action Plan (ccGAP). Dhaka: Ministry of Environment, Forest, Government of the People's Republic of Bangladesh.

MoEF. (2015). Roadmap for Developing a National Adaptation Plan for Bangladesh. Dhaka: Ministry of Environment, Forest, Government of the People's Republic of Bangladesh.

MoEF. (2017). Bangladesh Country Investment Plan for Environment Forestry and Climate Change. Dhaka: Ministry of Environment, Forest, Government of the People's Republic of Bangladesh.

MoEFCC. (2018a). Nationwide Climate Vulnerability Assessment in Bangladesh. Dhaka: Ministry of Environment, Forest and Climate Change, Government of the People's Republic of Bangladesh. https://moef.gov.bd/sites/default/files/files/moef.portal.gov.bd/notices/d31d60fd_df55_4d75_bc22_1b0142fd9d3f/Draft%20NCVA.pdf

MoEFCC. (2018b). Third National Communication of Bangladesh to the United Nations Framework Convention on Climate Change. Dhaka: Ministry of Environment, Forest and Climate Change, Government of the People's Republic of Bangladesh.

MoEFCC. (2020a), Projections of Sea Level Rise and Assessment of it's Sectoral Impact, Department of Environment, Ministry of Environment, Forest and Climate Change, Government of the People's Republic of Bangladesh.

MoEFCC. (2020b), Update of Bangladesh Climate Change Strategy and Action Plan (Draft), Ministry of Environment, Forest and Climate Change, Government of the People's Republic of Bangladesh.

MoEFCC. (2022a), Transformative Capacity Building Action Plan for Climate Change Adaptation, Dhaka: Ministry of Environment, Forest and Climate Change, Government of the People's Republic of Bangladesh

MoEFCC. (2022b), Knowledge Management Plan for Climate Change Adaptation, Dhaka: Ministry of Environment, Forest and Climate Change, Government of the People's Republic of Bangladesh

MoF. (2014). Climate Fiscal Framework. Dhaka: Ministry of Finance, Government of the People's Republic of Bangladesh.

MoF. (2018). Public Climate Finance Tracking in Bangladesh, Ministry of Finance, Dhaka, Bangladesh

MoF. (2020). Bangladesh Climate Fiscal Framework. Dhaka: Ministry of Finance, Government of the People's Republic of Bangladesh.

MoF. (2021). Climate Financing for Sustainable Development (Budget Report 2021-22). Dhaka: Finance Division, Ministry of Finance, Government of the People's Republic of Bangladesh.

NAP Global Network. (2017). A Framework for Gender-Responsive National Adaptation Plan (NAP) Processes. https://napglobalnetwork.org/wp-content/uploads/2017/07/napgn-en-2017-a-framework-for-gender-responsive-nap-processes.pdf

NWMP. (2001). National Water Management Plan, Ministry of Water Resources, Government of the People's Republic of Bangladesh, Dhaka, Bangladesh

OECD. (2015). G20-OECD Work on Long-term Financing. https://www.oecd.org/g20/topics/financing-for-investment/g20-oecd-long-term financing.htm

PROVIA. (2014). Supporting NAP development with the PROVIA Guidance: A user companion. https://www4.unfccc.int/sites/NAPC/Documents/Supplements/PROVIA-NAP-user-companion-2014.pdf

Rashid HE (1991) Geography of Bangladesh. University Press Limited, Dhaka

Rahman, M. R. (2015). Climate Change in Bangladesh: a Spatio-temporal Analysis and Simulation of Recent Temperature and Rainfall Data Using GIS and Time Series Analysis Model. Theoretical and Applied Climatology, Springer Link, vol-128, pp 27-41.

Rodell, M. (2018). Emerging trends in Global Freshwater Availability. N A T U R E, 22. https://doi.org/10.1038/s41586-018-0123-1

Roy, K., Gain, A.K., Mallick, B. et al. (2017). Social, Hydro-ecological and Climatic Change in the Southwest Coastal Region of Bangladesh. Regional Environmental Change 17, 1895–1906 (2017). https://doi.org/10.1007/s10113-017-1158-9

Salam, M., Krupnik, T., Montes, C., Nessa, B., Khatun, M. T., Ali, M. P., Shahrin, S., Mannan, M., Hassan, S.M. Q., Aziz, M., Uddin, M. (2019). Potential Impact of Climate Change on Crop Insect Pests and Diseases in Bangladesh: Future Scenarios and Strategies for Climate Services. In: Climate change and Bangladesh agriculture: Adaptation and Mitigation Strategies, KGF, Dhaka.

Saroar MM, Routray JK (2012) Impacts Of Climatic Disasters In Coastal Bangladesh: Why Does Private Adaptive Capacity Differ? Reg Environ Chang 12(1):169–190

SRDI. (2010). Saline Soils of Bangladesh. SRMAF Project, Ministry of Agriculture, Government of the People's Republic of Bangladesh.

Sridevi, et. al. (2021). Role of river Discharge And Warming On Ocean Acidification and pCO2 levels in the Bay of Bengal. Tellus B: Chemical and Physical Meteorology. https://doi.org/10.1080/16000889.2021.1971924

Ullah, M.W., Ahmed, F. and Sourav, M.S.H., 2015. Ecosystem Based Planning And Management Of Resources For Deltaic Countries. 5th International Conference on Water and Flood Management, Institute of Water and Flood Management, Bangladesh University of Engineering and Technology, Dhaka.

UNDP. (2009). Capacity Development: a UNDP Primer

UNEP. (2021). Guidelines for Integrating Ecosystem-based Adaptation (EbA) into National Adaptation Plans (NAPs). https://wedocs.unep.org/handle/20.500.11822/36703

UNFCCC. (2015a). The Paris Agreement. Available at: https://unfccc.int/resource/docs/2015/cop21/eng/l09r01.pdf

UNFCCC. (2015b). Strengthening Gender Considerations In Adaptation Planning And Implementation In The Least Developed Countries. Available at: https://unfccc.int/files/adaptation/application/pdf/21673_unfccc_leg_gender_low_v5.pdf.

UNFCCC. (2020). Building capacity in the UNFCCC process. https://unfccc.int/topics/capacity-building/the-big-picture/capacity-in-the-unfccc-process.

UN RC Bangladesh (2022). Bangladesh: 2022 Severe Flash Flood, Office of the UN Resident Coordinator Situation Update #2 (22 June 2022), available at:

WMO. (2003). Integrated Flood Management Case Study-Bangladesh: Flood Management, World Meteorological Organization and Global Water Partnership Associated Programme on Flood Management

WHO. (2020). WHO Guidance for Climate Resilient and Environmentally Sustainable Health Care Facilities. World Health Organisation.

WMO. (2021a). State of the Climate in Asia 2020. WMO-No. 1273. World Meteorological Organisation.

WMO. (2021b). State of Climate Services Report. World Meteorological Organisation.

World Bank. (2010). The Cost of Adapting to Extreme Weather Events in a Changing Climate.

World Bank. (2021). “Clement, Viviane; Rigaud, Kanta Kumari; de Sherbinin, Alex; Jones, Bryan; Adamo, Susana; Schewe, Jacob; Sadiq, Nian; Shabahat, Elham. 2021. Groundswell Part 2: Acting on Internal Climate Migration. World Bank, Washington, DC. © World Bank. https://openknowledge.worldbank.org/handle/10986/36248 License: CC BY 3.0 IGO.”

Abbreviations and Acronyms

Abbreviations and Acronyms

3R	Reduce, Recycle and Recovery
4th IR	Fourth Industrial Revolution
ACI	Advanced Chemical Industries
ADB	Asian Development Bank
ADP	Annual Development Program
ADCOM	Adaptation Communication
AEZ	Agro-Ecological Zones
AF	Adaptation Fund
AI	Artificial Intelligence
AIGA	Alternative Income Generation Activities
FAO	Food and Agriculture Organization of the United Nations
AMR	Anti-Microbial Resistance
AR6	Sixth Assessment Report of the IPCC
ARI	Agricultural Research Institute
ARI	Acute Respiratory Infection
ASC	Adaptation Sub-Committee
AWD	Alternate Wetting and Drying
BADC	Bangladesh Agricultural Development Corporation
BARI	Bangladesh Agricultural Research Institute
BB	Bangladesh Bank
BBS	Bangladesh Bureau of Statistics
BBS-ECDS	Bangladesh Bureau of Statistics-Environment, Climate Change and Disaster
B-CCKTN	Bangladesh Climate Change Knowledge and Technology Network
BCCRF	Bangladesh Climate Change Resilience Fund
BCCSAP	Bangladesh Climate Change Adaptation Strategy and Action Plan
BCCT	Bangladesh Climate Change Trust
BCCTF	Bangladesh Climate Change Trust Fund
BCR	Benefit Cost Ratio
BDP2100	Bangladesh Delta Plan 2100
BDRS	Bangladesh Disaster Related Statistics
BDT	Bangladeshi Taka
BEPZA	Bangladesh Export Processing Zones Authority

BEZA	Bangladesh Economic Zones Authority
BFD	Bangladesh Forest Department
BFDC	Bangladesh Fisheries Development Corporation
BFIDC	Bangladesh Forest Industries Development Corporation
BFRI	Bangladesh Fisheries Research Institute
BGMEA	Bangladesh Garment Manufacturers and Exporters Association
BIDA	Bangladesh Investment Development Authority
BIDS	Bangladesh Institute of Development Studies
BINA	Bangladesh Institute of Nuclear Agriculture
BIWTA	Bangladesh Inland Water Transport Authority
BKMEA	Bangladesh Knitwear Manufacturers and Exporters Association
BLRI	Bangladesh Livestock Research Institute
BMD	Bangladesh Meteorological Department
BMDA	Barind Multipurpose Development Authority
BNBC	Bangladesh National Building Code
BoB	Bay of Bengal
BoI	Board of Investment
BOO	Build-Own-Operate
BOOT	Build-Own-Operate-Transfer
BOT	Build-Operate-Transfer
BP	Blood Pressure
BPH	Brown Plant Hopper
BRAC	Bangladesh Rural Advancement Committee
BRRI	Bangladesh Rice Research Institute
BSCIC	Bangladesh Small and Cottage Industries Corporation
BSEC	Bangladesh Securities and Exchange Commission
Bt Brinjal	Bacillus thuringiensis Brinjal
BUET	Bangladesh University of Engineering and Technology
BUILD	Business Initiative Leading Development
BWDB	Bangladesh Water Development Board
BYLC	Bangladesh Youth Leadership Center
CBO	Community-based Organization
CBL	Chalan beel and low-lying area of north-western region
CCA	Climate Change Adaptation
CCAFS	Climate Change, Agriculture and Food Security
CCAP	Climate Change Action Plan
ccGAP	Climate Change Gender Action Plan
CCIKM	Climate Change Information and Knowledge Management
CCIRAF	Climate Change Impact and Risk Assessment Framework
CCKTN	Climate Change Knowledge and Technology Network
CCM	Climate Change Mitigation
CCRIF	Climate Change Research and Innovation Fund

CCU	Climate Change Unit
CCW	Climate Change Wing
CDD	Consecutive Dry Days
CDIA	Climate and Disaster Impact Assessment
CDP	Committee for Development Policy
CDSP	Char Development and Settlement Project
CECCR	Center of Excellence for Climate Change Research
CEGIS	Centre for Environmental and Geographic Information Services
CEIP	Coastal Embankment Improvement Project
CGIAR	Consultative Group on International Agricultural Research
CHT	Chattogram Hill Tracts
CHI	Char and Islands
CHT-CAP	Chattogram Hill Tracts Climate Action Plan
CHTDB	Chattogram Hill Tracts Development Board
CIRAF	Climate Impact and Risk Assessment Framework
CIS	Climate Information Services
City-CAP	City Climate Action Plan
CKHCC	Central Knowledge Hub of Climate Change
CKHCC	Central Knowledge Hub of Climate Change
cm	Centimeter
CMA	Conference of the Parties serving as the Meeting of the Parties to the Paris Agreement
CMSMEs	Cottage, Medium, small and micro-enterprises
CNRS	Center for Natural Resource Studies
CoP	Conference of the Parties
CPEIR	Climate Public Expenditure and Institutional Review
CPP	Cyclone Preparedness Programme
CPUE	Catch Per Unit Effort
CRA	Climate Risk Assessment
CRI	Climate Risk Index
CReLIC	Climate Resilient Local Infrastructure Center, LGED
CRF	Climate Resilience Fund
CRSA	Climate Resilient and Smart Agriculture
CSA	Climate Smart Agriculture
CSO	Civil Society Organization
CSER	Corporate Social Environment Responsibility
CSMES	Cottage, Small and Medium Enterprises
CSR	Corporate Social Responsibility
CTCN	Climate Technology Center and Network
CVF	Climate Vulnerable Forum
CWC	Central Water Commission
D/S	Drainage Structure
DAE	Department of Agricultural Extension
DAE	Direct Access Entity

DAM	Department of Agricultural Marketing
DAP	Detailed Area Plan
DAPP	Dynamic Adaptive Policy Pathway
DBA	Drought Prone and Barind Area
DBFOM	Design-Build-Finance-Operate-Maintain
DBHWD	Bangladesh Haor and Wetland Development Board
DCCI	Dhaka Chamber of Commerce & Industry
DDM	Department of Disaster Management
DGC	Delta Governance Council
DGHS	Directorate General of Health Services
DIA	Disaster Impact Assessment
DLS	Department of Livestock Services
DO	Dissolved Oxygen
DoE	Department of Environment
DoF	Department of Fisheries
DoL	Department of Labour
DPHE	Department of Public Health Engineering
DPP	Development Project Proforma
DRF	Development Result Framework
DRIP	Disaster and climate Risk Information Platform
DRR	Disaster Risk Reduction
DSS	Department of Social Services
DYD	Department of Youth Development
EACC	Economics of Adaptation to Climate Change
EbA	Ecosystem-based Adaptation
ECA	Ecologically Critical Areas
ECC	Environment and Climate Change
ECDS	Environment, Climate Change and Disaster Statistics
EEZ	Exclusive Economic Zone
EFCC	Environment, Forestry and Climate Change
EIA	Environmental Impact Assessment
EMS	Environmental Management System
ERD	Economic Relations Division
ERMT	Erosion Risk Management Tool
ETP	Effluent Treatment Plant
EVI	Environmental Vulnerability Index
EWDS	Early Warning Dissemination System
EWS	Early Warning System
F & A	Fisheries and Aquaculture
FAD	Fish Aggregating Device
FAO	Food and Agriculture Organization of the United Nations
FBCCI	Federation of Bangladesh Chambers of Commerce & Industries
FD	Fishery Demonstrator

FFWC	Flood Forecast and Warning Centre
FGD	Focused Group Discussion
FPE	River, floodplain and erosion prone area
FWG	Facilitative Working Group
FY	Fiscal Year
G20	Group of Twenty
GAP	Good Agricultural Practices
GBM	Ganges-Brahmaputra-Meghna
GCA	Global Center on Adaptation
GCF	Green Climate Fund
GDP	Gross Domestic Product
GED	General Economics Division, Bangladesh Planning Commission
GEF	Global Environment Facility
GII	Gender Inequality Index
GIS	Geographic Information System
GNI	Gross National Income
GoB	Government of Bangladesh
GRCRF	Gender Responsive Community Resilience Fund
GRF	Global Refugee Forum
GSP	Global Support Programme
GW	Groundwater
GWP	Global Water Partnership
HAI	Human Assets Index
HCF	Health Care Facility
HFF	Haor and flash floods area
HYV	High-Yielding Variety
iBAS++	Integrated Budget and Accounting System
ICDDRB	International Centre for Diarrhoeal Disease Research, Bangladesh
ICM	Integrated Crop Management
ICRD	Integrated Coastal Resources Database
ICT	Information and Communications Technology
IDB	Islamic Development Bank
IDCOL	Infrastructure Development Company Limited
IEC	Information, Education and Communication
IFC	International Finance Corporation
IFRC	The International Federation of Red Cross and Red Crescent Societies
IMED	Implementation Monitoring & Evaluation Division, Ministry of Planning
IMTA	Integrated Multi-Trophic Aquaculture
INDC	Intended Nationally Determined Contributions
INGO	International Non-Governmental Organization
IOT	Internet of Things
IPC	Infection Prevention and Control
IPCC	Intergovernmental Panel on Climate Change

IPM	Integrated Pest Management
IRR	Internal Rate of Return
ISCCC	Inter-ministerial Steering Committee on Climate Change
ISAP-CC	Integrated Section Action Plan on Climate Change
IT	Information Technology
IUCN	International Union for Conservation of Nature
IWRM	Integrated Water Resources Management
KABIKHA	Food for Work
KII	Key Informant Interview
km	Kilometer
LAPA	Local Adaptation Program of Action
LCIPP	Local Communities and Indigenous Peoples Platform
LDC	Least Developed Country
LDCF	Least Developed Countries Fund
LEC	Local Executive Committee
LEED	Leadership in Energy and Environmental Design
LEG	Least Developed Countries Expert Group
LGD	Local Government Division
LGED	Local Government Engineering Department
LGI	Local government institution
LGRD	Local Government and Rural Development
LID	Low Impact Development
LLA	Locally-Led Adaptation
LoGIC	Local Government Initiatives on Climate Change
LUE	Land Use Efficiency
M&E	Monitoring and Evaluation
MAR	Managed Aquifer Recharge
MATH	Modern Agricultural Technology in the Hills
MCA	Multi- Criteria Analysis
MCCI	Metropolitan Chamber of Commerce and Industry, Dhaka
MCPP	Mujib Climate Prosperity Plan
MDGs	Millennium Development Goals
MEAL	Monitoring. Evaluation, Accountability and Learning
MSME	Medium, Small and Micro Enterprises
mm	Millimeter
Mm3	Million Meter Cube
MoA	Ministry of Agriculture
MoC	Ministry of Commerce
MoD	Ministry of Defense
MoDMR	Ministry of Disaster Management and Relief
MoEFCC	Ministry of Environment, Forest and Climate Change
MoF	Ministry of Finance
MoFL	Ministry of Fisheries and Livestock

MoI	Ministry of Industries
MoL	Ministry of Land
MoLGRDC	Ministry of Local Government, Rural Development and Co-operatives
MoP	Ministry of Planning
MoPEMR	Ministry of Power, Energy and Mineral Resources
MoWCA	Ministry of Women and Children Affairs
MoWR	Ministry of Water Resources
MPA	Marine Protected Area
MRV	Measurement, reporting and verification
NAC	National Agriculture Council
NAP	National Adaptation Plan
NAPA	National Adaptation Plan of Action
NARS	National Agricultural Research System
NBR	National Board of Revenue
NbS	Nature based Solution
NCECC	National Council on Environment and Climate Change
NDA	National Designated Authority
NDC	Nationally Determined Contribution
ND-GAIN	Notre Dame Global Adaptation Initiative
NEC	National Executive Committee
NECCC	National Environment and Climate Change Council
NGO	Non-Government Organization
NIE	National Implementing Entities
NNW	Northern north-western region
NPK	Nitrogen (N), Phosphorus (P) and Potassium (K)
NPV	Net Present Value
NSCC	National Steering and Coordination Committee
NSO	Neighborhood Service Organization
NTACCC	National Technical Advisory Committee on Climate Change
NWMP	National Water Management Plan
NWRC	National Water Resources Council
NWRD	National Water Resources Database
ODK	Open Data Kit
O & M	Operation and Maintenance
OECD	Organisation for Economic Co-operation and Development
OECM	Other Effective Area based Conservation Measures
PA	Protected Area
PDSI	Palmer Drought Severity Index
PEC	Project Evaluation Committee
PES	Payment for Ecosystem Services
PFM	Public Financial Management
pH	Potential of Hydrogen
PIC	Project Implementation Committee

PKSF	Palli Karma-Sahayak Foundation
PMO	Prime Minister's Office
PPP	Public-Private Partnership
PPPA	Public Private Partnership Authority
ppt	Parts Per Trillion
PPTAF	Public-Private Partnership Technical Assistance Financing
PROVIA	The Programme of Research on Climate Change Vulnerability, Impacts and Adaptation
PSE	Private Sector Engagement
PSF	Private Sector Facility
PWD	Public Works Department
R & D	Research and Development
RAS	Re-circulatory Aquaculture System
RCM	Regional Climate Model
RDA	Rural Development Academy
REDD+	Reducing Emissions from Deforestation and Forest Degradation
RHD	Roads and Highways Department
RRI	River Research Institute
RS	Remote Sensing
SALT	Sloping Agricultural Land Technology
SAP	Sector Action Plan
SARS	Severe Acute Respiratory Syndrome
SDG	Sustainable Development Goal
SDII	Simple Daily Intensity Index
SEZ	Special Economic Zone
SLR	Sea Level Rise
SMART	Specific, measurable, achievable, relevant and time bound
SME	Small and Medium Enterprise
SMS	Short Message Service
SNAP	Stocktaking for National Adaptation Planning
SoB	Survey of Bangladesh
SOD	Standing Order on Disasters
SPARRSO	Bangladesh Space Research and Remote Sensing Organization
SPEC	Special Project Evaluation Committee
sq. km.	Square Kilometer
SRDI	Soil Resource Development Institute
SSD	Security Service Division
SSP	Shared Socioeconomic Pathway
SST	Sea Surface Temperature
SUDS	Sustainable Drainage System
SUHII	Surface Urban Heat Island Intensity
SWM	Southwestern coastal area and Sundarbans
SEE	Southeast and eastern coastal area
TAC	Technical Advisory Committee

TRM	Tidal River Management
UAV	Unmanned Aerial Vehicle
UDD	Urban Development Directorate
UN	United Nations
UNCC	United Nations Climate Change
UNCED	United Nations Conference on Environment and Development
UNDP	United Nations Development Programme
UNFCCC	United Nations Framework Convention on Climate Change
USD	United States Dollar
USG	Urea Super Granule
URB	Urban Areas
VAT	Value-Added Tax
VCF	Village Common Forests
VGF	Viability Gap Financing
WARPO	Water Resources Planning Organization
WASA	Water and Sewerage Authority
WASH	Water, Sanitation and Hygiene
WGI	Working Group I
WGII	Working Group II
WHO	World Health Organization
WMO	World Meteorological Organization
WRM	Water Resources Management
YLAP	Youth-led Adaptation Plan

Glossary

Term	Definition
Adaptation limits	The point at which an actor's objectives (or system needs) cannot be secured from intolerable risks through adaptive actions.
Adaptation pathway	An adaptation pathway is a planning approach addressing the uncertainty and challenges of climate change decision-making. It enables consideration of multiple possible futures and allows analysis/exploration of the robustness and flexibility of various options across those multiple futures.
Adaptation strategy	An adaptation strategy is a programme, project or approach that has been developed to respond to anticipated climate change impacts in a specific area of potential concern.
Adaptation tipping point	An adaptation tipping point is reached when the magnitude of external change is such that a policy no longer can meet its objectives, and new actions are needed to achieve the objectives.
Adaptive capacity	The ability of systems, institutions, humans and other organisms to adjust to potential climate change induced hazards and damages, take advantage of opportunities or respond to consequences.
Adaptive management	Refers to the process of iteratively planning, implementing, and modifying strategies for managing resources in the face of climate uncertainty and climate change. Adaptive management involves adjusting approaches in response to observations of the negative effects of climate change in the system brought on by resulting feedback effects and other variables.
Autonomous adaptation	Adaptation in response to experienced climate change and its effects, without planning explicitly or consciously focused on addressing climate change. It is also referred to as spontaneous adaptation.

Term	Definition
Climate anomaly	The change or the difference between the average climate over a period of several decades or more, and the climate during a particular month or season.
Climate change	Climate change refers to a change in the state of the climate that can be identified (e.g., by using statistical tests) by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer. Climate change may be due to natural internal processes or external forces such as modulations of the solar cycles, volcanic eruptions and persistent anthropogenic changes in atmospheric composition or land use.
Climate change adaptation	An adjustment process to the actual or expected climate and its effects. In human systems, adaptation seeks to moderate harm or exploit beneficial opportunities. In natural systems, human intervention may facilitate adjustment to the expected climate and its effects.
Climate change commitment	The further change in temperature after the atmospheric composition is constant is referred to as the constant composition temperature commitment or climate change commitment. The constant emission commitment is the committed climate change that would result from keeping anthropogenic emissions constant and the zero-emission commitment is the climate change commitment when emissions are set to zero.
Climate change impacts	The effects on natural and human systems of extreme weather and climate events and of climate change. Impacts generally refer to effects on lives, livelihoods, health status, ecosystems, economic, social and cultural assets, services (including environmental) and infrastructure due to the interaction of climate changes or hazardous climate events occurring within a specific period and the vulnerability of an exposed society or system.
Climate change mitigation	Climate change mitigation means avoiding and reducing emissions of heat-trapping greenhouse gases into the atmosphere to prevent the planet from warming to more extreme temperatures.
Climate change scenario	A plausible and often simplified representation of the future climate, based on an internally consistent set of climatological relationships that has been constructed for explicit use in investigating the potential consequences of anthropogenic climate change, often serving as an input to impact models.

Term	Definition
Climate change trend	Changes in climate that show a similar direction over time. An observed/historic trend could be, for example, the later arrival of rainfall over the last five years. Projected trends give a possible future direction, e.g., decreasing rainfall in summer. If combined with a data range, such trends can help to devise adaptation measures.
Climate Hazard	The potential occurrence of a natural or human-induced climate event or trend, or climate change impact, which may cause loss of life, injury or other health impacts as well as losses and damages to property, infrastructure, livelihoods, service provision and environmental resources.
Climate model (spectrum or hierarchy)	A numerical representation of the climate system based on its physical, chemical and biological properties, interactions, feedback processes, and accounting for some of its known properties. Climate models are applied as a research tool to study and simulate the climate, and for operational purposes, including monthly, seasonal and interannual climate predictions.
Climate resilience	The capacity of a socioecological system to cope with a hazardous climate event, responding or reorganizing in ways that maintain its essential function, identity and structure while also maintaining the capacity for adaptation, learning and transformation.
Climate-resilient development	Climate-resilient development means ensuring that people, communities, businesses and other organizations are able to cope with current climate variability as well as adapt to future climate change, preserving development gains and minimizing damages. Climate-resilient development is about adding the consideration of climate impacts and opportunities to development decision-making to improve development outcomes, rather than implementing development activities in a completely new way.
Climate risk	The potential for climate change impacts where something of value is at stake and where the outcome is uncertain, recognizing the diversity of values. Risk is often represented as the probability of occurrence of hazardous climate events or trends multiplied by the impacts if these events or trends occur. Risk results from the interaction of vulnerability and hazard.

Term	Definition
Climate signal	Climate signals are defined as long-term trends and projections that carry the fingerprint of climate change. Examples of observable long-term trends linked to climate change include rising sea levels, an increase in the frequency of extreme precipitation events and warming sea surface temperatures.
Climate vulnerability	The degree to which a system is susceptible to, and unable to cope with, adverse effects of climate change, including climate variability and extremes. Vulnerability is a function of the character, magnitude and rate of climate change and the variation to which a system is exposed, its sensitivity and its adaptive capacity.
Cold spell	A cold spell is a distinctive type of extreme atmospheric event that manifests as anomalous low-temperatures over consecutive days. Even during periods of global warming, extreme cold temperatures continue to increase, with a stronger tendency for cold spell occurrences in certain regions of the world.
Community-based adaptation (CbA)	Ideally, CbA is a community-led and -driven process. It is a partnership between institutions and communities rather than something done for and imposed upon local peoples. The processes of assessment, planning, intervention and evaluation must be participatory, including all sections of local society, and incorporating peoples' diverse priorities, concerns, perspectives and cultures.
Contextual vulnerability (starting-point vulnerability)	A present inability to cope with external pressures or changes, such as changing climate conditions. Contextual vulnerability is a characteristic of social and ecological systems generated by multiple factors and processes.
Coping capacity	The ability of people, institutions, organizations and systems to address, manage and overcome adverse climate conditions in the short to medium term by using available skills, values, beliefs, resources and opportunities.
Coping mechanism	The use of available skills, resources and opportunities to address, manage and overcome adverse climate conditions, which aims to achieve the basic functioning of people, institutions, organizations and systems in the short to medium term.
Direct access entity (DAEs)	Direct access entities are subnational, national or regional organizations nominated by developing country national designated authorities (NDAs) or focal points. Organizations nominated to become direct access entities may be eligible

Term	Definition
	to receive GCF readiness support. This funding is designed to help organizations in developing countries prepare to become accredited entities as well as helping those already accredited to strengthen their organizational capacities.
Disaster risk reduction (DRR)	Disaster risk reduction is aimed at preventing new and reducing existing disaster risks and managing residual risks, all of which contributes to strengthening resilience and therefore to the achievement of sustainable development.
Dry spell	One form of drought is the interruption of the rainy season by a so-called dry spell. A dry spell can be defined as a sequence of dry days, including days with less than a threshold value of rainfall.
Ecosystem-based adaptation (EbA)	Ecosystem-based adaptation uses the range of opportunities for the sustainable management, conservation and restoration of ecosystems to provide services that enable people to adapt to the negative impacts of climate change.
Exposure	The presence of people, livelihoods, species or ecosystems, environmental services and resources, infrastructure, or economic, social or cultural assets in places that are exposed to the negative effects of climate change, with the potential to be adversely affected.
Future projection	A projection is a potential future climate event, often computed with the aid of a model. Climate projections are simulations of the Earth's climate in future decades (typically until 2100) based on assumed scenarios for the concentrations of greenhouse gases, aerosols and other atmospheric constituents that affect the planet's radiative balance.
Hard adaptation limit	No adaptive actions are possible to avoid intolerable risks.
Locally led adaptation (LLA)	Locally led adaptation (LLA) can unlock, support and leverage the enormous potential and creativity of communities to develop and implement solutions. Shifting power to local stakeholders, without expecting them to shoulder the burdens of adaptation, can catalyze adaptation that is effective, equitable and transparent.
Low-regret policy	Refers to a policy that would generate net social and/or economic benefits under the current climate and a range of future climate change scenarios.

Term	Definition
Maladaptive actions (maladaptation)	Actions that may lead to an increased risk of adverse climate-related outcomes, increased vulnerability to climate change or diminished welfare, now or in the future.
Multilateral implementing entity (MIE)	Organizations both national and international can access funds from the GCF once they are accredited or qualified for sufficient fiduciary capacity, showing they can be trusted with donors' funding. One of the ways to access the fund is the international access track for international entities, including United Nations organizations, multilateral development banks (MDB), international financial institutions and regional institutions, which are also called multilateral implementing entities. (MIE). The multilateral implementing entities (MIE) presently operating in Bangladesh are: Agence Française de Développement (AFD), Asian Development Bank (ADB), Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmBH, European Investment Bank (EIB), Food and Agriculture Organization of the United Nations (FAO), HSBC Holdings plc, International Bank for Reconstruction and Development (IBRD) and International Development Association (IDA) - World Bank (WB), International Finance Corporation (IFC), International Fund for Agricultural Development (IFAD), International Union for Conservation of Nature (IUCN), Japan International Cooperation Agency (JICA), Kreditanstalt für Wiederaufbau (KfW), United Nations Development Programme (UNDP), United Nations Environment Programme (UNEP), World Food Programme (WFP), World Meteorological Organization (WMO).
National designated authority (NDA)	National designated authorities (NDAs) are government institutions that serve as the interface between a country and the GCF. They provide broad strategic oversight of the GCF's activities in the country and communicate the country's priorities for financing low-emission and climate-resilient development. In November 2014, the Economics Relations Division (ERD) under the MoF was nominated by the Government of Bangladesh to be the national designated authority (NDA) to the Green Climate Fund (GCF).
National implementing entity (NIE)	National implementing entities (NIE) are accredited entities that are expected to mobilize and manage GCF finance in a country. Their primary roles are to develop and submit funding proposals for projects and programmes; oversee project and programme management and implementation; deploy a range of financial instruments (grants, concessional loans, equity and guarantees) and mobilize private sector capital. Two institutions in Bangladesh are accredited as NIEs. The NIEs are: Infrastructure Development Company

Term	Definition
	Limited (IDCOL) and Palli Karma-Sahayak Foundation (PKSF).
Nature-based solutions (NbS)	Nature-based solutions are actions to protect, sustainably manage and restore natural and modified ecosystems that address societal challenges effectively and adaptively, simultaneously benefiting people and nature.
Preeclampsia	Preeclampsia is a serious blood pressure condition that develops during pregnancy. Women with preeclampsia often have high blood pressure (hypertension) and high levels of protein in their urine (proteinuria). Preeclampsia typically develops after the twentieth week of pregnancy.
Representative concentration pathways (RCPs)	These describe different levels of greenhouse gases and other radiative forcings that might occur in the future. Four pathways span a broad range of forcing in 2100 (2.6, 4.5, 6.0, and 8.5 watts per meter squared) but these do not include any socioeconomic narratives to go alongside them. The RCPs set pathways for greenhouse gas concentrations and, effectively, the amount of warming that could occur by the end of the century.
Sensitivity	The degree to which climate variability or change affects a system or species adversely or beneficially. The effect may be direct (e.g., a change in crop yield in response to a change in the mean, range or variability of temperature) or indirect (e.g., damages caused by an increase in the frequency of coastal flooding due to sea-level rise).
Shared Socioeconomic Pathways (SSPs)	Over the past few years, an international team of climate scientists, economists and energy systems modellers have built a range of new pathways that examine how global society, demographics and economics might change over the next century. They are collectively known as the SSPs. The SSPs set the stage on which reductions in emissions will or will not be achieved. They are based on five narratives describing broad socioeconomic trends that could shape future society. These are intended to span the range of plausible futures. They include: a world of sustainability-focused growth and equality (SSP1); a 'middle of the road' world where trends broadly follow their historical patterns (SSP2); a fragmented world of 'resurgent nationalism' (SSP3); a world of ever-increasing inequality (SSP4); and a world of rapid and unconstrained growth in economic output and energy use (SSP5).
Soft adaptation limit	Options may exist but are currently not available to avoid intolerable risks through adaptive action. But such limits can

Term	Definition
	be overcome by addressing a range of constraints such as financial, governance, institutional and policy constraints.
Surface urban heat island intensity (SUHII)	The difference in temperature between the urban and surrounding rural areas is possibly the most visible effect associated with the urbanization process and is mainly due to increased human activities. This observed temperature gradient is typically known as the urban heat island (UHI). Two major types of UHIs are the atmospheric urban heat island (AUHI), and the surface urban heat island (SUHI).
System of interest	The 'system of interest' is the unit or space chosen to assess concerning climate change impacts. Depending on the objective of the analysis, the system of interest may be determined at different levels, e.g., a single crop system, an ecosystem or a region.
Transformation	A change in the fundamental attributes of a system, often based on altered paradigms, goals or values due to climate change impacts. Transformations can occur in technological or biological systems, financial structures, and regulatory, legislative or administrative regimes.
Transformative adaptation	Transformative adaptation is a strategy that aims to reduce the root causes of vulnerability to climate change in the long-term by shifting systems away from unsustainable or undesirable trajectories. Systems become more adaptive to climate change by transforming their primary characteristics through transformative adaptation.
Transformative capacity-building	Transformative capacity is the capacity of an individual, an organization or a system to be able to both transform themselves and their society in a deliberate, conscious way. This involves the ability to transform the fundamental and core attributes of a system to tackle the adverse effects of climate change.
UNFCCC	The UNFCCC is the main global platform for climate change negotiations. It was adopted in 1992 and entered into force in March 1994 and now has 195 Parties that meet annually as the COP. The UNFCCC sets out the basic legal framework and principles for international climate change cooperation with the aim of stabilizing atmospheric concentrations of greenhouse gases (GHGs) to avoid dangerous anthropogenic interference with the climate system.

Supported by

Md. Mizanul Hoque Chowdhury, Additional Secretary, MoEFCC and
National Project Director, NAP Formulation Project

Consortium Lead

CEGIS
Center for Environmental and Geographic Information Services

In Association with

Centre for Climate Change and Environmental Research (C3ER), Brac University

Bangladesh Centre for Advanced Studies

International Centre for Climate Change and Development