**Bangladesh Vision 2041**

**Background Study No.13:**

**Addressing climate change, green growth, environment, and water resources for sustaining shared prosperity**

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**Bangladesh Vision 2041**

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**Addressing climate change, green growth, environment, and water resources for sustaining shared prosperity**

# **1. Introduction**

## **1.1 Background**

The economic cost of climate change is most acutely felt in developing countries like Bangladesh, one of the world's densest nations and also one of the most vulnerable to climate change. Bangladesh has achieved recent gains in the area of economic growth (growing consistently by 6% since 1996) that could be halted due to climate change. However, a 2010 World Bank study in partnership with the Government of Bangladesh (GoB) finds that climate related disasters continue to result in large economic losses — reducing economic growth and slowing progress in reducing poverty. The report highlights that over the past decade, approximately 0.5 – 1% of GDP has been lost to damages in infrastructure, livelihoods, and from forgone production.

Rising sea-levels, floods and extreme storms, which are increasing in frequency in Bangladesh, often result in the destruction of essential infrastructure and housing. The cost of recovery and rebuilding is likely to intensify in the future with the increased frequency and ferocity of climatic events, further exacerbated by high population density and an underdeveloped infrastructure. With an increased threat of climatic events, the GoB will need to redirect resources away from development projects into mitigation and adaptive measures, for example, by building early warning systems and adding emergency responders to cope with extreme events.

Disruptions in daily life related to climate change can mean lost work and school days and harm trade, transportation, agriculture, fisheries, energy production, and tourism. Severe rainfall events can delay planting and harvesting, cause power outages, snarl traffic, delay air travel, and otherwise make it difficult for people to go about their daily lives. These sectors are particularly vulnerable to climate change and any disruptions will have a direct impact on the national GDP and trade balance.

Climate-related health risks also reduce productivity, such as when extreme heat curtails construction, or when flooding prevents employees from getting to work. Higher temperatures might cause propagation of new pests and disease vectors, while common diseases such as dengue, malaria, and water borne diseases (such as cholera) will take a significant toll on human health conditions.

In 2015, the Government of Bangladesh estimated that five major disasters since 1998 have caused damage equal to roughly 15 percent of GDP with an average of 2.7 percent per event (Planning Commission 2015). In an interview with The Guardian, Prime Minister Sheikh Hasina of Bangladesh, highlighted how a 1°C rise in temperature resulted in 10 percent productivity loss in farming, amounting to US$2.5 billion or 2 percent of the national GDP (Harvey 2012). If the damages to property and other associated losses are factored in, it equates to about 3 to 4 percent of GDP, thereby hampering economic growth.

In additional to economic damages, climate change has the potential to create significant social impact, with direct and immediate effects from damaged infrastructure and loss of livelihoods, to far reaching effects such as poverty, migration, and health impacts.

Climate induced damages and losses in Bangladesh generally tend to be concentrated in rural and coastal areas that also have higher concentrations of poor populations, affecting them disproportionately. A 2010 World Bank study explains, “they live in thatch or tin houses that are more susceptible to direct damages from cyclones, storm surges, and floods.”

For the thirty-year period between 1980 and 2010, approximately 191,836 people were killed and it is estimated that over 323 million people were affected by disaster the majority below the poverty line (Majumder 2013). Furthermore, the livelihoods of most rural and underprivileged households depend largely on agriculture, which is vulnerable to climate change and extreme weather events. The loss of their assets and livelihoods leaves the poor with a limited capacity to recover.

Climate change will also lead to "climate refugees"—people who are forced to leave their homes because of climate change-related factors. In Bangladesh, this is likely to translate to a mass migration into urban centers and major urban corridors, leading to a hasty urbanization process, and further complicating living conditions including sanitation, housing, and health (Planning Commission 2015). Rapid, unplanned urban migration can also exacerbate urban unemployment and drive up prices of commodities in specific areas.

## **1.2 Geographic Vulnerability**

Bangladesh is one of the most disaster-prone countries in the world, experiencing floods, tropical cyclones, storm surges, and droughts. It has most recently been rated 6th most vulnerable on the Climate Risk Index. Losses due to disaster continues to increase due to increased intensity, economic growth, increases in assets, population growth, and urbanization.

Bangladesh’s hydro-geological features significantly contribute to its high vulnerability to disasters and climate change. Approximately 88 percent of the country’s landmass consists of a floodplain, located in the world’s largest delta. Additionally, because of the position of the Ganges-Brahmaputra-Meghna (GBM) river basin, this region must drain over 92 percent of the monsoon rainfall runoff generated in the combined catchment, within a period of only 4 and a half months (June to mid-October) (Planning Commission 2012). During the peak of the monsoon, neap tides are high enough to penetrate coastal plains, even those that are protected by embankments, leaving entire areas inundated with saline water (Ahmed 2006). Finally, owing to an inverted funnel-shaped shoreline, and in the path of storms and surges from the Indian Ocean, the country is highly vulnerable to cyclonic disasters (Ali 1999).

Bangladesh is flat and low-lying, with most of the country less than 10 meters about sea level, apart from hilly regions in the north- and south-east corners (MoEF, 2012). The coastal belt is even more low-lying, with most of the coast only 2 meters, and some areas at one 1 meter above sea level. The low-lying topography of the coastal zone and its dynamic morphology contribute to its vulnerability to sea level rise. Finally, following the monsoon season, a lack of rainfall and evaporation also leads to aridity (Ahmed 2006).

# **2. The past and present**

## **2.1Climate Change**

### **2.1.1 Vulnerability to Climate Change**

As one of the world’s most vulnerable nations, Bangladesh is already experiencing the impacts of a changing climate with the countries’ most disadvantaged population bearing the burden of adapting to initial shifts in the weather. Many of the impacts of climate change in Bangladesh will look similar to the seasonal challenges it has dealt with for years: flooding, cyclones, erosion, and saltwater contaminating land. However, change in the climate will make these challenges more frequent, more intense and less predictable than they have been in the past. For this reason, it is crucial that national leaders become aware of its effects and work to maximize the country’s resilience.

Scientific projections of climate change indicate that the Earth’s average temperature may increase within a 3 to 6℃ range by 2100. In addition to raising global average temperatures, surface warming also contributes to a rise in sea surface temperatures. This leads to the oceanic expansion of water volume, as well as the melting of permafrost in Arctic and Antarctic regions, contributing to a net rise in sea level around the world. The Intergovernmental Panel on Climate Change’s (IPCC) Fifth Assessment Report confirms that sea level rise is actually occurring much faster than was previously projected, and these changes challenge economic progress and human resilience, especially in coastal areas.

Higher temperatures and vaporization in ocean waters will increase total rainfall across the globe. Rainfall patterns will also be destabilized due to an imbalance in seasonal temperatures, adversely affecting systems of food production and straining the capacity of smallholder farmers. Increases in surface temperature and a shrinking drinking water supply will also adversely impact the health of humans and livestock.

Bangladesh has been repeatedly listed as the country that is most vulnerable to climate change, due to is location in the tropics, dominance of floodplains, low elevation, high population density, and low economic and technological capacity. The IPCC’s Fifth Assessment Report projected the following climate change impacts for Bangladesh:

1. Temperature rise will be slightly lower than the global average and sea level rise will be close to the global average, with population at risk of sea level rise predicted to grow to 27 million by 2050.
2. Though frequency of tropical cyclones may remain unchanged, they will likely become more intense, and will be combined with higher storm surges and sea level extremes.
3. Precipitation on average will increase, monsoon season could become longer, and rivers will likely experience increased flow from added rain and melting glaciers in the Himalayas.
4. More flooding is expected, with protective coastal mangroves facing greater risk from sea level rise and increased salinity of storms.

Almost every part of Bangladesh is already suffering changes in micro-climates, with local communities dealing with the effects of erratic rainfall and temperature fluctuations. These are leading to damages to agricultural productivity as well as constraints on the availability of fresh water.

Bangladesh has already been experiencing increasing temperature trends, with average temperatures increasing by 0.64oC during the period of 1948-2011. In addition, winter, pre-monsoon, monsoon, and post-monsoon precipitation has shown to have increased significantly at a rate of about 4.0mm per year, a total of 8.6 percent during this period. There is also evidence that sea surface temperature is increasing at a rate of 0.094°C per decade, which may enhance tropical cyclogenesis in the Bay of Bengal during the months of October and November (Quadir and Iqbal 2008). Models of climate change suggest higher than average monsoon rainfall in the future, with modelling data for three timelines outlined in Table 1 (Agrawala et al. 2003). While winter months will become warmer and drier, monsoon months will become warmer and wetter.

**Table 1:Temperature and precipitation scenarios (Source: Ahmed et al. 2015)**

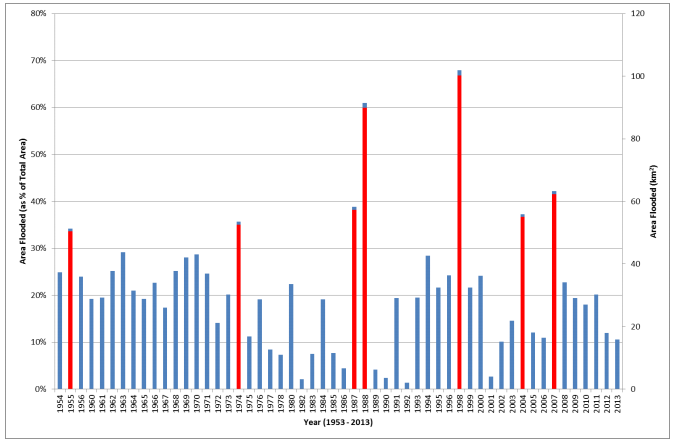
|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Timeline** | **Mean Temperature Change (oC)** | | | **Mean Precipitation Change (%)** | | | **Sea Level Rise (cm)** |
| **Annual** | **DJF** | **JJA** | **Annual** | **DJF** | **JJA** |
| 2030 | 1.0 | 1.1 | 0.8 | 5 | -2 | 6 | 14 |
| 2050 | 1.4 | 1.6 | 1.1 | 6 | -5 | 8 | 32 |
| 2100 | 2.4 | 2.7 | 1.9 | 10 | -10 | 12 | 88 |

**Note**: DJF indicates dry season, comprised of December, January and February, while JJA indicates peak monsoon, comprised of June, July and August months (Agrawala et al. 2003; MOEF-UNDP 2005).

Increases in pre-monsoon precipitation may indicate early onset of monsoon activity. This has already made the country more vulnerable to flooding during the month of May. Furthermore, increases in monsoon precipitation during the past 50 years have also increased the country’s vulnerability to severe floods (Jain et al. 2012). The unprecedented floods of 1974, 1987, 1988, and 1998, and severe floods of 2004 and 2007 are examples of increased severity of flooding due to greater precipitation over Bangladesh and in the upper catchments.

Bangladesh is already considered a global hotspot for natural disasters (World Bank 2005; World Risk Report 2016), and has been ranked fifth globally in terms of disaster risk. This includes risks from floods, cyclones, sea level rise, salinity intrusion, drought, and landslides.

Floods are nearly annual extreme events in Bangladesh and can be devastating to the socio-economic condition of the country. On average, about a quarter of Bangladesh is inundated with floods annually, and once every 4 to 5 years, severe floods inundate about 60 percent of the country. While most of the country is susceptible to river and rainwater flooding, low-lying coastal areas are also vulnerable to tidal flooding. Figure 1 illustrates extreme flooding events between 1954 and 2013. Additionally, sharp rainfall episodes greatly aggravate urban drainage congestion that, combined with the filling of urban wetlands and ponds, will significantly accentuate water logging and urban flooding.



**Figure 1: Inundation area (in percentage) by major historical floods since 1950s (Source: Flood Forecasting and Warning Centre, BWDB)**

Riverbank erosion, a secondary consequence of floods, is also endemic to Bangladesh, with about 1200km of riverbanks currently experiencing erosion. Greater rainfall can cause increased runoff through floodplains, increasing the potential for riverbank erosion. High wave activity will also erode land along the sea coast.

Flood modelling has demonstrated that the total flood-affected area will increase between 2020 and 2050 (Hassan et al. 2010). The inundation area due to climate change will increase by 6 percent in the decade following 2030, and 14 percent in the decade following 2050, compared to a base year of 2005 (Hassan et al. 2010).

In addition to floods, coastal areas of Bangladesh are frequently hit by cyclones formed in the Bay of Bengal, with severe cyclones hitting the country every three years. The primary damage from cyclones is from storm surge flooding. If cyclones make landfall during high tide, surges are higher, penetrate deeper inland and are deadlier. Unnikrishnan et al. (2006) argue that there will be a significant increase in the frequency of high storm surges in the Bay of Bengal due to climate change, though it is possible that overall frequency of storm surges may not increase. Emanuel (2005) also projects increased intensity of tropical storms by 2100 for the North Indian Ocean. Combined with expected rises in sea-level, these higher intensity cyclones are predicted to cause increased tidal surge heights.

Dasgupta et al. (2014) modelled cyclone storm surge impacts under a changing climate scenario, in order to determine potential future inundation zones by 2050. Table 2 contains their results. Additionally, most recently, in June of 2017, landslides led to over 100 deaths in Rangamati and Bandarban, as well as the destruction of homes and property. As storms and monsoons become more intense and more frequent, these devastating landslides are also likely to increase in frequency.

**Table 2: Vulnerable Area Estimates (sq. km)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Inundation Depth** | **2050 Without Climate Change (sq. km)** | **2050 with Climate Change (sq. km)** | **% Change** |
| More than 1m | 20,876 | 23,764 | + 14% |
| More than 3m | 10,163 | 17,193 | + 69% |

CCC (2016), in an effort to assess the historical change of sea level rise along Bangladesh’s coast, assessed data from 15 monitoring stations and analyzed changes between 1980 and 2012. They found that sea level rise has increased in the coastal zone by 6 to 21mm per year. According to the Ministry of Environment and Forests, the country can expect to experience sea level rise of 14cm, 32cm, and 88cm by the years 2030, 2050, and 2100, respectively. Both historical increases in sea level and projected increases due to climate change are expected to have significant impacts, including increased salinization of freshwater sources.

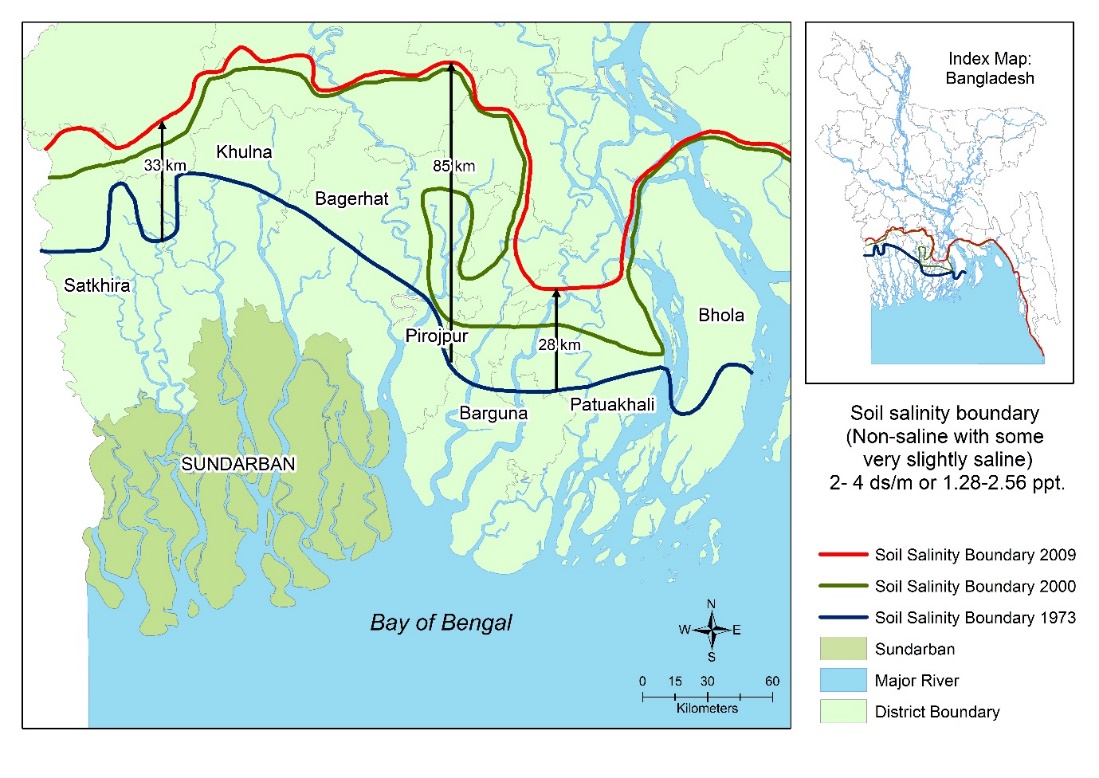


**Figure 2. Water level trends for the coastal sub zone of Bangladesh based on the data of the last 30 years (from CCC 2016)**

As sea levels rise, issues with salinity intrusion become an even greater problem in the coastal zone of Bangladesh. Multiple studies show evidence that the saline areas in coastal districts and soil salinity are already increasing and moving further inland, illustrated in Table 3 and Figure 3 (Miah et al. 2010; Dasgupta et al. 2015).

**Table 3: Increase of soil salinity affected area over the years (1973-2009)[[1]](#footnote-1)**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Year** | **Salinity class and area (000’ha)** | | | | |
| Non-saline with some very slight saline (S1)  ***1.28-2.56 ppt*** | Very slightly saline with some slight saline (S2)  ***2.62-5.12 ppt*** | Moderate to some strongly saline (S3)  ***5.18-10.24 ppt*** | Very Strongly saline with some strongly saline (S4)  ***>10.24 ppt*** | Total Salt affected area |
| 1973 | 246.67 | 397.83 | 71.75 | 34.7 | 750.95 |
| 2000 | 244.65 | 264.74 | 320.78 | 85.17 | 915.34 |
| 2009 | 269.32 | 241.4 | 339.9 | 100.16 | 950.78 |

Figure 3. Movement of the Salinity Front between 1973 and 2009; Salinity boundary was set at 2.0-4.0 dS/m (or 1.28-2.56 ppt)

Increases in surface and river water salinity have also been found in coastal rivers. Saline river water accumulates more than 150km inland in the west part of the country and 50km inland in the east part of the country during the dry season. Under a scenario of 30cm sea level rise, the surface water salinity pattern will change significantly. The dry season saline line is projected to move 30 to 70km north, affecting most of the Khulna, Barisal, Patuakhali, and Nohakali Districts.

Groundwater salinity from connate salts and tidal flooding is also a key challenge for the coastal region in terms of drinking water and irrigation. Nearly 6 million people are already exposed to high salinity, but because of climate change the number is expected to increase to 13.6 million by 2050 and 14.8 million by 2080. A study conducted in Khulna, Bagerhat, and Satkhira projects that a sea level rise of 32cm could reduce the suitable area for Aman rice cultivation to 60 percent, and to only 12 percent with a sea level rise of 88cm.

Along with the challenge of too much water, long-term data indicates that Bangladesh experiences a major drought once every 5 years on average, having suffered from 20 severe drought conditions over the past 50 years. By 2030, a temperature increase of 0.5°C and annual rainfall reduction of 5 percent could reduce runoff into the Ganges, Brahmaputra and Meghna Rivers by 14 percent, 11 percent, and 8 percent, respectively. With a 12 percent reduction in runoff, the population living in severe drought prone areas would increase from 4 percent to 9 percent under moderate climate change scenarios.

Finally, climate change poses a significant challenge to the health of the population of Bangladesh. Globally, the impact of climate change on health and wellbeing will be profound. According to the Lancet Commission, “climate change is the biggest global health threat of the 21st century” (Costello et al. 2009). The World Health Organization (WHO) estimates that the increasing trend in warming and precipitation due to climate change in the past 30 years has already claimed over 150,000 lives annually (McMichael et al 2003). Populations in low-income countries will bear a disproportionate burden of adverse health consequences

Climate change may cause health impacts through multiple pathways (Figure 4), and directly or indirectly (Figure 5). The direct effects of climate change include increased heat stress, floods, drought, and increased frequency of intense storms while population health may be indirectly threatened through changes in air pollution, spread of disease vectors, food and water insecurity, under-nutrition, displacement and mental ill-health. Such impacts will affect most populations, especially the poor and marginalized section of the society, disproportionately. Climate change also amplifies existing inequalities, reinforcing gender inequities between women and men in their vulnerability to and capacity to cope with the impacts of climate change (Mitchell et al 2007).

In Bangladesh weather and extreme weather were found to be associated with mortality (Alam et al. 2012). Public health consequences associated with cyclones include storm related mortality, injury, infectious diseases, psycho-social effects, displacement, damage to health care infrastructure, disruption of public health service, transformation of ecosystems, social dislocation, loss of jobs, livelihoods and economic crisis (Shultz et al. 2005). For temperature extremes, strong heat effects have been linked to different causes of death for different sub-populations and age groups (Burkart et al. 2014). It has also been found that those living in urban areas are more vulnerable than those living in rural areas (Burkart et al. 2011). Vector borne diseases such as malaria, dengue fever, Kala-azar are expected to become more widespread and possibly more severe among non-immune populations as temperatures rise (Hunter 2003; Hossain et al. 2011). Cholera risk may also be amplified by local flooding (Rodó et al. 2002). Finally, Recent studies suggested that drinking water salinity has been associated with pre-eclampsia and gestational hypertension during pregnancy, causing increased cardio-vascular diseases and strokes risk (Khan et al. 2011).



Figure 4: Climate change and health: pathway from driving forces through exposures to potential health impacts. Arrows under research needs represent input required by the health sector [Adapted from Macmicel et al. 2003]



Figure 5: The direct and indirect effects of climate change on health and wellbeing (adapted from Watts, N., et al 2015)

### **2.1.2 National Policies on Climate Change**

Bangladesh has been active in international efforts to address climate change and its impacts since the United Nations Framework Convention on Climate Change (UNFCCC) was signed in 1992 and ratified in 1994. The country also ratified the Kyoto Protocol in October 2001. The government of Bangladesh submitted its Initial National Communication (INC) to the UNFCCC in October of 2002 and its second national communication in October of 2012. It has additionally adopted the Hyogo Framework for Action on disaster resilience and committee to its five areas of priority action and guiding principles.

The government has been active in establishing various policy and institutional initiatives to integrate climate change into its national planning. In particular, the Ministry of Environment and Forests has been set up as the UNFCCC focal point, and has taken the lead in discussing, planning and developing policy programs on climate change. This includes the development of the National Adaptation Programme of Action (NAPA), the 2009 Bangladesh Climate Change Strategy Action Plan (BCCSAP), the establishment of the Climate Change Unit (CCU) to strengthen government coordination and management on adaptation and mitigation projects, as well as the creation of the Climate Change Trust Fund and Resilience Fund.

**Table 4: National legislation and policy frameworks related to climate change**

|  |  |
| --- | --- |
| **Policy documents** | **Description** |
| 7th Five Year Plan, 2016 | Climate Change Management and Resilience (comprised of adaptation and mitigation) |
| National Women Development Policy, 2011 | Takes measures to increase the overall safety and security of women and children, with special attention to disabled women, particularly in helping them deal with extreme climate events and disasters. |
| Disaster Management Act, 2012 | Aims to make disaster management activities coordinated, object-oriented, and strong in formulating rules to build infrastructure for resilience. |
| Coastal Zone Policy, 2005 | Acknowledges the importance of ecosystems and biodiversity conservation on the coasts and supports coastal people in developing sustainable livelihoods. |
| National Plan for Disaster Management, 2008-2015 | Calls for comprehensively addressing DRR and CAA in all development plans, programs, and policies through assessing climate change risk, emphasizing community-based programs, building public awareness, improving early warning systems, and strengthening communication facilities and emergency response. |
| Bangladesh Climate Change Strategy and Action Plan (BCCSAP), 2009 | Recognizes the need for adaptation action and highlights the GoB’s willingness to follow a low-carbon development pathway. Acts as the reference for mainstreaming climate change across sectors, via six thematic areas, 44 programs, and 145 actions. |
| National Adaptation Program of Action, 2005 | Identifies 15 priority activities for adaptation action, including general awareness raising, capacity building, and project implementation in vulnerable regions, with a focus on agriculture and water resources. |
| Standing Order on Disasters, 2010 | Works to make relevant persons understand and perform their duties and responsibilities regarding disaster management at all levels. |
| Climate Change and Gender Action Plan, 2013 | Focuses on the transformative potential of gender-focused climate change interventions, potentially enhancing the effectiveness and efficiency of socioeconomic responses. |

Several institutions have been established by the GoB to address climate change, particularly following the BCCSAP (Ahmed et al. 2015). The paragraphs below give a brief account of these institutions. The Ministry of Planning has also worked to integrate climate change into the national development processes in a coordinated manner. The General Economics Division (GED) formed an inter-ministerial body to review and recommend changes to the development project proposal process, in order to fill gaps that could better integrate climate change issues along with gender, environmental, and poverty issues.

The GoB is committed to promoting a whole of government approach to address climate risk. Climate change has been highlighted in its own chapter since the Sixth Five Year Plan. Furthermore, GED has developed the handbook “Mapping of Ministries by Targets in the Implementation of SDGs in aligning with the Seventh Five Year Plan (7FYP),” the document “Data Gap Analysis for Sustainable Development Goals (SDGs): Bangladesh Perspective,” and the “SDGs Needs Assessment and Financing Strategy: Bangladesh Perspective. These and other documents work to ensure that targets will be achieved and that goals will be implemented.

**Table 5: Institutions related to deal with the adverse impact of climate change**

|  |  |
| --- | --- |
| **Institution** | **Description** |
| Climate Change Trust | Assists the Ministry of Environment and Forests with implementation of the BCCSAP and provides secretariat support services for the BCCTF. |
| Bangladesh Climate Change Trust Fund (BCCTF) | A fund established by the GoB and managed by the Ministry of Environment and Forests for projects that fall under the main pillars of the BCCSAP. A Trustee Board works to examine project requests and make decisions on eligible projects. |
| Bangladesh Climate Change Resilience Fund (BCCRF) | A multi-donor grant fund set up jointly by the GoB and bilateral development partners that allows for donor-funded support for the implementation of the BCCSAP. The World Bank manages the fund and assesses projects, though 10 percent is controlled by Palli Karma Sansthan Foundation (PKSF) as an NGO-window for small-scale community-based projects. |
| Designated Authority | An individual nominated by the MoEF to work with the National Implementing Authority (NIE) to seek funds through the Adaptation Fund (AF). However, NIE accreditation has not yet been successful. |
| National Designated Authority | The Ministry of Finance has been identified as the National Designated Authority (NDA) for Bangladesh to deal with matters related to the Green Climate Fund (GCF), such as identifying fund-worthy projects and implementing them. |

The GoB has also financed over 300 projects adaptation and mitigation projects, using about 60 percent of the BCCTF (MOEF 2014). Through World Bank Funding and the BCCTRF, GoB has also identified and implemented 7 projects totaling approximately US$190 million. Although the trust fund is being utilized in sync with the development priorities of the BCCSAP, there has been a strong and uneven preference for specific themes and practices. Generally, the projects are adaptation- rather than mitigation-focused, a few projects have actually been implemented (Ahmed et al. 2015). The funding has gone primarily to water infrastructure (20.21 percent); followed by food security, social protections, and health (8.05 percent); comprehensive disaster management (5.83 percent); research and knowledge management (3 percent); and capacity building and institutional strengthening (3 percent). Though the BCCSAP is meant to encourage the integration of climate actions across ministries, in reality it mainly funds the activities in a few ministries and departments. For example, the Bangladesh Water Development Board (BWDB) received the largest amount of funding from the BCCTF at 45 percent (Rai et al., 2014).

As of September 2013, donor agencies had contributed US$188.2 million to the BCCRF, which was disbursed to 13 projects. BCCRF supports a comprehensive program of work with a balanced combination of adaptation approaches, including infrastructure, research, and knowledge management. The Resilience Fund has scaled up construction of multipurpose shelters and early warning systems, which have played a vital role in housing people during recent cyclones. Early warning systems have also been funded through public-private partnership models, bringing together the government and mobile providers to provide early warning information through text messages (ICAI 2011).

GoB has also worked to implement that top-most priority project outlined in Bangladesh’s NAPA, to promote adaptation in the coastal zone with a strong community orientation. This project received the UNFCCC Best Practices Award on Adaptation (Ahmed et al. 2015). In a Climate Public Expenditure and Institutional Review, it was found that GoB typically spends about 6-7 percent of its combined development and non-development budget on climate sensitive activities. This amount was estimated at about US$1 billion per year (GED 2012). GoB has also considered a coastal green belt project, and has supported strip plantation along embankments and roads as part of its participatory afforestation program in the past (MOEF 2012). A new major afforestation programme all along the coastal areas of the country can also be considered.

Apart from the GoB, Bangladeshi communities must consider a variety of responses to resist climate hazards and disaster, and the majority of national efforts are comprised of autonomous efforts. Development partners also often come forward to implement resilience-building, disaster relief, and rehabilitation projects. On flood-management specifically, one-fifth of all support provided to stakeholders is contributed by development partners, with direct involvement from humanitarian NGOs. For example, the Cyclone Preparedness Program (CPP) would not have been implemented had it not been for the Bangladesh Red Crescent Society and its thousands of volunteers.

Non-government stakeholders have taken the lead in many initiatives, highlighted in brief below:

* Creating a knowledge base of vulnerability and adaptation assessments, especially in using disaster risk reduction (DRR) techniques to build community-based adaptation (CBA).
* GoB makes use of the recommendations in the Asia Least Cost Greenhouse Gas Abatement Strategy (ALGAS)
* Multiple donors - including UNDP, UKAid, AusAid, DFID, EU, Norwegian Embassy, and SIDA – have given support on the second phase of the Department of Disaster Management’s Comprehensive Disaster Management Program (CDMP).
* The EU’s DIPECHO program brought six INGOs together to work on DRR and humanitarian assistance under the NARRI Consortium.
* UNDP has developed a unique set of resources to assist high-risk countries like Bangladesh in gender-sensitive DRR and recovery planning, including awareness and advocacy.
* The Bangladesh Red Crescent Society, Oxfam GB, CARE Bangladesh, ActionAid, IUCN, and others have long worked on disasters in Bangladesh, including community disaster preparedness and community-based development initiatives.
* UN Women has taken climate change challenges as an opportunity to reduce women’s particular vulnerability, and advocate for more gender-sensitive climate change policy.

Despite the many important initiatives to promote climate action that have already been undertaken in Bangladesh, there are still a plethora of challenges that inhibit the effective implementation of climate change-related policies and activities. Some of the key challenges are highlighted below. The problems especially lie within the GoB and are the reason that non-government agencies have been so crucial to the country’s climate action so far. While these problems are not unique to the issue of climate change, it is important to understand how they impact the production and implementation of climate-related policies if Bangladesh wants to become self-reliant and truly resilient. They include issues with capacity, coordination, institutional and policy arrangements, a lack of an inclusive process, and corruption.

First, agencies in Bangladesh are fraught with capacity constraints, both in terms of technical knowledge and human resources. This is particularly true for lower tier institutions. Officials have a general lack of understanding about climate change and its effects. Both the MoEF and the DoE lack technical expertise, trained staff, baseline information, and strong information management systems (ADB 2004). Furthermore, abrupt changes in ministry personnel leads to a lack of institutional memory, and incurs additional costs for designing and implementing climate change policies (Alam 2007).

Climate change impacts cut across several sectors and therefore overlap with the responsibilities of a wide range of ministries. This leads us to the second issue that strong coordination is necessary among ministries, something which is currently lacking. At the community level, there is an absence of strong mechanisms and administrative infrastructure to facilitate interaction between the central government and local level stakeholders. Additionally, there are no specific strategies or rules that work as a coordination mechanism across the different local level government departments.

Third, though the BCCSAP outlines activities and priorities for climate action, it remains more of a “knowledge strategy” in that it does not contain details for implementation. Furthermore, the incorporation of climate change policies in institutional development planning processes is often inadequate and poorly defined. The current institutional arrangement generally does not sufficiently provide an enabling and encouraging environment for actors and agencies to work in a concerted was to tackle climate change.

Fourth, the policy- and strategy-making process in Bangladesh is overwhelmingly top-down, driven by experts and bureaucrats and excluding the poor and vulnerable. The same is true for the preparation of specific projects, where public participation is very limited, leading to poor outcomes. A lack of gender sensitivity further exacerbates exclusivity, not only in an absence of women involved in planning, but also in a lack of attention to gender issues in policy documents (Huq et al. 2015).

Finally, fifth, there are shortcomings in the oversight and control of corruption within institutions, often allowing it to go unchecked. There is no ombudsman system in Bangladesh, and there are concerns regarding the capacity and independence of the Anti-Corruption Commission to handle cases of corruption and fraud in the delivery of climate finance from both international and national sources (TIB 2013). The national climate funds have both been criticized for allocating resources based on nepotism and partisan politics rather than on vulnerability, thus preventing funds from reaching those most in need of support.

## **2.2 State of Environment and Pollution**

In addition to the challenges posed by climate change, there are also numerous environmental challenges that the country is facing that must be addressed. These include the impacts of a growing population, land use and degradation, industrialization and urbanization, unsustainable agricultural practices, forest degradation, and biodiversity loss.

The population in Bangladesh currently stands at around 152.52 million people (BBS 2012), and is expected to grow to 200 million people by 2050 (UNDESA 2010). Moreover, icddr,b (2010) has shown that, relative to 1900, there may be a 10-fold growth in population by 2100. Such a growing population leads to high population density and pressure, a major driving force for environmental change. Urbanization and industrialization that accompanies this population growth also causes serious strain on environmental quality and natural resources, including air, water, and soil pollution. This threatens ecosystems and public health as well as economic growth, therefore addressing pollution is increasingly a priority in the country’s development goals.

Changes in land use patterns and land degradation are also problems for Bangladesh. Bangladesh’s total land surface is about 14.85 million hectares, of which about 9.23 million are used for agriculture (BBS 2010). The net cultivable area was calculated to be about 62 percent as of 2009-10, a decrease of about 3 percent from 1980-81 measurements. As the population grows, the per capita share of land shrinks, making the resource base for agriculture, forests, and wetlands more vulnerable, as demands for food water and shelter challenge the country’s resource capacity. Land degradation is occurring through loss of soil fertility, loss of organic matter in the soil, erosion sue to surface runoff, soil acidification, river bank erosion, soil salinization, and ground water table depletion. Furthermore, every year over 80,000 hectares of agricultural land is being converted to non-agricultural uses (Planning Commission 2009).

There are also large numbers of people migrating from rural to urban areas due to environmental stresses, consequently increasing pressure on land, housing, education, sanitation, and infrastructure. This trend demands planned growth in the nation’s cities, especially with regard to environmental considerations. Running parallel to this change, increases in industrialization to support growing populations and facilitate Bangladesh’s participation in global markets produce huge quantities of wastes, which are discharged or poorly disposed of. This also leads to soil degradation.

Brick kilns in particular are degrading land quality. Khan et al., (2007) reported that vast areas of agricultural lands have been degraded because of the construction and operation of brick kilns, which cover about 6,500 hectares of land nationally. As topsoil is removed for clay in the making of bricks, almost three-quarters of the soil fertility is reduced. Furthermore, the firing of the soil in the process of brick-making also emits pollutants that are harmful to the atmosphere and contribute to climate change.

Agricultural practices are another important environmental consideration for the country. Bangladesh has the highest percentage of land dedicated to agriculture (70 percent) and the highest degree of intensification of agriculture (Alauddin and Quiggin 2007). The intensification of land use for food production, including the use of chemical fertilizers and high yield crop varieties, have contributed to the degradation of much of the arable land in Bangladesh (Ali 2004). Groundwater use has also increased to meet the demand from the rapid expansion of irrigated agriculture.

In the Chittagong Hill Tracts, deforestation has led to soil erosion and landslides, causing sedimentation in the drainage channels. Additionally, cultivation (Jhum cultivation) has intensified to maximize harvest, which also degrades land productivity. Similar instances of land erosion are also occurring in the northern piedmont areas, and at the foothills of the Sylhet and Comilla districts. Increased loss of topsoil in these hilly regions causes the slopes to lose their integrity, increasing the frequency of landslides and lives lost because of them.

Finally, Bangladesh faces significant threats of forest degradation and biodiversity loss. Bangladesh supports a rich diversity of plants and animals, with approximately 5,000 species of flora and 1,600 species of fauna in its small geographic boundary. The diverse array of ecosystems and biodiversity in the country plays a significant role in its socio-economic development in the fishing, forestry, agricultural, and tourism industries. The most significant causes of biodiversity loss in Bangladesh are habitat destruction and the overexploitation of biological resources. Climate change exacerbates the effects of population pressure, poverty, land-use change, intensification of agriculture, pollution, and the introduction of invasive species.

Worsening salinization due to political as well as climatic factors along the coast is having a negative impact on the Sundarbans mangrove forest. The Farakka barrage, built by India in 1975 along the Ganges River has caused a decrease in water discharge. As a result, salinity levels in the south-eastern part of the Sundarbans has increased and the natural re-vegetation of the Sundari tree, the main species in the forest, is decreasing (Islam and Gnauck 2008; Islam and Gnauck 2009).

### **2.2.1 Environmental pollution**

Ultimately, the state of environment of the country is under pressure of unsustainable development, anthropogenic activities, and the changing climate. Severe air, water, soil and noise pollutions are threatening human health, ecosystems and economic growth. Air pollution is exacerbated by population growth, burning fossil fuels, industrialization, and motorization. The surface water in Bangladesh is polluted due to industrial discharge. The groundwater in different parts of the country has been contaminated by arsenic. Soil quality is highly degraded by uncontrolled use of chemical fertilizer and polythene. Finally, residents of major cities of Bangladesh are also exposed to high level of noise pollution.

Environmental pollution especially water, air, and soil pollution are increasingly getting priority in the country’s development strategies and plans. Environmental degradation is affecting the country’s economic growth. A lack of proper implementation and monitoring of environmental rules, however, hinder the achievement of environmental goals.

The Ministry of Environment and Forests has initiated a project called “Clean Air and Sustainable Environment” with the aim of improving the country’s air quality. Under this project, the DoE has established 11 Continuous Air Monitoring Stations (CAMS) in 8 major cities: Dhaka, Chittagong, Gazipur, Narayanganj, Sylhet, Barisal, Khulna, and Rajshahi. The findings thus far from these monitoring stations is highly alarming, especially during the dry months, with particulate matter and sulfur dioxide concentrations frequently exceeding standard limits.

Bangladesh has also developed an Air Quality Index (AQI), which compares ambient air quality relative to national air quality standards. The AQI is worst in February and March and improves from May to August. The sources of air pollution in Bangladesh can be divided into three major categories: point, non-point, and transboundary sources. Point sources include brick kilns, textile industries, power plants, and fertilizers. Non-point sources of pollution are primarily emissions from vehicles. In addition, transboundary pollution comes from across national borders, and is impacted by wind direction and seasonal variation.

Water pollution, then, comes primarily from industrial discharges, municipal waste, agrochemicals, salinity intrusion, and arsenic contamination. Pollution not only compromises water quality, but also impacts health through the bioaccumulation of toxic substances. In addition to pollution, groundwater is also over-exploited, making it increasingly more difficult to ensure that the population has access to an adequate water supply. This is especially pertinent since approximately 87 percent of Bangladeshis depend on groundwater, and about 79 percent of irrigation for agriculture comes from groundwater (BBS 2010).

Effluents and wastes from different industries accumulate in water sources from both their direct disposal on the surface and from seepage through soil layers into groundwater. Saha and Ali (2001) examined the contamination of groundwater in Dhaka city from tanneries. They found high concentrations of sulfide, lead, manganese, and chromium in ground water samples, which matches the pollutants that are released by the tannery industry. These types of industrial waste disposal threaten both human and environmental health.

Additionally, excess use of fertilizer and pesticides causes runoff, which pollutes water bodies and rivers. Rivers are also polluted from sewage in cities, which often goes untreated. The sewage discharge from cities creates pollution problems in stagnant water bodies in rural areas. Furthermore, ships cause river pollution as sea traffic and accidents increase, damaging ecosystems.

Municipal solid waste also poses a serious environmental challenge for urban areas in Bangladesh Poor solid waste management leads to failures in drainage systems, water clogging, deterioration of soil quality, soil pollution, air pollution, foul odor, surface and groundwater pollution, and the spread of infectious and vector borne diseases in landfill areas (Chowdhury et al. 2013). Only between 44 and 76 percent of the total municipal solid waste is collected, leaving huge amounts uncollected and untreated. This creates a public nuisance as well as a health hazard (Waste Concern 2005). As population and waste generation increase rapidly, the consequences of poor waste management are only likely to grow in the future.

Noise pollution is another, less recognized type of pollution in urban areas that is emerging as a serious environmental challenge in Bangladesh. Lack of enforcement of noise-related rules and regulations has led to noise levels exceeding the acceptable limit of 50 decibels in major divisional cities. Sources of this pollution include road, rail, and air traffic, as well as industry, construction, and hydraulic horns. GoB has thus far remained apathetic to the noise pollution problem despite the fact that it can lead to several health hazards and mental conditions.

There are enormous health consequences from the pollution sources outlined thus far Bangladesh has ranked fourth among 91 countries with the worst urban air quality, according to the latest air pollution monitoring report of the World Health Organization (WHO). Air pollution is detrimental to public health and can lead to premature death. Air pollution causes respiratory problems, asthma, bronchitis, headaches, dizziness, nasal congestion, and renal damage. Around 7 million people in the country suffer from asthma, about half of which are children. It is estimated that a 20 to 80 percent decrease in air pollution in Bangladesh could save between 1,200 and 3,500 lives annually.

Additionally, water contamination causes major water-borne diseases such as diarrhea, cholera, jaundice, and typhoid. These problems become even more prevalent during floods. Arsenic contamination in drinking water has also been shown to lead to melanosis, leucomelanosis, keratosis, dorsum, and gangrene, have been identified in 37 districts in Bangladesh. Those exposed to arsenic over a long period also have shown increased risk of skin, lung, liver, kidney, bladder, and prostate cancer.

Finally, poor waste management then leads to various communicable diseases. It has been estimated that 20 percent of biomedical waste, for example, is highly infectious and often ends up in sewage systems or drains (Bhuiya, 2007). Reports have suggested that most cases of child mortality can be linked to this poor sanitation problem. Mosquitos and bad odor can also lead to health consequences and are among the negative impacts of poor waste management (Memon 2002).

### **2.2.2 National Policies on environment**

Bangladesh is on track to become a middle-income country by 2021. However, investments in the Environment, Forestry, and Climate Change (EFCC) sectors have suffered from a lack of coherence and have delivered uncertain results.

**Table 6: Policy documents in environmental sector**

|  |  |
| --- | --- |
| **Policy documents** | **Description** |
| 7th Five Pear Plan, 2016 | Sets goals for wetland and coastal restoration projects, pollution reduction, and promoting zero discharge effluent practices, but has weak monitoring and evaluation mechanisms and underdeveloped sustainability approaches. |
| BCCSAP, 2009 | In addition to addressing climate change, the BCCSAP promotes energy sector development, expanding the forestry program, coastal program, and clean energy program. |
| Country Development Analysis Environment; ADB | Reviews the environment sector, focusing on development, pollution, wetlands, forestry, biodiversity loss, and energy. |
| Perspective plan of Bangladesh (2010-2021) | Envisions Bangladesh’s development future while concentrating on forestry and forest coverage as well as energy efficiency and renewable energy. |
| The Bangladesh Environment Conservation Act, 1995/2010 | Discusses Bangladesh’s conservation rules and policies through DoE, samples collection, environmental impact assessments, and the declaration of ecologically critical areas. |
| National Report onSustainable Development, 2012 | Describes achievements on various dimensions of sustainable development in Bangladesh since the 1992 Rio Earth Summit and outlines future directions and challenges. |
| National Environment Management Action Plan (NEMAP), 1995 | Aims to provoke the development of policies for the future of environment and forestry development. |
| National Biodiversity Strategy & Action Plan (NBSAP), 2004 | A national framework for conserving biodiversity outlining its benefits. Aims to conserve biodiversity for future generations, maintain environmental stability for ecosystems, ensure the protection of biological heritage, and prevent species invasion. |
| Coastal Zone Policy 2005/ Integrated Coastal Zone Management Plan, 2005 | Focuses on the management of coastal resources to ensure sustainability, defining appropriate policies. |
| National Land Use Policy, 2001 | Reduces illegal land use conversion to ensure that land use activities are in line with environmental conservation. |

## **2.3 State of Water Resources**

Bangladesh faces immense challenges related to water. Located in the Ganges-Brahmaputra-Meghna (GBM) river system, the availability of water is mostly seasonal and dependent on upper riparian countries. A burgeoning population, increasingly intensive modern agricultural practices, and industrial activity in the GBM catchment all threaten the country’s water resources. Additionally, repetitive flood and water scarcity is the most critical issue for water resources in Bangladesh.

The water resources available to Bangladesh consist of surface water resources (from rainfall and runoff), trans-boundary inflows, and groundwater. The surface water resources include main and regional rivers and a vast network of wetlands. These sources are at serious environmental risk due to pollution, encroachment, and disconnections between wetlands and the river system. Groundwater is critical for agricultural irrigation, but is threatened by pollution and depletion from overuse.

Bangladesh, through a complex system of rivers, drains an area of approximately 1.76 million square kilometers in the GBM catchment, only about 7.5 percent of which lies in Bangladesh (Islam and Albrecht 2011). There are 405 rivers crisscrossing the country, of which 57 are transboundary. Because Bangladesh is located at the downstream part of the basin, the activities upstream also have a large impact on the nation’s environment. Due the dam and barrage construction in the upper reaches of the Ganges, sediment-influx into Bangladesh has decreased, resulting in higher coastal erosion, lower sedimentation, intensification of tidal range, and lower land formation (Khalequzzaman, 2013).

### **2.3.1 Water quality and pollution**

Surface water quality issues in Bangladesh can be divided into two broad categories: salinity and pollution. Surface water salinity depends on the volume of freshwater discharges from upstream river systems, the salinity in the Bay of Bengal, and the circulation pattern of coastal waters induced by ocean currents. A reduction in freshwater inflows from the Ganges River, siltation of the tributaries of the Ganges, and siltation of other rivers following the construction of the coastal polder system has resulted in a significant increase in river salinity during the dry season (World Bank, 2014). Pollution of surface water can be broken down into three major categories: domestic/municipal, agricultural, and industrial. Sources of pollution include industrial effluent discharge, thermal pollution from power plants, fecal contamination, residual pesticides, oil products, and hospital waste.

About 11 percent of the rivers in Bangladesh are polluted by industry wastes, and 32 rivers are considered to have severe pollution from industry (BDP baseline study, 2016). Industries are primarily concentrated along the banks of rivers, especially in and around the Dhaka watershed. Agricultural contamination, though relatively less polluting, also affects the water quality of ponds and beels across the country. About 1.6 million tons of chemical fertilizer and 4 to 5 thousand tons of pesticides are used in agriculture annually. Though illegal, 9 out of 12 persistent organic pollutants (POPs) are being used for agricultural and household purposes, which ultimately gets into waterways (BDP baseline study, 2016).

Groundwater availability and contamination also must be taken seriously. Massive groundwater development has taken place since the 1980s, especially in the Barind Tract. Shamsudduha et al. (2011) show that shallow groundwater levels declined rapidly between 1985 and 2005. In addition to declining levels, major groundwater quality problems had been considered coastal salinity and localized highly dissolved iron, until arsenic was detected. About three million tubewells, installed at shallow depths (10 to 50 meters), discharge groundwater with arsenic concentrations above the Bangladesh drinking water standard of 50 µg/l (BGS-DPHE, 2001). About 28 to 35 million Bangladeshis have been exposed to drinking water containing arsenic exceeding the national standard. In addition to arsenic, some deeper aquifer systems are characterized by high manganese concentrations, and increasingly chloride.

Water availability and usage is also of concern in Bangladesh. The per capita water consumption in the country is 7,939 m3 per year, but only 688 m3 per person per year is generated within the country. Water is actually the most abundant resource available in Bangladesh. It is estimated that around 80 percent of the people in Bangladesh have access to an improved water source; an increase from 75 percent from 1990 (BDP baseline study, 2016). Apart from domestic and municipal water supply, industry, fishery, forestry and navigation are the other main water using sectors. It has been estimated that the total annual freshwater withdrawal in Bangladesh was 35.87 billion cubic meters in 2009 of which water withdrawal for the agriculture sectors was 87.82 percent, domestic 10.04 percent, and industry 2.15 percent. A quickly growing economy, and the potential risks associated with climate change and trans-boundary infrastructure development, requires the countries’ water planners to undertake precise and comprehensive balancing of water supply and future demand.

There are both natural and man-made challenges to water resource management, including alternating floods and droughts, cyclones, a growing population, large-scale sedimentation and erosion, rapid urbanization and industrialization, deforestation, and climate change. An additional and growing challenge is the deterioration of surface and groundwater quality, the decline of natural wetlands and water bodies, and the maintenance of healthy aquatic ecosystems. Critical challenges include:

* Decline of wetlands and the disconnection of wetlands from the regional and main river system, negatively impacting water quality, the quality of fish habitats and ecology, and pressure on ecologically sensitive areas.
* Unsustainable groundwater use in the north-west and north-central hydrological regions (including Dhaka).
* Decreased dry season and tidal flows in the south-west due to decreases in dry-season flows and an obstruction of drainage paths from flood control dam construction, causing water-logging and increased salinity in the coastal area.
* Deteriorating surface and groundwater quality caused by untreated effluent disposal by industrial and domestic sources.
* Flood risks from extreme rainfall, cyclones, and storms, likely to increase with urbanization and economic growth in the near future.
* Water-logging in urban and rural areas cause by unplanned and ineffective drainage, encroachment on wetlands, and the hampering of tidal flows in the coastal area.
* Gender-focused planning, given the important role of women in providing drinking water and food security for their families, as well as their own vulnerability to water hazards.
* River bank erosion occurs at a rate of approximately 6000 hectares per year, resulting in the undermining of embankments, farmers losing their land, and an estimated annual displacement of around 50,000 people.

### **2.4.2 National Policies on water resources**

The policies and rules-regulations pertaining to water resources management and water pollution control are presented in Table

**Table 7: Policy documents in water resources management**

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| **Policy documents** | **Elements/highlights on water resource management** |
| Irrigation water rate ordinance, 1983 | Consolidate and amend the law relating to the imposition of a water rate for supply, regulation or storage of water for irrigation or drainage. |
| Groundwater management ordinance, 1985 | An ordinance to manage the groundwater resources for agricultural production. |
| National Environment Policy, 1992 | The policy adheres to environmentally sound development of each sector and sustainable use of natural resources including water resources. |
| Water resources planning act, 1992 | An act made to ensure the development and balance use of water resources. |
| Environment conservation act, 1995 and its subsequent amendments | The act has the provisions on conservation of the environment, improvement of environmental standards and control and mitigation of water pollution; the amended act includes stringent measures to the perpetrators. |
| National Fisheries Policy, 1998 | Poverty alleviation through creating self-employment and improvement of socio-economic conditions of the fisheries; achieve economic growth through earning foreign currency by exporting fish and fish products; Maintain ecological balance, conserve biodiversity, ensure public health and provide recreational facilities. |
| National Policy for Safe Water Supply & Sanitation, 1998 | This policy was formulated with the objective of making water and sanitation services accessible to all within the shortest possible time at a price affordable to all. |
| National water policy, 1999 | The main objective of this policy is to guide both public and private sectors to ensure optimal development and management of the water sector that benefits both individuals and the society at large. |
| National Agricultural Policy (1999) | Emphasis is placed on efficient irrigation and where this is possible from an environmental and social point of view (maintaining safe drinking water supplies), increase the development of groundwater irrigation. Specific attention is paid to promoting socially and environmentally friendly agriculture and maintaining a client-oriented agriculture system. |
| Natural water body protection and prevention of open space and playground act, 2000 | The act has been enacted to preserve the natural water bodies, open place and playground. |
| National water management plan, 2001 | This policy adheres to the environmental impact assessment process and highlights the adequacy of upland flow in water channels, resuscitation of natural water bodies, stopping illegal filling up of water bodies and land encroachment. |
| National Land use policy 2001 | There are mention of various land types and their sustainable management including management of wetlands. |
| National policy for arsenic mitigation 2004 & Implementation Plan for Arsenic Mitigation in Bangladesh | Access to safe water for drinking and cooking shall be ensured through implementation of alternative water supply options in all arsenic affected areas. All arsenic cases shall be diagnosed and brought under an effective management system. Impact of arsenic on agricultural environment shall be assessed and addressed. Policy includes general guidelines for slow sand filters and protocol for installation of arsenic safe tube wells in arsenic affected delta and floodplain areas of Bangladesh. |
| Coastal Zone Policy, 2005 | The policy has the imperative towards integrated management of coastal resources for ensuring the sustainability. |
| Pro-poor Strategy for Water Supply and Sanitation in Bangladesh, 2005 | Emphasizes that the existing policy of the government is to contribute 10 percent of the capital cost of water supply projects irrespective of the poverty level to the beneficiary household. |
| Bangladesh Climate Change Strategy and Action Plan 2009 | This strategy emphasizes planning, design and implementation of resuscitation of canals and rivers through dredging and de-siltation works. |
| Hazardous waste management and ship breaking rules, 2011 | The rules enacted under environment conservation act provides a regulatory management system on ship-breaking and hazardous wastes. |
| National water act, 2013 | Water Act 2013 is based on the National Water Policy, and designed for integrated development, management, extraction, distribution, usage, protection and conservation of water resources in Bangladesh. |
| Haor Master Plan, 2013 | This Master Plan is a framework plan for developing the haor areas through optimal utilization of natural and human resources for the next 20 years (up to FY 2031-32). |
| River Protection Commission Act, 2013 | It establishes composition, duties and responsibilities of the above mentioned Commission, entitled to: manage and control water and environmental pollution, caused by industrial pollution of rivers, construction of illegal structures and to prevent irregularities and restore the normal flow of the river, to control flood and drainage; hydrology, the use of surface and ground water; and to examine the equipment. |
| Participatory Water Management Rules, 2014 | The Rules relate to formation and functions of water management organizations (WMOs) in water resources projects. The most important shift which the PWM Rules 2014 suggest is that from now on the WMOs will be registered under Bangladesh Water Development Board (BWDB) rather than the Department of Cooperatives (DoC). The Rules emphasize on larger enrollment of local stakeholders in the water management groups (WMGs) and their participation in operation and maintenance (O&M) of the water management infrastructures. |
| National Industrial Policy, 2016 | It has a section on environment friendly industries (section-14). It says while setting up of an industry, its impacts on local land, water and environment and on human should be properly assessed including setting up of ETP and waste management aspects should be ensured. |
| The 6th Five-year Plan | The Sixth Five Year Plan (SFYP, 2011 to FY2015) of the Bangladesh Government ascribes significant importance to the water resources sector and the concept of Integrated Water Resource Management (IWRM) in support of economic, social and environmental sustainability. |
| Perspective Plan of Bangladesh (2010-2021) | Making Vision 2021 a Reality” is a strategic articulation of the development vision, mission, and goals of the Government in achieving a prosperous Bangladesh grounded in political and economic freedoms a reality in 2021. In water sector, it emphasizes the efficient, adaptive management considering the aspects in Integrated Water Resource Management, Water Management for Irrigation, Water scarcity, Climate change and Long-term Water Resource Management Strategies. |
| The 7th Five-year Plan | The Seventh Five Year Plan (SFYP, 2016 to FY2020) of the Bangladesh Government emphasizes on safe drinking water for all, promote Zero discharge of industrial effluents, urban wetlands restoration and protections etc. |
| Delta plan 2100 | “Ensure long term water and food security, economic growth and environmental sustainability while effectively coping with natural disasters, climate change and other delta issues through robust, adaptive and integrated strategies, and equitable water governance. |

# **3. THE FUTURE**

## **3.1 Building Capacity for Climate Change, Environment, and Water Resources**

The government of Bangladesh must have a vision for 2041 of combating climate change while also pursuing economic growth. The vision for capacity building must bring all stakeholders together in a participatory policymaking and implementation process. It should aim to build a highly-informed society that offers inclusive access to quality knowledge services and democratic input.

Capacity has become a policy buzzword; its definition is highly dependent on context. The Food and Agriculture Organization (FAO), for example, characterizes capacity as, “the capacity of individuals, associations, and society all in all to deal with their actions effectively.” It conveys notions of instruction, preparation, and human resources, emphasizing the space in which people, hierarchies, and social networks connect. Capacity building does not imply a lack of existing capacity. It instead asserts that existing capabilities of individual and organizations should be expanded and strengthened. It also calls for the coming together of various stakeholders to combine their capacities to better tackle issues, define goals, and implement solutions.

The primary avenue for enhancing national capacity is education – for policymakers, practitioners, and local communities. Such education must include knowledge about the ecological, social, and economic ramifications of climate change, and job training for fields that take on these challenges.

Article 11 of the Paris Agreement demands that capacity building be nation-driven and in light of and receptive to national needs. Capacity building must be guided by lessons learned from other countries, participatory processes, cross-cutting collaboration, and gender inclusiveness. This should be true for adaptation and mitigation actions, and should facilitate technology development, access to climate finance, public awareness-raising, and the transparent, timely, and accurate communication of information.

### **3.1.1 Components of capacity building**

Individuals are at the core of any effort to respond to climate change, regardless of whether they are government leaders, businesspeople, NGO workers, or members of civil society. Mitigating and responding to the impacts of climate change requires a cumulative effort from all levels in order for Bangladesh to thrive. Additionally, it is important that those with increased capacity in identifying the impacts of climate change and formulating solution are supported in country to put their expertise to use in initiatives specific to Bangladesh.

Everyone has the capacity to learn, and to achieve a sustainable future, individuals must engage in a transformative learning process to change traditional perspectives and open new doorways (Wals 2007). This can be done collectively through “learning by doing” among community members, helping to improve understanding, the need to take action, and to enhance strategy-building through communal reflection. Mentoring systems can be a beneficial means for improving individuals’ understanding of an existing problem. Facilitated discussions area an important tool for encouraging people to think critically and act promptly. Facilitators can help participants build plans and learn from experience, establishing effective strategies such as platforms for open dialogues, using social media of outreach, and organizing awareness-raising campaigns. This can occur through both formal and non-formal education systems.

Community-based adaptation refers to actions taken at the local level by accumulations of individuals in communities that are vulnerable to the impacts of climate change. It includes the identification, assistance, and implementation of community-driven development projects that strengthen the capacity of the local people to adapt to living in a riskier and more uncertain climate. Moreover, community-based adaptation includes planning and implementation through participatory processes, involving local stakeholders and disaster risk reduction practitioners. It integrates climate adaptation and development by improving livelihoods of poor, vulnerable groups.

Generating adaptive capacity at the community level is critical because it builds social networks and a strong sense of collective community responsibility, mutual aid, all of which facilitate the sharing of food and equipment to ensure rapid response to crisis (Ayers and Forsyth 2009). Adaptation must involve learning through action, engaging with indigenous capacities, and honing experiential knowledge. New activities, technologies, and practices can then be introduced as appropriate (Reid and Huq 2007).

Gender inclusiveness must also become central to capacity building. Social and cultural norms cause women to face greater challenges due to climate change and environmental stressors than men do. The decisions at COP22 (the 22nd Conference of the Parties under the UNFCCC) emphasizes the importance of adopting a gender-responsive climate policy. This involves capacity building for both men and women in areas such as technology development and transfer. Identifying the different roles and responsibilities of men and women will enhance the possibility of an environmentally resilient society in Bangladesh (UNDP 2010).

While gender inclusiveness has been integrated into national policymaking, it also needs to be articulated at the local level (UNDP 2010). Women are often the primary managers of natural resources in poor countries, but in most cases lack the power to make independent decisions. Inability to access formal and non-formal education, as well as limited to no access to information and restricted mobility makes women more susceptible to climate change risks. The BCCSAP, 7th Five Year Plan, and National Plan for Disaster Management all address the issue of women’s greater vulnerability to climate change and sensitivity to disaster events. Therefore, women’s knowledge in environmental management and conservation should be given priority, and investments should be made in education, capacity building training, technology transfer, and women-focused environmental projects.

To create a holistic approach to climate change, young people must also be thoroughly engaged. Integrating climate education into the formal education system is a great first step in building informal, global citizens, who are ready to build solutions. This relates directly to the UNFCCC’s “Climate Change Education” thematic area (UNESCO). Furthermore, knowledge dissemination should occur not only through formal but also non-formal avenues for knowledge sharing, such as media, cross-sector partnerships, and social networks.

The GoB has worked to incorporate climate change into education policy (National Education Policy 2010). NGOs and think tanks are also working with young people to promote climate change awareness, and are making use of media and technology to advance knowledge and a call to action. Capacity building trainings for this group might include alternative sustainable livelihood skills, water monitoring, green entrepreneurship, and early warning identification. The public sector should do this and more to mobilize young people in this field.

The education of girls to fight climate change should be a priority. While women’s empowerment in Bangladesh is accelerating, it is critical that the country invests in girls’ education so that they can become agents of change in the environmental sector. By educating girls they can become initiators of alternative livelihoods, such as home gardening and livestock raising, and can be made the primary family caregivers during natural disasters. Everyone that is able should contribute to the effort to combat climate change.

The vision for long term national stability and prosperity cannot be achieve without strong institutional capacity to understand and plan for the impacts of climate change. Universities in particular are important institutions as they are centers of knowledge, excellence, and shared thinking, with the potential to sustain the socioeconomic and environmental development of the nation. They are well-positioned to generate solutions for climate change, which requires knowledge and collaboration across disciplines. Thus, they are an ideal context for capacity building. Universities have a mandate to train and educate students, and their students have the potential to advance sustainable initiatives. Efforts should then be made to develop a comprehensive curriculum for tertiary academic research, and training (Okoli 2014; Mangizvo et al. 2010; Waas et al. 2010).

There is an increasing need for knowledge production and sharing on matters related to environmental issues and climate change. Effectively managing knowledge is essential for tackling these issues and serving as a catalyst for action (OHCHR KM 2011). The GoB has already shown interest in this strategy at both the local and the national level (Planning Commission 2015). Digitally managing knowledge related to climate change is crucial in that it allows for easy knowledge sharing. Additionally, knowledge brokers can work to bridge the gap between policymakers and researchers to build comprehensive and effective solutions.

Regarding information access, the GoB has made a progressive move in making reports, news, storm warnings, policies, and public dialogues on ministry websites. Additionally, the ministries circulate information via social media, including on Facebook. These efforts to make information broadly available should be expanded, especially to ensure dissemination and access for those who are illiterate or without internet access.

The private sector is also working to build their knowledge hub. Think tanks, NGOs, and research institutions are creating their own knowledge portals for research journals and other publications. The Intergovernmental Panel on Climate Change (IPCC) also shares their research documents for free, via their official website. In addition, the UNFCCC capacity building portal also shares regional and country-based climate change information free of charge. These resources can help link information between countries for better understanding and action (Williams et al. 2015).

Dialogues on climate resilient development planning present an opportunity to bring policymakers together across sectors, and build consensus about common goals. To ensure that consensus and sharing is possible, policymakers should develop specific infrastructures to nurture these results. Additionally, to move from policies to implementation, there should be a shared understanding of a collective approach that will bridge traditional sectoral divides, such as those between environment, planning, energy, and agriculture. Such learning and exchange should then also include broader stakeholder consultation and dialogue. This sort of multi-stakeholder engagement platform can additionally advise how country systems can absorb climate finance and better construct five year plans.

Short courses of about a week in length should be developed, in which participants from various backgrounds and disciplines can learn from instructors about issues and strategies related to climate change and the environment. Participants will have the opportunity to not only learn from experts, but to network with others and take home new skill and knowledge sets. Courses should target professionals from NGOs, INGOs, and government offices, who can contribute on adaptation and mitigation efforts.

Furthermore, joint knowledge production implies not only the cooperative exchange of knowledge across sectors, but also the application of that knowledge. This should include stakeholder preferences regarding management options, as well as a broad understanding of the values, specific interests, and perspectives that underlie these preferences. When differences are recognized, it becomes easier to ensure success (Hegger et al 2012).

### **3.1.2 International collaboration**

Climate change is a complex problem that requires cross-cutting and multi-scalar global efforts to address it. Though multinational collaboration may not be enough to stop climate change entirely, it can work to ensure sustainable development in countries like Bangladesh, which should continue through 2041.

Bangladesh is well-positioned to lead in knowledge transfer across Global South nations, especially in fostering new ideas in the public sector (Chowdhury 2017). The fields of water management, agriculture, and environmental management can especially benefit from integrated responses from researchers, academics, policymakers, and practitioners between southern countries (UNFCCC Tech Brief #9). Virtual hubs can be useful tools for idea sharing, research exchange, technology transfer, partnership development, and networking connections.

However, there are already countries that have bilateral relationships with Bangladesh on climate-related collaborative projects. China, for example, is providing a soft loan for the “Shahjalal Fertilizer Factory” to improve agricultural activity and socioeconomic development (Planning Commission 2015). Argentina is also a project partner to Bangladesh on technology transfer in agricultural water usage, conservation, and impacts on the natural environment and health. Additionally, the Republic of Korea has plans to work with Bangladesh on environmental protection programs (Planning Commission 2015). There is also a need to focus on improving women’s livelihood. For example, the Argentine project mentioned above could improve the livelihood of women to collect water from far away, and engage with technology.

There are also limitations in south-south cooperation. As most global south countries qualify as developing or poor, they have a lack of financial resources, insufficient regulatory frameworks, and inadequate technical capacity (7th Five Year Plan). Knowledge, though, is easily transferable with little cost. Bangladesh is a good example of a country with few economic resources, but one that has much to share in knowledge and practice of climate change adaptation measures**.** South-South as well triangular cooperation means between developing countries (South-South) and between developing as well as developed countries (Triangular)

In addition, north-south collaboration should complement the south-south collaboration process. As Bangladesh grows in terms of climate adaptation and development, it can benefit from technology transfer for green energy pathways, energy efficient transportation, water security, and knowledge sharing. Thus, north-south collaboration should be encouraged in these areas.

On energy, 105 developing countries pointed out in their Nationally Determined Contributions (NDCs) to take action on energy efficiency and standards for appliances, buildings and industries, and efficiency in power generation. The transportation sector also have room for improvement via technology transfer, as it is still largely dependent on petroleum and natural gas (Huq 2017). Water management can also be improved through new technologies, including water-saving irrigation systems and wastewater treatment.

There are also opportunities for transferring knowledge from southern to northern countries. Thus, a combination of knowledge generation and sharing between all countries will work to build capacity at a larger global scale.

Finally, triangular cooperation is an important avenue for exploration in addressing climate change. The U.N.’s working definition of triangular cooperation is, “Southern-driven partnerships between two or more developing countries, supported by a developed country(ies) or multilateral organization(s), to implement development cooperation programmes and projects.” It is strongly believed that south-south and triangular collaboration will be the key modalities for addressing climate change. Through triangular cooperation, Southern development assistance providers can benefit from the financial and technical support, experience and technical know-how of multilateral and developed-country partners. The beneficiaries’ country priorities however, should be central to the triangular cooperation process including negotiation, formulation, implementation, and evaluation (Fordelone 2009).

## **3.2 Green Growth and Renewables**

The term “green growth” has expanded in use over the last 30 years, sparking varied and sometimes conflicting definitions. Two prominent examples, from the OECD and the World Bank respectively, are:

*“fostering economic growth and development while ensuring that natural assets continue to provide the resources and environmental services on which our well-being relies;” and*

*“making growth processes resource efficient, cleaner and more resilient without necessarily slowing them down.” (EDGG 2017)*

Further, green growth has been defined from a policy angle as:

*“an integrated policy approach balancing low carbon development, macroeconomic growth, social inclusion, environmental sustainability and climate resilience.” (Savage and Chiappe 2014).*

Two key elements are central to these formulations of green growth: continued economic growth, and sustainable and efficient use of resources. The policy definition also specifies the development of a low carbon and climate resilient policy approach, as well as social sustainability, as two additional aims of green growth. Another definition of green growth emphasizes climate change:

*“the optimum tradeoff between ‘catching’ climate change in time while maintaining a reasonable rate of growth, even in the short term.”* (Aghion et al. 2009).

**(Comment 11: Can you briefly explain about South-South Triangular Cooperation?)**

According to Savage and Chiappe (2014), green growth has generally not been well defined in South Asian policy so far, and there is little evidence of policy being formulated around the concept in the region. This presents an opportunity in Bangladesh for formulation of both a forward-looking definition of green growth, and policy that can deliver on this vision.

### **3.2.1 Climate change and green growth**

There are several macroeconomic development policies and plans in Bangladesh that provide for ideas and strategies that pertain to elements of green growth. The Seventh Five Year Plan (2015) and the Perspective Plan of Bangladesh (“Vision 2021”) (2010) both address elements of green growth, such as environmental strategy in Vision 2021. The National Adaptation Plan of Action (2005) and the Bangladesh Climate Change Strategy Action Plan (BCCSAP) constitute the core planning framework for climate change (Savage and Chiappe 2014). Finally, the National Sustainable Development Strategy of Bangladesh (2008) aims to:

*“ensure sustained economic growth, environmental protection and social justice which implies improvement of livelihood options of the people, reduction of poverty; ensuring wise use of natural resources, good governance and people’s participation;”*

with four priority areas of sustainable economic development, agriculture and rural development, social security and protection, and environment and natural resource management (McGregor et al. 2016). However, there remains no single, comprehensive definition of green growth or strategy to implement it in Bangladesh. The balance of benefits and trade-off, inclusive policies to address inequality, and barriers to advancing green growth must be considered in creating and implementing a green growth strategy.

The green growth narrative highlights a narrative of positive progress. However, some benefits are more easily quantifiable than others, and those that are less so pose an evidential challenge (Savage and Chiappe 2014). Benefits of green growth include: (i) having sustained natural assets on which green growth and human well-being can be built, and which can provide inputs for marketable goods and ecosystem services; (ii) new opportunities for economic growth and new job opportunities, especially in ecosystem service provision and technological innovation; and (iii) reduced poverty (Savage and Chiappe 2014). Elaborated further, green growth includes benefits for:

* Climate Change – Political obligations in the Paris Agreement and looming domestic impacts are both policy drivers
* Protection of Natural resources – Protects natural resources from depletion, degradation and the impacts of industrialization and urban growth
* Promotes economic growth – Improves industrial competitiveness, creates green jobs and addresses short term challenges
* Sustainable finance opportunities – Addresses budgetary pressure through the creation of environmental taxes and leveraging finance from international climate funds
* Broad security issues – Has the capacity to improve renewable energy resources, food security, and rural livelihoods

Many countries choose to pursue green growth for these reasons to become more competitive in the global economy. Alternatively, environmental benefits are referred to as co-benefits of green growth rather than the driver for policy action (Savage and Uddin 2016).

Compared to the benefits, less is understood about the potential trade-offs in green growth, likely because this notion challenges the positive progressive narrative of sustainable development (Savage and Chiappe 2014). They include short-term investment injections that are required in specific sectors. For example, the cost of investing in industrial scale solar arrays may have an impact on GDP in the short term. However, it is expected that green growth can enable greater growth over the long term (Savage and Chiappe 2014).

Though there is limited evidence on the potential trade-offs between growth, environmental goals, and social objectives over time, potential trade-offs include the following: the size of the formal economy could reduce the effectiveness of policy instruments that are implemented. Additionally, high levels of inequality, and the dependence of the poor on natural resources, both require a greater focus on managing distributional costs and benefits of green growth. Weak competitiveness could potentially prevent innovation and expansion into new growth sectors (Savage and Uddin 2016).

Ultimately, policies and plans for green growth must be inclusive, providing benefits to all sectors of society, in order to address elements of social sustainability such as poverty and inequality (McGregor et al. 2016). Savage and Chiappe (2014) argue that social sustainability and poverty reduction, as they relate to green growth, share many fundamental synergies with equitable natural resources use and climate change impacts. They suggest that social work programs, oriented towards community development, are a key way of supporting local livelihoods while concurrently promoting ecosystem services.

Though green growth is critical, there are also barriers that must be acknowledged and overcome. A common barrier to green growth is regulatory uncertainty (McGregor et al. 2016). They propose that governments should articulate clear plans and strategies on bringing private and social returns together, in order to provide confidence to all actors in the green growth narrative. Savage and Chiappe (2014) also identify general barriers to public sector implementation of green growth strategy. This includes lack of commitment, lack of implementing power, weak inter-ministerial capacity, competition for scarce resources, a weak evidence base for green growth, and challenging operating environments.

Bangladesh faces several challenges in mainstreaming green growth as traditional growth models still dominate government thinking, in spite of advances made in climate change mitigation, resilience, and finance. There is a lack of an evidence base for green growth that could inform the costs and benefits of moving to such a strategy. For this reason, policymakers are hesitant to take action. There is also a lack of policy implementation (specifically environmental policies such as environment and climate risk screening and environmental impact assessments) are not conducted for every development project as there should be. Though there are policies for these environmental assessments and fines for not complying with them, they are still not properly implemented.

Furthermore, inter-agency coordination remains one of the biggest challenges for Bangladesh. Sector ministries lack the technical capacity to implement a green growth strategy on their own. Though several policy frameworks contain some elements of green growth, it is yet to be grounded in policy discourse (Savage and Uddin 2016).

In order to remove barriers to green growth, Bangladesh must work to build: (i) new institutions; (ii) coordination across government structures; (iii) environmental risk assessment of policy, plans, and programs; (iv) policy implementation review; (v) demonstration of benefits of green growth in key sectors; (vi) political devolution to the local government level; (vii) collaboration with private sector in development of all policy and investments; (viii) PPP acceleration through working with private sector and financial sector; (ix) green data development to underpin policy development; and (x) financial mechanism liberalization and development (McGregor et al. 2016).

Industry actors’ attitudes toward green growth also play a role (McGregor et al. 2016). As highlighted above, cost is a trade-off, with green growth likely causing long-term overall gains, but short-term costs for many sectors. Industry actors generally have a lower level of perception of green growth than policymakers (McGregor et.al. 2016). In addition, Bangladesh has a large informal economy, in which about 75 percent of the working population are engaged (McGregor et.al. 2016). This presents a challenge in developing policy to support the actual sources of income for most of the population, as well as in reporting and measuring impacts of that policy on the macroeconomic status of the country.

Bangladesh has the benefit of learning from many other countries have implemented green growth strategies and provide useful examples for Bangladesh. For example, Rwanda introduced the Green Growth and Climate Resilience National Strategy for Climate Change and Development in 2011, which aims to create a low carbon and climate resilient economy by 2050 through a secure low-carbon energy supply, sustainable water and land use, and social protections (including disaster risk reduction) (McGregor et al. 2016). Chile also launched its National Green Growth Strategy in December 2013, which outlines actions including environmental management instruments, promoting a market for environmental goods and services, and measuring progress over the short, medium and long term (Savage and Uddin 2016). In Ethiopia, the Climate Resilient Green Economy Vision (2011) and the Green Economy and Climate Resilience Strategy (2011) have been introduced (Savage and Chiappe 2014). These each can serve as a model for the development of a Bangladesh national strategy.

China and India are the two largest sources of imports to Bangladesh, and therefore influence the country’s production technology (McGregor et.al. 2016). In India, strong economic growth has come at a heavy environmental cost, so a clean energy fund has been established and novel partnerships are being pursued to increase green investment. China, which in 2012 accounted for 29% of global GHG emissions due to its heavy reliance on coal, has set binding targets for emissions reductions and created innovative financing mechanisms, including a loan loss reserve fund (‘LLRF’) (McGregor et.al. 2016).

Overall, there is much scope for Bangladesh to create and pursue synergistic policies for green growth, moving beyond the established categories of mitigation and adaptation and into policies that are designed to foster consistent pursuit of green growth from angle and sector. Green growth must be incorporated into the national vision.

### **3.2.2 Future investment areas in climate change and green growth**

Bangladesh has progressed in investment in green growth-related areas that support mitigation to climate change, i.e. a reduction in Greenhouse Gas (‘GHG’) emissions. For example, Bangladesh Bank has utilized various financial mechanisms, including supporting the development of clean power plants through a BDT 2 billion refinancing scheme at a 5% interest rate (McGregor et al. 2016). Bangladesh Bank has been instrumental in raising awareness of green finance in the banking sector (Dorasil and Gross 2014). In terms of adaptation, climate resilient infrastructure is key, and private sector involvement in this area is strongly encouraged (World Economic Forum 2013). And estimated 7% of public expenditure in Bangladesh should be invested in green growth-related measures (McGregor et.al. 2016). Savage and Chiappe (2014) estimate however that 80% of investment for Green Growth will come from the private sector. This raises the question: what are the key investment areas for the future and how will these be targeted?

Energy is a key sector in which green growth can be used to address climate change mitigation issues. It is particularly significant in Bangladesh because of the huge increase in anticipated power demand and production, with the vision in place to produce 50% of power from coal. However, this ‘lock-in’ to fossil fuel reliance and subsequent expansion of carbon footprint can be avoided (McGregor et.al. 2016).

The Bangladesh Bank Refinance Scheme for Renewable Energy & Environment Friendly Financeable Sectors focuses on green products such as solar energy, bio-gas plants, and effluent treatment plants (ETP). This refinance scheme was established by Bangladesh Bank with BDT 2 billion of its own fund in 2009. Initially it was launched with only 10 products, which has increased to 50 types under 11 categories: Renewable Energy, Energy Efficiency, Solid Waste Management, Liquid Waste Management, Alternative Energy, Fire Burnt Brick, Non Fire Block Brick, Recycling & Recyclable Product, Green Industry, Ensuring Safety & Work Environment of Factories and Miscellaneous. To date, 39 banks and 19 Financial Institutions have signed a participation agreement with Bangladesh Bank to avail finance from this scheme (Khan et al. 2017)

Solar has huge potential for power generation in Bangladesh, as evidenced by an IDCOL program that has brought solar home systems to millions. This has been supported through a combination of capital subsidies, interest rate subsidies and concessional financing (Dorasil and Gross 2014). However, there is a policy issue that may affect using renewables on a larger scale: base-load options under regulation do not yet recognize renewables (McGregoret.al., 2016). An update to this policy to include renewables could facilitate uptake of solar at a larger scale. Another promising policy direction is the development of feed-in tariffs, which received support from 98% of those surveyed by EDGG, including both policymakers and industry actors (McGregor et al. 2016).

Transport is another key area for climate change-focused green growth, as curbing GHG emissions from fossil fuel vehicles is essential for mitigation. There are also major co-benefits to improving transport systems, particularly in Dhaka, which has been said to suffer chronic traffic congestion, low quality and reliability of public transport, lack of safety for pedestrians, and worsening air pollution (McGregor et al. 2016).

Though the GoB has lead investment in this sector, there are now 13 public-private partnership (PPP) transport projects underway in Bangladesh. The Bangladesh Transport Policy Note (2009) by the World Bank reinforced the need to involve the private sector in transport development, since the cost of transport infrastructure projects often far exceed available public finances (McGregor et.al. 2016). So far, the private sector has not emerged as a ‘green champion’ in the transport field, but the rapid expansion of the field means it is an optimal time to engrain this vision. As the EDGG summarizes, “a national transportation green growth agency and a national green growth coordination committee would be essential to pursue green growth agenda,” (McGregor et.al. 2016).

Next, the garment industry makes up a large part of Bangladesh’s economy and has particular potential to make advancements in green investment to address climate change. This isdue to the fact that the majority of textile and garment factories are high emitters of GHGs, and are yet to adopt cleaner technologies (McGregor et.al. 2016). There appear to be multiple barriers to the adoption of green technologies in this sector. In an interview with a knitwear factory owner in Narayangonj conducted by EDGG, they identified the following barriers to adopting new, green technology at the factory: (i) large initial investment; (ii) incentives weighted in favor of larger companies; (iii) inadequate access to finance for green investment; and (iv) limited commercial incentives from the supply chain (McGregor et.al. 2016). One potential example model that could be emulated in Bangladesh to increase availability of lending for green factory upgrades is the LLRF model used in China. This fund uses finance from the IFC and GEF to guarantee commercial loans to energy management companies, and could be used as a model across industries in Bangladesh. Related issues are explored further below.

There is also significant possibility for increasing energy efficiency in industry. According to the surveys conducted by EDGG in its Green Growth Diagnostic (McGregor et.al., 2016), use of efficient motors in industry is below 25 percent and use of biogas is below 6 percent, indicating significant room for improvement. Over half of the respondents cited financial constraints as their rationale for not investing (McGregor et al. 2016). This suggests that incentives such as tax discounts could facilitate greater uptake for investments inefficiency. Figures 6 and 7below show the investments made in energy efficient technologies across sector type (Figure 6) and sector size (Figure 7). The consistency of technology investments across both charts indicates that macroeconomic factors have driven investment decisions (McGregor et al. 2016).

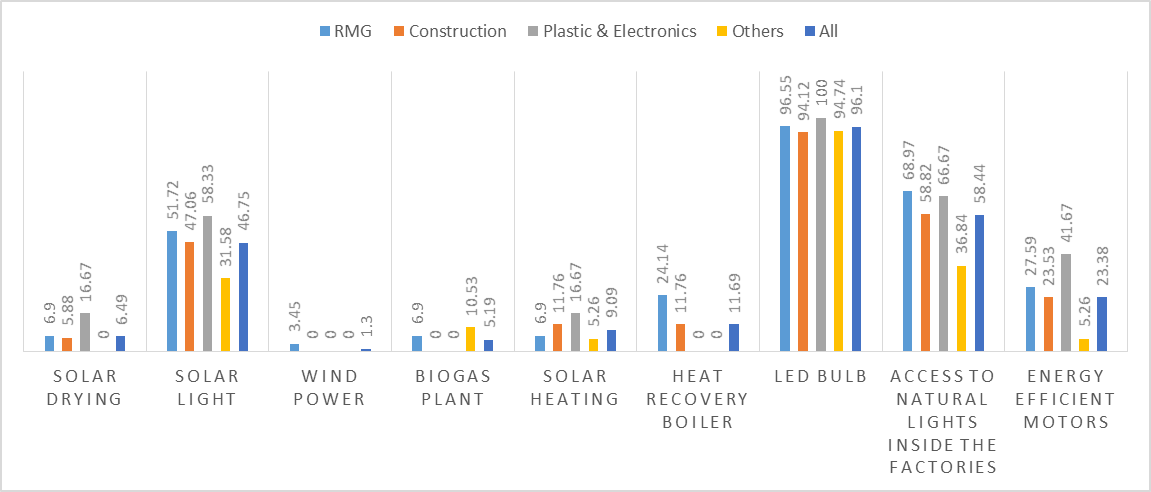


Figure 6: Investments in selected energy efficient technology by private sector respondents (EDGG 2016)

Figure 7: Use of Energy and Energy Saving Technology by Size of Industries

However, given the perceived financial savings that energy efficiency would bring, ranging from 19 to 34 percent of energy bills, it appears that cost is not the sole deterrent for investment (McGregor et al. 2016). Positive impacts on reputation and compliance with ISO standards may also incentivize investment, but more research is required to establish whether these drivers can be adopted for green growth (McGregor et al. 2016). This combination of financial and reputational incentives could encourage private sector industries to invest profits into mitigation technology.

### **3.2.3 Environment, water resources, and green growth**

When Bangladesh gained independence in 1971, it began its development trajectory from the very bottom. In less than 46 years the country has already made remarkable progress in terms of its economic growth and development. In order to continue that progress into the future while also preventing environmental degradation and its significant negative impacts on human wellbeing, the country must shift towards green growth.

Economic growth without considering environmental bottlenecks such as air pollution, water scarcity, and availability of scarce natural resources will have long term impacts on sustainability, risking overall economic growth and development (OECD 2012). Environmental degradation, depletion of natural resources, and pollution are widely observed in Bangladesh across sectors pursuing growth. In Bangladesh’s case, these effects have been exacerbated by over-population, poverty, and lack of awareness amongst the public (McGregor et al. 2016)

At present, global water demand is projected to increase by 55 percent by the year 2050, which will result water stress for at least 40 percent of the world’s population. By the same year estimations suggest a further decline in global terrestrial biodiversity by at least 10 percent (OECD 2012). Considering the state of natural resources on a global scale, green growth no longer seems like a choice, but perhaps the only way forward.

The cost of environmental degradation is difficult to quantify monetarily. A large portion of these impacts await us in the future, many of which will be irreversible, or close to it. For example, a destroyed rainforest may take thousands of years to grow back.

New evidence has shown that countries pursuing a green growth strategy exhibit higher economic growth, poverty reduction, increased resilience to climate change and natural disasters, greater energy security, and more secure livelihoods for those directly dependent on the use of natural resources. There are visible impacts to integrating green growth into policy making; the social benefits for poor and vulnerable communities include livelihood improvement, capacity building, gender equity, health benefits and job creation. Economic benefits include output growth, natural resource efficiency, cost effectiveness and improved productive capacity. Finally, environmental benefits include emissions reduction, energy efficiency measures and ecosystem conservation (McGregor et al. 2016).

Bangladesh is in the process of rapid industrialization and urbanization. If not conducted in a responsible manner, these processes could be harmful to the environment as well as to the population. The way development has been undertaken so far has not been particularly green, with the exception of the Solar Home System initiative; most of Bangladesh’s development strides have been considerate of economic aspects rather than environmental ones. In fact, the country has been ranked one of the lowest in the global Environmental Performance Index (2016), prepared by Yale Centre for Environmental Law and Policy. In sectors that are pursuing growth at a rapid pace there is a risk of environmental degradation, depletion of natural resources, and pollution, which are worsened by over-population, existing poverty, and lack of awareness among the public (McGregor et al. 2016).

For Bangladesh, green growth is still a new addition to the 7th Five Year Plan (FYP) and it will surely take time before it is mainstreamed within national plans and policies. The country however has excelled in the Millennium Development Goals (MDGs) and is taking preparation for achieving the Sustainable Development Goals (SDGs) or Agenda 2030. The SDGs with 17 goals and 169 targets aim to resolve some of the core social, economic, and environmental issues concerning the world today. Some of the targets under the SDGs are relevant to environmental sustainability. For example, goal 8 aims to:

*Promote sustained, inclusive, and sustainable economic growth, full and productive employment and decent work for all.*

Target 8.4 under goal 8 contains a more specific mandate to:

*Ensure global resource efficiency in consumption and production and endeavour to decouple economic growth from environmental degradation.*

The country has already mapped out the different SDGs under the various ministries responsible for addressing specific goals and targets. A special monitoring unit is set under the Prime Minister’s Office to keep SDG progress on track. Civil society has also taken initiative through the Citizens Platform for SDGs Bangladesh, to enable a platform for civil society organizations and NGOs working on different issues covered in the SDGs, to come together and take actions ensuring SDG success. Some of the other relevant goals under the SDGs are goal 6 on clean water and sanitation, goal 7 on affordable and clean energy, goal 11 on sustainable cities and infrastructure, goal 13 on climate Action, goal 14 on life underwater and goal 15 on life on land. Each of these have targets that are in line with the principles of green growth. Therefore, for the country to work towards achieving the SDGs, aspects of green growth must be embedded into the country’s action plans.

### **3.2.4 Future investment areas in environment, water resources, and green growth**

Bangladesh is largely dependent on the agriculture sector as approximately 87 percent of the rural population of the country relies on agriculture for their income. While agriculture has helped economic growth in Bangladesh, reducing poverty levels from 48.9 percent in 2000 to 31.5 percent by 2010 (Gautam and Faruquee 2016) the way the sector has not been structured in an environmentally conscious manner. As such, to some degree it can be said that the sector has expanded at the expense of the environment. In an attempt to obtain larger outputs excessive chemical fertilizer and insecticides, herbicides and pesticides have been used. Such practices negatively impact crop yield and soil fertility, which can also lead to adverse health impacts on farmers and consumers (World Bank 2012).

Intensifying agriculture at this rate can impact human, fish, and animal health. In fact, over-pumping groundwater affects the water table, causing salinity intrusion and decreasing potable water. These actions can lead to siltation of rivers and water bodies. Eutrophication, resulting from pesticide runoff from agricultural land into bodies of water harms aquatic life and pollutes drinking water sources. Despite its benefits, if farming is conducted on sensitive and protected land it can contribute to deforestation and affect the local ecological conditions of the area (McGregor et.al. 2016).

In order to make sure agriculture continues to boost the country’s economy without having adverse and sometimes even irreversible environmental damage, it is essential to focus on green growth. Globally, UNDP has taken measures such as the Green Commodities Program (GCP) with an aim to promote sustainable agriculture. The GCP works to enable 8 million farmers across the world to manage 20 million hectares of land sustainably and improve their agriculture practices. Some of the ways to incorporate green growth practices into the agricultural sector includes improving production techniques to enhance efficiency, higher yields, and better production quality. This is likely to reduce overuse of chemical fertilizers, save money, and decrease environmental impact (Soliman 2015).

So far Bangladesh has taken some steps towards developing sustainable agriculture practices by incorporating some green revolution strategies such as solar irrigation systems and improved seeds suitable for different geographical areas (McGregor et al. 2016). Future areas for investment should include research into salinity-tolerant crops to utilize salinized land in the coastal areas and improve livelihood and farming opportunities for the coastal population (Rabbani et al. 2013). Furthermore, Bangladesh should invest in efforts such as sandbar cropping. For example, in char areas of Rangpur, farmers are planting pumpkins that can grow with in sandy land with little water and moisture (Ali 2014).

Although Bangladesh has made significant progress in terms of energy generation, there are many pockets in the country that are still left without access to energy. However, ensuring universal access to energy in the future should not include exploitation of natural resources and reliance on fossil fuels. Expanding these traditional sources of energy will cease to be cost effective in the long run, as the price for oil will continue to rise and the cost of renewable energy technology will become more affordable. Owen (2006) said that the cost of solar energy is likely to decrease significantly due to technological progression and economies of scale combining to lower unit generating costs.

Therefore, Bangladesh should incorporate green growth within its plan for expanding the energy sector. This includes investing in sustainable and renewable energy sources. The GoB conducted a comprehensive assessment of renewable energy technologies that include utility-scale solar PV, grid-connected solar rooftop arrays, solar home systems, solar irrigation, solar mini-grids, wind, biomass, biogas, waste-to-energy facilities, small hydro, geothermal, hydrokinetic, tidal energy, and improved cook stoves. Bangladesh has already achieved success in this area, but there is ample opportunity to scale up renewable energy programs with the right mix of technology and finance (Khan et al. 2017).

Green growth investment should be made in sustainable waste management in Bangladesh. On a global scale, practices of *waste to energy* have flourished significantly, but in Bangladesh there is much left to be done and ample opportunity. For example, a Bangladesh-Denmark initiative on sustainable energy development called CCAMP has two engagements that are in line with the green growth agenda. The first is on Waste-to-Energy Engagement, which will be implemented by the International Finance Corporation. This will endorse waste-to-energy in poultry and large dairy farms throughout the country by employing successes from past experience. The engagement will extend to stakeholders such as service providers and the financial sector to explore and develop partnership opportunities. There are also plans to enhance the production of organic fertilizers from biogas slurry, which will be a natural substitute for chemical fertilizers that have negative effects on the environment. The biogas produced from the waste is also a source of energy that can be used for heating and cooking purposes.

Secondly, CCAMP also promotes e*nergy efficiency.* The Energy Efficiency Engagement will be implemented by the Nordic Chamber of Commerce and Industries (NCCI) and will encourage more companies to embark on energy efficiency initiatives. These companies will have access to professional guidance and funding to implement energy efficiency investments in Bangladesh. There is another initiative in this package known as the 3e initiative, implemented by NCCI and funded by DANIDA, which will reduce carbon dioxide emissions from selected industries and reduce energy costs. This will happen through exploring energy efficiency strategies within companies and industries.

Rural Bangladesh is already making efforts for clean cooking facilities. In the year 2014 five lakh clean cooking stoves were installed, which was increased to 7 lakh the year after. Bangladesh is in the top five countries to have installed domestic biogas plants. Currently the number of biogas plants stands at 45,610 in Bangladesh.

# **4. Key Goals for 2041**

## **4.1 Priority goals**

**1.Investing in girls to make them climate innovators**

**Justification:** Investing money, resources, and education in girls has been proven to have impacts beyond the individual, but also for their families and communities. This approach should not only be gender-sensitive but gender-biased. Though it is also important to invest in boys, the return for investing in girls will be greater. Rather than spending money on immediate need and only on themselves, girls have been seen to think more broadly and longer-term about investing to maximize the impact on the larger group. It will ensure that girls are engaged in advanced technologies and ICT in order to generate cost effective solutions for climate change that will be relevant not only for Bangladesh, but for the world.

**Expected results:** Girls hold enormous potential in innovation and development that has thus far remained largely untapped due to gender restrictions from religious and social norms. By highly educating girls in all fields, but especially in climate-related natural and social sciences, they can generate solutions that will benefit the whole country. Further, their already existing socialization as caretakers will likely lead them to generate solutions that consider several issues and their consequences for communities and families at once in a way that is more all-encompassing than many other initiatives.

**Plan for implementation:** Classes must be developed at all levels that specifically encourage girls to get the training required to develop ongoing solutions to climate change and related issues. This includes technological skills trainings as well as concerted efforts to bring girls into science and IT fields. This might include scholarships as well as female-only funding opportunities to pursue advanced degrees that focus specifically on climate change.

Outside of formal education, courses must be arranged at the community level that allows girls in climate-vulnerable areas to develop and manage local solutions to climate-related issues. Girls and young women can be trained in farming techniques, for example, that are more climate-resilient, can be trained to receive and interpret storm warnings, and can be taught to recognize early warning signs for weather and seasonal changes that may impact local livelihoods.

**Timeline:**

**2026** Scholarship programs and local training programs developed to encourage girls to focus their work on climate solutions.

**2031** All girls knowledgeable about climate change issues and solutions.

**2036** Girls’ contributions on climate change solutions continuously formally acknowledged and rewarded publically.

**2041** Women in at least half of government research, and academic positions, especially top positions, in environment- and climate-related fields.

**2. Climate change mainstreamed**

**Justification:** The approach of “grow first and clean later” that has so far guided development in Bangladesh must be discarded in favor of one that takes climate and environment issues into account from the start. Climate change is an issue that impacts all sectors at once. It cannot be taken as an isolated issue that should only be considered in contexts that are more obviously related to climate change, such as coastal erosion prevention and infrastructure development. Instead, all work and planning done in Bangladesh must incorporate climate change and fully consider the long-term environmental impacts. Furthermore, the implementation of plans and projects must follow through on the necessary steps and assessments that will ensure that it will not increase climate vulnerability and will not negatively impact the environment. This will ensure the long-term sustainability of projects and will prevent economic costs that will result from initiatives that are not resilient to climate change and that damage the environment and human health, disrupting national production and well-being.

**Expected results:** All climate will be climate finance and all development will be sustainable development. This means that all investments, business models (including business profit reporting and accounting), public policies, real estate plans, and technologies account for and positively address climate change, by being climate resilient and minimizing emissions, as well as funding positive transformational adaptation. Financial planning will automatically account for environmental inputs and losses in accounting.

Additionally, even after Bangladesh has achieved developed country status it will need to implement continuing development projects. Any development project must have zero or negligible environmental impact and must be sustainable into the foreseeable future without limitations. Economic growth must be foregone in favor of sustainability.

**Plan for implementation:** The country must develop and follow a green growth policy that is integrated in all ministries and sectors, and at all scales. Policymakers and project implementers must be trained in the specifics of green accounting and sustainable development with particular training on anticipating and minimizing impacts that would increase climate vulnerability and environmental harm. Conversely finance and development projects and should be acknowledged and rewarded for their work in mainstreaming climate change and prioritizing sustainability.

**Timeline:**

**2026** Development of comprehensive national green growth policy

**2031**

**2036**

**2041** All finance climate finance; all growth green growth

**3.Migrant-friendly cities**

**Justification:** Bangladesh is already experiencing strain due to an influx of migrants from coastal areas to cities, leading to extreme congestion and growing informal settlements. These migrants are overwhelming settling in Dhaka, as the urban center with the greatest economic opportunities and places where they have the strongest social ties. However, Dhaka cannot continue to handle the growing number of migrants flocking in each year, especially if planners want to improve city planning and enhance environmental conditions. Climate change will only increase the number of people moving to cities from vulnerable coastal regions, and thus all cities in Bangladesh must be made ready to accept them and to have ample opportunities that facilitate their transition to urban life both economically and socially.

**Expected results:** Cities will be restructured to be ready to receive migrant populations, as the uncertainties of climate change mean that flows of people could be entering a city without warning. All of the nations’ cities will be made migrant-friendly, with strong and efficient systems for facilitating migrant integration into the city, adequate housing for new populations, and job opportunities for those who are looking to work. All cities should have a network of social workers focused specifically on migrants, who keep track of their needs and work to enhance their well-being. Urban planners and city governments will continuously work with the migrant populations to ensure that the community’s needs are being met and that all who seek to migrate from climate-vulnerable regions are able to do so.

**Plan for implementation:** As urban development plans are implemented, special efforts should be made to develop systems for accepting and managing climate migrants. Migrants should be fully integrated into urban life and should become integral components to the functioning of the city. The planning for migration should begin at the level of community of origin, with a focus on climate-vulnerable areas that educates potential migrants about the services available once they arrive in urban areas and encourages them to move to various cities around the country. A new national service sector should be developed that deals with migrant issues and planning exclusively.

**Timeline:**

**2026** Urban areas outside Dhaka develop city plans to facilitate the welcoming of migrants; Dhaka creates a city plan to better manage and support its migrant population; and a national plan on encouraging migration to all urban centers will be developed.

**2031** All cities have infrastructure and social services to manage and support migrants; programs have been planned and implemented that educate potential migrants about the available services in urban centers.

**2036** Plans have been created and implemented that actively integrate migrants into urban life and communities of migrants are developed that are mutually supportive and contributing to the development of further planning to better manage and support migrants.

**2041** All cities have thriving migrant populations that are fully supported through national and city-specific services and planning.

**4.National mitigation plan**

**Justification:** Though Bangladesh is not currently one of the world’s top emitters of greenhouse gas emissions, as it develops the country will need to ensure that it is doing so in a way that does not further contribute to climate change. Thus, a national mitigation plan is essential for ensuring a sustainable future. Development will likely include an increase in emissions, and so the national mitigation plan should aim for zero emissions long-term.

**Expected results:** Besides the development of a national mitigation plan, renewable energy sources that meet 80 percent of the country’s energy needs should be implemented to contribute to mitigation action on the way to achieving the 100% renewable energy goal that is currently set for 2050. This will additionally contribute to the broader goals of making the country more climate resilient and environmentally sustainable.

**Timeline:**

**2026** 20% renewable energy

**2031** 40% renewable energy

**2036** 60% renewable energy

**2041** 80% renewable energy; National Mitigation Plan

## **4.2 Other goals**

**1. 100% food security through sustainable farming**

Bangladesh should be able to completely support its population through sustainable agricultural practices. Malnutrition should be eliminated and food distribution and access should be prioritized in the country’s plans. Most importantly, the practices used to produce this food should be sustainable in the long-term and without environmental impact. Environmentally contaminating fertilizers and pesticides cannot be used, water must be conserved and utilized responsibly, and exploitation of the soil through over-farming and high-yield methods should be eliminated. Furthermore, changes in agricultural practice must accord with the impacts of climate change, such as storm damage and salt water intrusion. GoB must be active in supporting farmers through crop damage and encouraging technological innovation to manage changes.

**2. 100% safe water and sanitation**

It is imperative that the national population has access to drinking water, and that this drinking water is free of contaminants that are harmful to human health, such as arsenic. This will include an elimination of harmful chemicals from agriculture, and the distribution of proper filtration and cleaning systems, either on a large scale or household-based, where water is already contaminated. Furthermore, this entails an end to litter and unsanitary sewage disposal, especially in cities. An effective sewage system must be implemented in all cities and large villages. Waterways must be dredged and cleaned wherever possible, and new pollutants must be avoided at all costs.

**3. Pollution/carbon tax**

Pollution is currently a major problem in Bangladesh and must be eliminated by 2041. A pollution tax should be implemented to deter industries and development projects from contaminating the environment and harming human health. Alongside a pollution tax, a carbon tax should be implemented, in accordance with the national mitigation plan described above. This will discourage the development of climate-damaging industries such as coal in the country’s pursuit of economic growth.

**4. National resilience to disasters**

Despite efforts to mitigate and adapt to climate change, Bangladesh will continue to face natural disasters such as cyclones and landslides. First, all individuals in the country should be taught to understand early warning signals and what to do in case of an emergency. Next, strong health services must be developed so that disaster victims have access to care, not only in the immediate aftermath but over the long-term. Following a disaster, a first aid team should include emergency support for infections, pregnancy and lactation support, snake bite assistance, water purification, mold prevention, food supplies, and mental health services. This last component – mental health services – is particularly important and thus far has been entirely neglected from post-disaster care. Individuals need support in dealing with the stress and loss after a traumatic event. The development of these services around disaster is in addition to greater emphasis on mental health services nationally, and a de-stigmatization of mental illness.

**5. Sustainable production and consumption**

Production and consumption in Bangladesh must be reimagined so that it does not have environmental consequence. This includes the entire lifecycle of products that are produced and the manner in which they are consumed. The current state of production and consumption is extremely harmful to the environment and human health in that it involves enormous amounts of waste that is poorly disposed of, creating further environmental consequences. The country must make a concerted effort to completely revamp production and consumption.

**6. Promoting and implementing research and innovation**

There is currently a disconnection between researchers, innovators, and policymakers. GoB must work to build a strong connection with research institutions, scientists, and technological innovators to ensure that the latest knowledge and technology are integrated into national planning and that innovation is directed at country priorities. This is crucial for there to be continuous climate adaptations as the challenges faced by the country continue to evolve.

**7. Mobilize the private sector for green investments in mitigation and adaptation**

All resources and contributors are needed in order to continue tackling climate change. The private sector has some of the greatest potential to develop projects that will be effective in mitigating emissions as the country develops, as well as adapting to changes that will inevitably occur. GoB must begin working closely with the private sector and implementing incentives that will encourage private investment in sustainable projects. These projects should especially include ones that address the impacts of climate change, through adaptation and mitigation. Public-private partnerships should also be pursued to maximize the possibilities for green growth and sustainable development in Bangladesh.

**8. Green transportation system**

**Justification:** Green transportation system includes ensuring the banning of the vehicles that are old and causes excess smoke emission. The transport system can be converted to pollution free by using biofuel instead of fossil fuel, electric vehicles, imposing penalties to the pollution maker in transportation system, giving incentives to the owners (transportation organizations) of the green vehicles and so on.

**Expected Result:** This will obviously reduce the carbon emission. Though Bangladesh is not one of the most carbon emitter but with the time rising, the industrialization and urbanization would led to an increase in carbon emission. It is better to take measures early so that the emission rate would get slow with the time.

**Plan for implementation:** The law implementation authority and officials related to green energy supply should work together. The perfect collaboration of administration, fuel supply and distribution authority and law imposer could turn this system a greener one.

**9. Green and environment-friendly industries**

**Justification:** Every industries in Bangladesh should follow the ISO 14001 Environmental management system for less pollution and low emission of CO2 with sustainable production capabilities. The industries should use environment friendly technologies for their production and operation. As much as solar power and renewable energysources should be used. The whole walls and the building can be covered by useful and non-damaging plants for mitigation of carbon emission. Trees should be planted in and around the industrial areas. The industries should ensure the occupational health and safety for the workers and ensure better pollution free working environment.

**Expected Result:** It would reduce the environmental pollution and carbon emission. It will help Bangladesh to decrease environmental pollution and other associated problems. Moreover it will reduce the fossil fuel burning and demand of fossil fuel which would reduce the pressure on non-renewable resources. The people working in those industries would also grow themselves as environment conscious for working in such industries.

**Plan for implementation:** This type of plans should consider at the ministry which deal with the industrial issue and also the DoE. In this case the implementation of the rules or environmental consciousness should be broaden by DoE and the enforcing of the industries to turn them to green industries should be led by the ministry of commerce and industry under the sub-secretariats related to this issue. And last, but not the least, Bangladesh need investors for this.

**10. Ecological security and eco-tourism**

**Justification:** Ecological security view the nature as an individual entity. That means, harm of any single part of that individual can cause disturbance or illness to the whole system of ecology. The systems and paradigms of the cycle are all interrelated. So, ecological security to different aspects of the ecology should be ensured. It can be done by imposing law and prevention of different illegal and curse full attempts to various parts of the ecology.

Eco tourism is on other hand, a growing economical investment for Bangladesh. It has enough tourist attraction places, but without maintaining the conventional state, the attraction and the beauty won’t be ensured for long. Both, the marketing plan and the conserving regulation should be followed unitedly.

**Expected Result:** The ecology and biodiversity would be saved by this type of steps. The richness and balance would increase. On the other hand, this will attract the environment conscious tourists from all over the world which would be a source of foreign currency. It would be better for different researcher around the world for coming to Bangladesh and do their research on different issues. As Bangladesh has enough endemic organisms as well as unique natural indicators like mangrove forest and world’s longest seas beach.

**Plan for Implementation:** This type of projects should be run by the board of tourism with the help of DoE. And the administrative bodies should be involved too, for ensuring security and enforcement of law.

**11. Including courses about environment and climate change in the education system**

Environmental and climate change related courses should be included in the primary, secondary and tertiary level of education. These will help every citizen to have the basic knowledge about environmental and climate change. It will make the future generation more concern about saving the environment and become climate resilient.

**12. Zero poverty and 100% employment with green job facilities**

**Justification:** In poverty mitigation, Bangladesh is uprising its situation. The inclination should be maintained as before with green job facilities. To get rid of poverty fully, the people should be ensured of jobs or inspired to be entrepreneur. The social environment also has a great effect on poverty termination. The whole process or system should work together for mitigating this problem as this is one of the driving force of all other problems.

According to UNEP, “Work in agricultural, manufacturing, research and development (R&D), administration and service activities that contributes substantially to preserving or restoring environmental quality”

So Bangladesh should create different job opportunities for the youth who are eager to work for the country’s welfare. As a country BD has not so much fossil fuel sources. She might face a great problem in energy generation if the situation of present energy source is not examined and replaced with other renewable sources. In that case, green job opportunity is a must.

**Expected results:** Of the poverty goes to 0%, then anything can be possible for Bangladesh. The driven force of people is ensuring their daily meal. So, the working capacity would increase and all will be changed for marinating the increasing standard of living.

The new job holders may examine the quality, ensure the green activities, and implement different eco-friendly systems or imposing laws related to environmental management. As Bangladesh has limited resource physically but with her population, she can do better. In future they would lead the youths with their experiences.

**Plan for Implementation:** To convert to this statement need all department’s collaboration as well as the related ministry. The ministry of education is needed, the ministry of commerce is needed and so on. And also Bangladesh need investors for starting different green agencies.

**13. Green technology based modern agricultural operation and market system**

**Justification:** Different green technology can be imposed to agricultural system. They should use more bio-composting materials and non-chemical sources, different gene technology can help in this context. The small home farming in urban areas can be a great source of different food items in small scale. It can also lessen the pressure of the farmers. Hydroponic farming can be a great measure in Bangladesh as many of the lands of her lies under water for a certain time. Upgrading of composting, implementation of drought and saline tolerant variant would be great for random use.

The market system should be friendly for agro-products. More preserving cells should be built for ensuring preservation of agro-products.

**Expected Result:** Without using the chemical fertilizers or less insecticides, the soil fertility would increase. Using different non-land harvesting would lessen the pressure to the soil. With the modern market system, with the use of e-commerce, the farmers would get their valid money for any good. As they can meet the buyer directly through e-commerce system. And modernization would lessen the rotting of food materials.

**Plan for implementation:** Department of agriculture and associated offices should work accordingly. To implement these processes or modernization, they have to work from the root level. This type of implementation need more baseline data, surveying and remote examination than office works or documents.

**14. Online environmental database and forecasting with predictions for all hazards and disasters**

**Justification:** There should be web portal which will provide necessary information on environment and climate change to the grassroots people. All the baseline data on environmental survey should be available online to the citizen of Bangladesh. The climatic data and the predicted models should be shared with public so that they have the idea of present situation and future environmental hazards. It will help the vulnerable groups to be prepared for any hazardous events. The online database should be maintained properly as, the present age is the era of modernization. Simulation through software about different hazards and disaster predictions are common in present butsome strong methodology should be developed of for predicting hazardous events.

**Expected Result:** People all over the world might get the news about Bangladesh climate and environment with one click. Before any disaster and hazards, it would be easier to take preventive and mitigating steps than the past.

**Plan for implementation:** ICT department and the administration would implement this system with the help of weather department, SPARSO, relief and disaster management ministry and other experts of remote sensing, GIS, meteorology and other sub-division of prediction and mitigation of disaster and hazard.

**15. Bangladesh as a Climate change adaptation knowledge powerhouse**

It is known that Bangladesh is one of the most adaptive countries in the world in the context of climate change. Bangladesh is practicing various adaptive measures to combat with the adverse impact of climate change from decades. The adaptation knowledge of Bangladesh can be exported to the other vulnerable countries. The exchange of this adaptive local measures with the other disaster prone countries would be better for them for adapting the calamities. The process and techniques of Bangladesh for adaptation is easy and cost effective, so other countries will be benefited if the experts from Bangladesh train them to adapt in disaster in best possible way. Bangladesh will become the global leader of climate change adaptation.

**16. Healthy Bangladesh with no environmental diseases**

**Justification:** In this context, the most important thing is to manage the pollutant in the environment, as most of the environmental diseases which are making people vulnerable are rises from air, water, soil and noise pollution and damage human health. Pollution reduction in different sources and eco-friendly technologies can help to develop healthy Bangladesh.

**Expected Result:**Less death from diseases from environmental pollution.

**Plan for implementation:** The health department can work for the survey and judgement of environmental diseases patients, also the minimum rate of exposures to different pollutant can be imposed by them but they can’t ensure the maintenance without the law enforcing department. Good law enforcement with other preventing measures in environmental pollution and implementing those could be a solution.

**17. Sustainable River management with resolved trans-boundary issues**

Sustainable river management, including dredging and illegal infrastructure removal should be done by eco-friendly way. The internal issues can be solved by law enforcement and awareness, but the most important issue about this subject is solving the trans-boundary issues. The trans-boundary meeting and settlement should also consider the issues related to environmental and ecological disturbance.

**18. Comprehensive environmental and climate change governance**

The experts on relevant field having strong background on the current global and regional environmental negotiations should be placed in different sectors for environment and climate change governance for the best result. It is another important thing to develop strong and relevant policies for marinating the environment properly. Global negotiations and establishment of environmental laws, protocols and ethics can be done by comprehensive environmental and climate change governance.

**19. Decentralization of the capital**

Dhaka city suffers from pervading water pollution, air pollution, accommodation crisis, electricity crisis and so on. Every year almost half a million people move to Dhaka and the city has not the infrastructure to accommodate its current residents. Considering the present situation, immediate decentralization and proper adaptation are essential for the development of the country. It includes the decentralization of administration, education, health facilities etc. High manpower dependent industries should be moved to district towns with proper effluent treatment facilities. To ensure this, private and public investors will have to be encouraged to invest in other districts to create employment opportunities. A modern and effective policy, short and long term, should be prepared for this. Without the development of our districts we cannot think for our total development. So, we have to increase the consciousness about decentralization of assets and thus ensuring proper utilization of resources.

**20. Ensuring that everyone works together on implementation**

This is the most important issues among the issues that are discussed above. As the above systems and measures can’t not be implemented without the help of mass people. So the people should make aware of the issue environment and ecology and their usefulness to our lives.

**Timeline**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Investing in girls |  |  |  |  |  |  |  |
| Climate change mainstreamed |  | Development of comprehensive national green growth policy |  |  | All finance climate finance; all growth green growth |  |  |
| Climate friendly cities | Elimination of poverty |  |  |  | Infrastructure and support for migrants in all cities |  |  |
| National mitigation plan |  |  | 40% Renewable Energy | 60% Renewable Energy | 80% Renewable Energy | 100% Renewable Energy |  |
| Policies | 8th FYP; Vision 2021 | 9th FYP | SDGs; Paris Agreement;  10th FYP | 11th FYP | Vision 2041; 12th FYP |  | Delta Plan |
| **Years** | **2021** | **2025-26** | **2030-31** | **2035-36** | **2041** | **2050** | **2100** |

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1. Miah et al. 2010 (salinity values were originally reported as dS/m which converted to ppt by multiplying the dS/m values with 0.64) [↑](#footnote-ref-1)