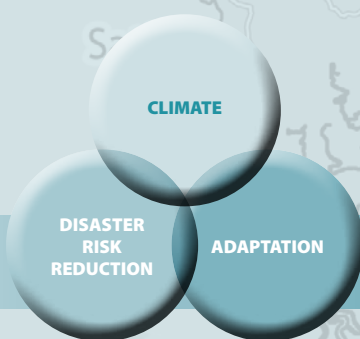




# Vulnerability, Risk Reduction, and Adaptation to Climate Change

## BANGLADESH



**GFDRR**  
Global Facility for Disaster Reduction and Recovery

CLIMATE  
INVESTMENT FUNDS



## COUNTRY OVERVIEW

Bangladesh is located in a low-lying delta, formed by the dense network of the distributaries of the mighty Ganges, the Brahmaputra and the Meghna, between the Himalayas and the Bay of Bengal. The total land area is 147,570 sq. km<sup>1</sup> and consists mostly of low and flat land, with some hilly areas in the northeast and southeast. A network of more than 230 major rivers and their tributaries crisscrosses the country.<sup>2</sup> With an average elevation of 4 to 5 meters above mean sea level (MSL), nearly a third of the country is susceptible to tidal inundation and nearly 70% gets flooded during heavy monsoons.<sup>3</sup> About 10% of the country is only 1 meter above the mean sea level, and one-third is under tidal excursions.<sup>4</sup>

Bangladesh has a population of about 150 million and Gross Domestic Product (GDP) of US\$ 67.7 billion per annum.<sup>5</sup> With over 1000 people per sq. km. the country has one of the highest population densities in the world. Poverty has declined from 57% of the population in 1990 to 40% in 2005<sup>6</sup>; however, around 56 million people are still living below the poverty line. Infant mortality has declined steadily from 92 per thousand live births in 1992 to 53 in 2002.<sup>7</sup>

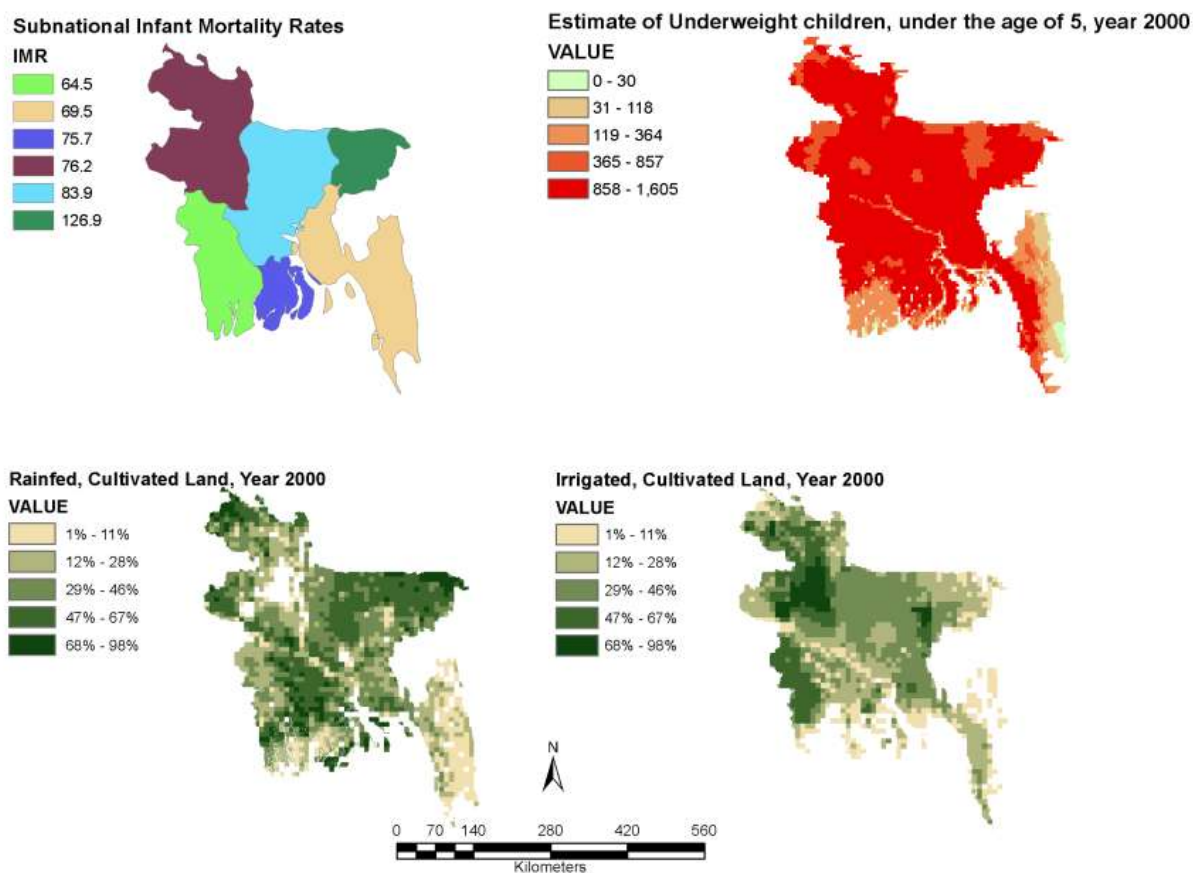


Figure 1: Infant mortality, malnourishment, and agriculture practices in Bangladesh

<sup>1</sup> <http://www.bbs.gov.bd/Home.aspx>.

<sup>2</sup> <http://www.adaptationlearning.net/bangladesh/profile>.

<sup>3</sup> Strategic Program for Climate Resilience: Bangladesh, 2010.

<sup>4</sup> Ibid.

<sup>5</sup> <http://web.worldbank.org/WBSITE/EXTERNAL/COUNTRIES/SOUTHASIAEXT/BANGLADESHXTN/0,,menuPK:295765~pagePK:141159~piPK:141110~theSitePK:295760,00.html>.

<sup>6</sup> Ibid note 3.

<sup>7</sup> <http://www.un-bd.org/bgd/index.html>.

**Key Sectors**

• Agriculture and Food Security
• Coastal Zones and Marine Ecosystems
• Water Resources
• Public Health

Source: Bangladesh National Adaptation Program of Action

Similarly, the under-five mortality rate (U5MR) has declined from 144 per thousand live births in 1990 to 76 in 2002. Inadequate power and gas supplies are a major constraint to growth. Only 47% of households have an electricity connection. In addition, Bangladesh is one of the most vulnerable countries in the world to natural calamities like cyclones and floods - 60% of the worldwide deaths caused by cyclones in the last 20 years occurred in Bangladesh.<sup>8</sup>

The Bangladeshi economy is based predominantly on agriculture, forestry, and fishing, though recently it has diversified to include manufacturing. Manufacturing contributes more than agriculture to the national income, steadily increasing its percentage of GDP. Agriculture, however, is still crucial as it supports a large number of people and most other sectors (like energy) or activities depend on it—either for processing its products or for servicing it. Overall, climate change is expected to decrease agricultural GDP by 3.1 percent each year—a cumulative \$36 billion in lost value-added for the period 2005-2050.<sup>9</sup>

**CLIMATE BASELINE AND CLIMATE FUTURE**

**CLIMATE BASELINE**

Bangladesh has a humid, warm climate, influenced primarily by monsoon and partly by pre-monsoon and post-monsoon circulations and frequently experiences severe local storms and tornadoes. Average temperatures are 26.1°C, but can vary between 15°C and 34°C throughout the year. The warmest months coincide with the rainy season (March-September), while winter (December-February) receives less rainfall. Bangladesh is one of the wettest countries of the world, with most areas receiving at least 1500 mm and others receiving as much as 5800 mm of rainfall.<sup>10</sup> Rainfall is driven by the south-west monsoon, which originates over the Indian Ocean and carries warm, moist, and unstable air, beginning approximately during the first week of June and ending in the first week of October (See Figure 3).

Major Climate Processes	Impacts on Climate
Easterly Trade Winds	- Warm and relatively drier circulations
South West Monsoons	- Brings most of the rains
ENSO	- Drier weather

Four seasons are recognized<sup>11</sup>:

- ➔ The Pre-Monsoon Season (March - May) – where high temperatures dominate at an average maximum of 36.7°C, with very high rates of evaporation, and erratic but occasional heavy rainfall from March to June. In certain areas temperatures occasionally rise to over 40°C. The peak of maximum temperatures is observed in April, the beginning of pre-monsoon season. In pre-monsoon season, the mean temperature gradient is oriented in southwest to northeast direction with the warmer zone in the southwest and the cooler zone in the northeast.
- ➔ The Monsoon Season (June - September) is typically hot and humid, with heavy torrential rainfall contributing to most of the year’s rainfall. Mean monsoon temperatures are higher in the western

<sup>8</sup> Ibid note 3.

<sup>9</sup> Economics and Adaptation to Climate Change - Bangladesh available at [http://climatechange.worldbank.org/sites/default/files/documents/EACC\\_Bangladesh.pdf](http://climatechange.worldbank.org/sites/default/files/documents/EACC_Bangladesh.pdf).

<sup>10</sup> Initial National Communication in Response to the United Nations Framework Convention on Climate Change (UNFCCC) Project, Bangladesh, 2002.

<sup>11</sup> Ibid. note 8.

districts compared to those of the east. Warm conditions generally prevail throughout the season, interspersed with cooler days during heavy downpours.

- ➔ The Post-Monsoon Season (October - November) – a short season characterized by less rainfall and lower temperatures, particularly in the evenings.
- ➔ The Winter Season (December-February) – typically relatively cooler and drier, with an average temperature ranging from a minimum of 7.2 to 12.8°C and a maximum of 23.9 to 31.1°C. Minimum temperatures occasionally fall below 5°C in the north, although frost is extremely rare. There is a south to north thermal gradient in winter mean temperature: generally the southern districts are 5°C warmer than the northern districts.

**Annual Mean Temperature**

**VALUE**

- 25.98c - 31.9c
- 21.12c - 25.97c
- 17.14c - 21.11c
- 13.88c - 17.13c
- 9.9c - 13.87c
- 5.05c - 9.89c
- 0.01c - 5.04c
- 0.01c
- 0.89c - 0c
- 27.8c - -0.9c



**Mean Diurnal Range**

**VALUE**

- 0.9c - 5.6c
- 5.61c - 7.4c
- 7.41c - 8.8c
- 8.81c - 10.1c
- 10.11c - 11.4c
- 11.41c - 12.7c
- 12.71c - 14.1c
- 14.11c - 15.4c
- 15.41c - 16.7c
- 16.71c - 21.3c



**Max Temperature of Warmest Month**

**VALUE**

- 39.61c - 48.9c
- 35.11c - 39.6c
- 31.01c - 35.1c
- 26.81c - 31c
- 22.51c - 26.8c
- 18.41c - 22.5c
- 13.81c - 18.4c
- 8.41c - 13.8c
- 1.91c - 8.4c
- 8.6c - 1.9c



**Min Temperature of Coldest Month**

**VALUE**

- 15.91c - 25.8c
- 9.11c - 15.9c
- 2.31c - 9.1c
- 5.99c - 2.3c
- 12.99c - -6c
- 19.79c - -13c
- 26.39c - -19.8c
- 33.19c - -26.4c
- 40.09c - -33.2c
- 55.9c - -40.1c

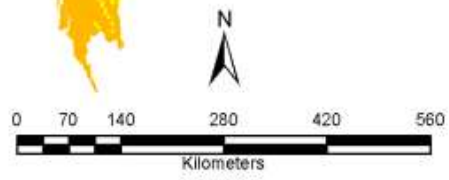


Figure 2: Baseline temperature characteristics across Bangladesh

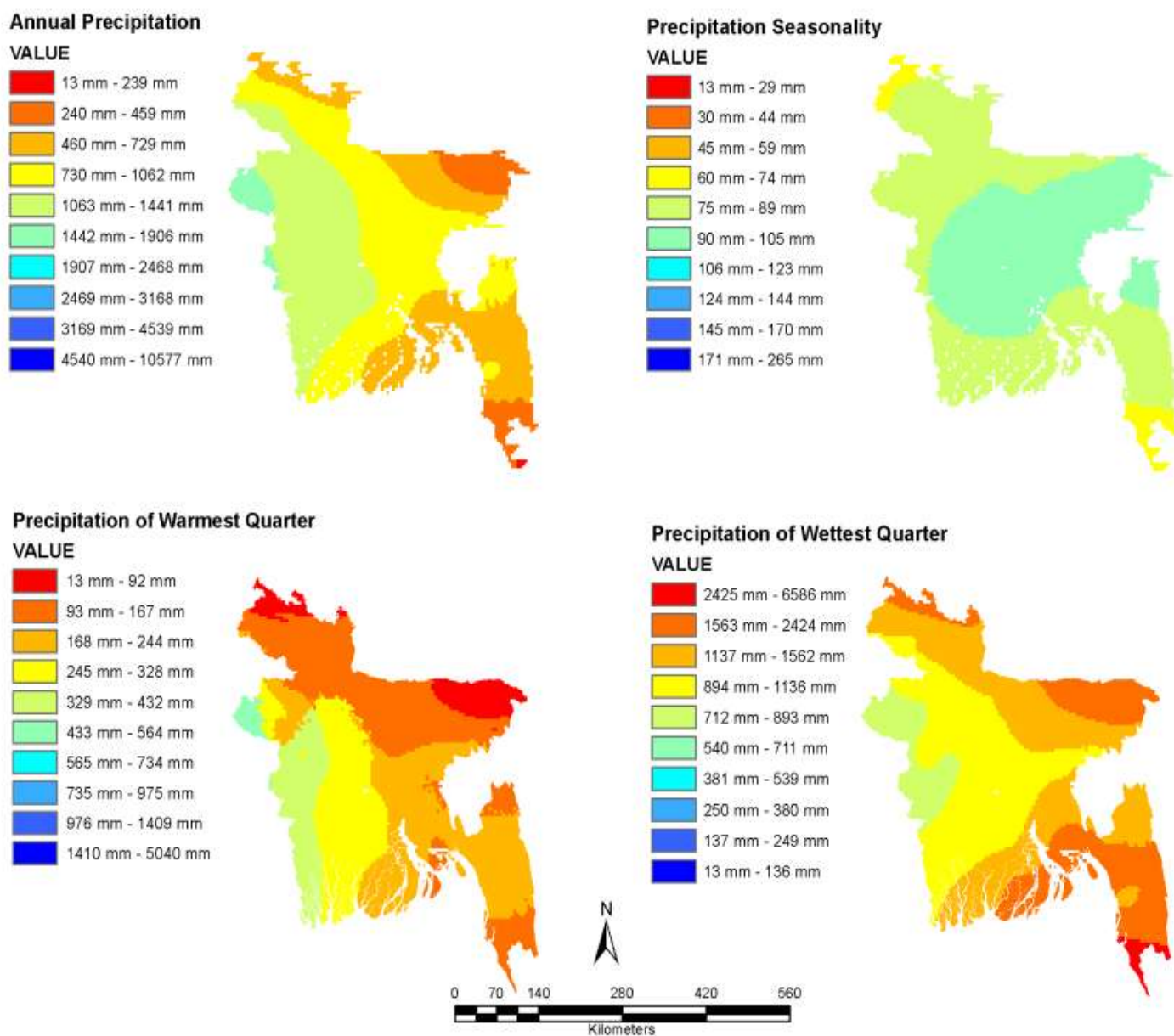


Figure 3: Baseline rainfall for Bangladesh

**RECENT CLIMATE TRENDS<sup>12,13</sup>:**

- ➔ Observed data indicate that the temperature is generally increasing in the monsoon season (June, July and August).
- ➔ Average monsoon-season maximum and minimum temperatures show an increasing trend annually at the rate of 0.05°C and 0.03°C, respectively.

<sup>12</sup>SAARC Meteorological Research Council (SMRC), 2003.<sup>13</sup><http://www.ipcc.ch/pdf/assessment-report/ar4/wg2/ar4-wg2-chapter10.pdf>.

- ➔ An increasing trend of about 1°C in May and 0.5°C in November during the 14 year period from 1985 to 1998 has been observed.
- ➔ The erratic nature of rainfall and temperature has increased in Bangladesh.<sup>14</sup> Significant increasing trends in the cyclone frequency over the Bay of Bengal during November and May, which are main months for cyclone activity in the Bay of Bengal, have been observed.<sup>15</sup>

## CLIMATE FUTURE

The climate science community sources a suite of models to inform decision makers on future climate. Among the most widely used are GCMs (Global Climate Models), RCMs (Regional Climate Models), downscaling techniques (both empirical and statistical), and several comprehensive reviews are available on the subject. Global Climate Models (GCMs) are our primary source of information about future climate. GCMs comprise simplified but systematically rigorous interacting mathematical descriptions of important physical and chemical processes governing climate, including the role of the atmosphere, land, oceans, and biological processes. The bullet points below offer insights into a changing climate that are derived for Bangladesh from a suite of GCMs used by the Intergovernmental Panel on Climate Change.

However, it should be noted that many factors that contribute to climate change are still not fully understood and are yet to be incorporated in the GCMs. While broad aspects of Asian climate change show consistency among simulations, some sources of uncertainty remain. Among these, 1) there is lack of observational data in some areas, which limits model assessment, 2) little assessment of the projected changes in regional climatic means and extremes has been done so far, 3) there are substantial inter-model differences in representing monsoon processes, and 4) a lack of clarity over changes in ENSO further contributes to uncertainty about future regional monsoon and tropical cyclone behavior<sup>16</sup>. All of these factors need to be kept in mind when applying model information to adaptation decision making.

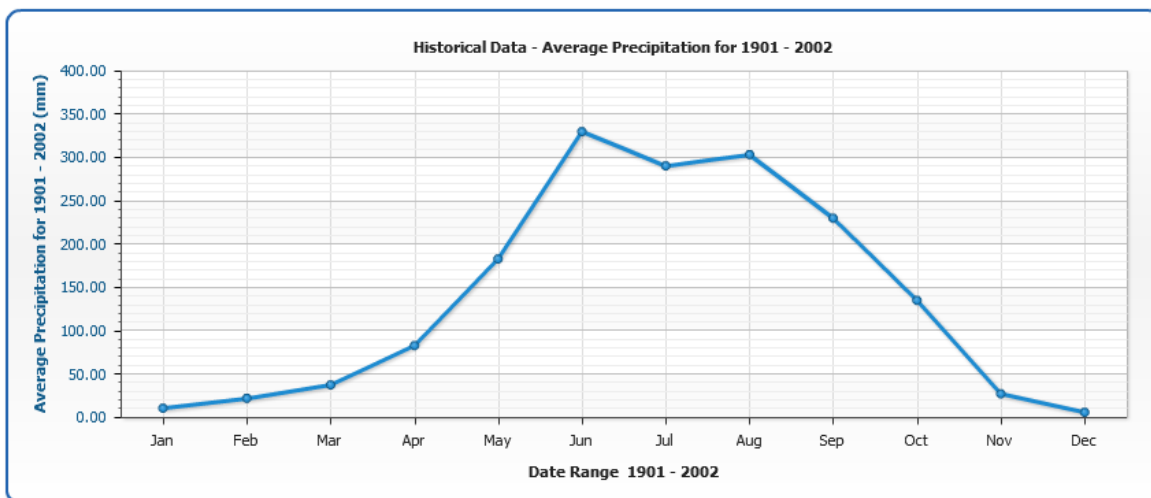


Figure 4: Historical data shows high precipitation during the monsoon season (May-September)

<sup>14</sup> NAPA Regional Workshop Reports 2005.

<sup>15</sup> SAARC Meteorological Research Council (SMRC).

<sup>16</sup> <http://www.ipcc.ch/pdf/assessment-report/ar4/wg1/ar4-wg1-chapter11.pdf>.

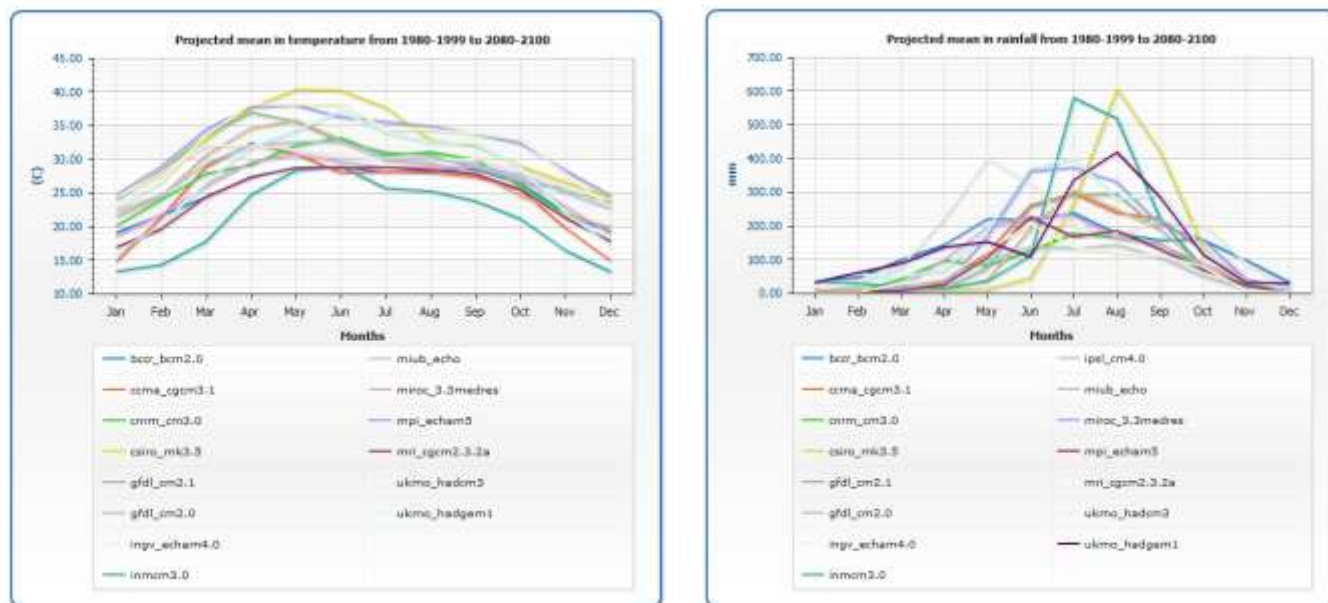


Figure 5: Projected mean in temperature and rainfall values for the period 2080-2100 as compared to 1980-1999

Projected future climate change scenarios for Bangladesh:

- ➔ Mean temperatures across Bangladesh are projected to increase between 1.4°C and 2.4°C by 2050 and 2100, respectively. This warming is expected to be more pronounced in the winter months (December-February).
- ➔ The frequency of tropical cyclones in the bay of Bengal may increase and, according to the Intergovernmental Panel on Climate Change's Third Assessment Report, there is "evidence that the peak intensity may increase by 5% to 10% and precipitation rates may increase by 20% to 30%" (IPCC 2001). Cyclone-induced storm surges are likely to be exacerbated by a potential rise in sea level of over 27cm by 2050.
- ➔ Sea level rise is projected for Bangladesh, although there is disagreement on what the degree of sea level will be—one study suggests an increase of 30-100 cm by 2100, while the IPCC Third Assessment gives a global average range with slightly lower values of 9 to 88 cm.
- ➔ As yet it is difficult to project rainfall changes for the Ganges river flood plain, with some models projecting wetter and others projecting drier conditions (See Figure 5).
- ➔ Runoff (precipitation minus evapotranspiration), a measure of water availability, is projected to increase.
- ➔ The time between rainy days is expected to increase.
- ➔ Peak 5-day rainfall intensity (a surrogate for an extreme storm event) is projected to increase.
- ➔ Average temperatures are expected to increase between 1 and 2°C by 2100, with similar rates of warming projected to occur in all three regions of the country.<sup>17</sup>

<sup>17</sup> World Bank Climate Change Knowledge Portal.

## CLIMATE CHANGE IMPACTS ON NATURAL HAZARD VULNERABILITY

Historically, Bangladesh is frequently inundated with seasonal floods and flash floods and is periodically affected by cyclones, droughts, and earthquakes. Because of its geographical location and other environmental reasons, the country is one of the most disaster-prone countries in the world (World Bank, 2005):

- ➔ **Cyclones:** Sixty percent of the worldwide deaths caused by cyclones in the last 20 years occurred in Bangladesh. The cyclone that struck the coastal areas of Bangladesh in November 1970 caused over 300,000 deaths and US\$ 2.5 billion worth of damage to property. Two recent tropical cyclones 'Sidr' and 'Aila' caused extensive damages as well. 'Sidr' struck the south-west coast of Bangladesh on 15 November 2007, affecting 2.3 million households and causing damage and losses estimated around US\$ 1.7 billion. 'Aila' struck the southern coast of Bangladesh on 25 May 2009, affecting nearly 5 million people and causing infrastructure damage of over US\$ 60 million.<sup>18</sup>
- ➔ **Floods:** Floods and riverbank erosions affect some one million people annually in Bangladesh (Figure 6). Floods affect a greater population base than any other natural hazard in the country (Figure 7). Once every three to five years, up to two-thirds of Bangladesh is inundated by floods. Substantial damage is caused to infrastructure, housing, agriculture, and livelihoods. The 1998 flood inundated over two-thirds of Bangladesh and resulted in damages and losses of over \$2 billion, or 4.8 percent of GDP<sup>19</sup>. Such disasters have both direct effects (such as loss of lives and property) and indirect effects (such as loss of employment and income, reduced access to products and services, and opportunity cost of resources that need to be diverted to relief and rehabilitation).
- ➔ **Droughts:** Seasonal droughts in Bangladesh most commonly affect the northwestern region, as it receives lower rainfall than the rest of the country. These droughts have a devastating impact on crops thereby also affecting the food security of subsistence farmers. Seasonal hunger or '*Monga*' caused by these droughts lasts till the rice harvest in November-December. Climate change is expected to result in increasing droughts, especially in drier northern and western regions of the country, which are already facing droughts. The moderately drought-affected areas will be turned into severely drought-prone areas within the next 20-30 years. During 1960 to 1991, there were 19 drought years, which affected as much as 47% of the country's area and 53% of the current population.<sup>20</sup>
- ➔ **Earthquakes:** Bangladesh is located in a seismically active and high-risk region. Between 1869 and 1950, seven earthquakes ranging from 7.0 to 8.7 on the Richter scale have been recorded in the Bangladesh region.<sup>21</sup> The northern and eastern regions of the country are particularly susceptible to earthquakes (Hotspots Study by the University of Columbia's Earth Institute).

The present national strategy for disaster management, although in an early phase of implementation, is based on three key elements, including:<sup>22</sup>

- ➔ Defining and redefining the risk environment, entailing systematic and improved hazard analysis and vulnerability/community risk assessments; and risk treatment and ranking, including incorporation of climate change impacts.
- ➔ Managing the risk environment, including achieving a good balance of risk reduction options; moving from generic hazard to risk specific programs; and mainstreaming risk reduction across sectors through advocacy, policy and planning reform, and capacity building.

<sup>18</sup> Strategic Program for Climate Resilience: Bangladesh, 2010.

<sup>19</sup> Disaster Risk Management Programs For Priority Countries South Asia – Bangladesh available at <http://gfdrr.org/ctrydrmmnotes/Bangladesh.pdf>.

<sup>20</sup> Ibid note 14.



- ➔ Responding to the threats to the environment, including activating systems and mobilizing resources; utilizing vulnerability and risk databases for emergency response planning; and maintaining effective communications and early warning systems.

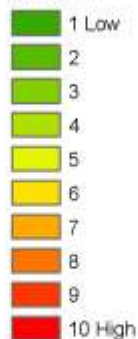
**Estimated Risk Index for Flood Hazard**

**VALUE**



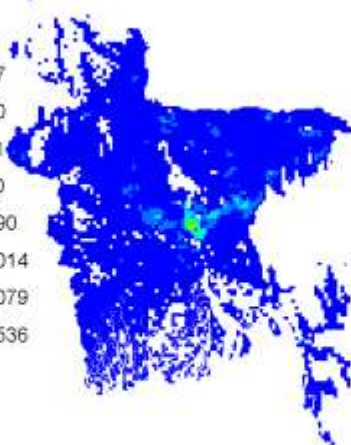
**Flood Mortality Risks and Distribution**

**VALUE**



**Economical Exposure to Flood**

**Annual GDP in USD Exposed**



**Physical Exposure to Flood**

**Annual Population**

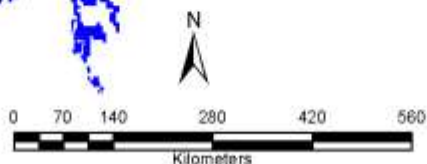
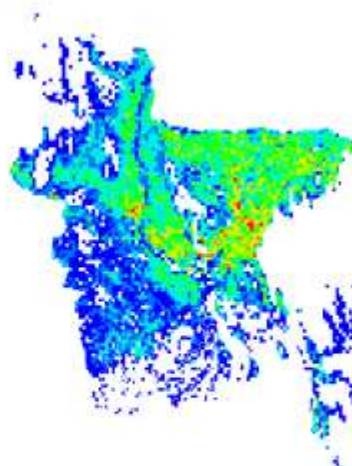
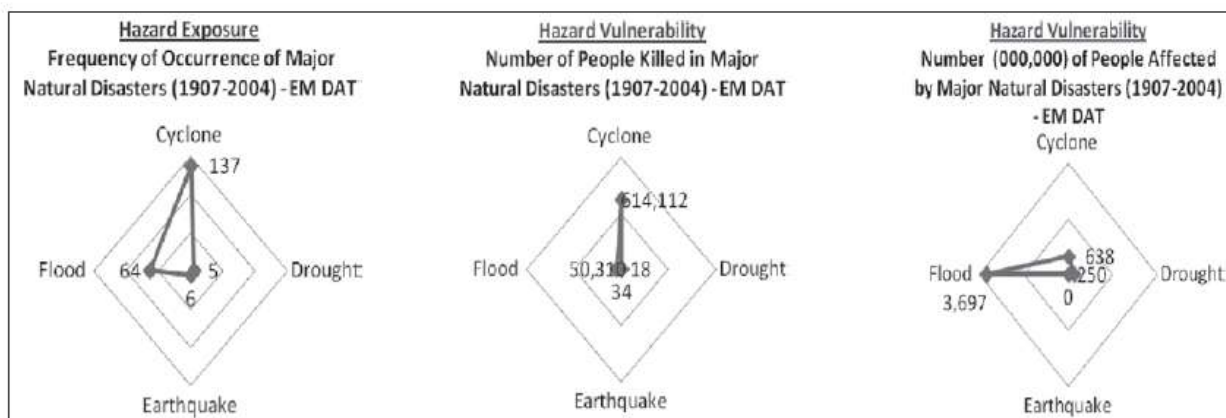


Figure 6: Flood-related mortality risks and economic losses in Bangladesh

Figure 7: Nature hazard vulnerability and exposure for Bangladesh<sup>23</sup>

## PROJECTED IMPACTS BY SECTOR

### AGRICULTURE AND FOOD SECURITY

The agriculture sector in Bangladesh is important for national food security and for providing raw materials to the manufacturing industry (e.g., cotton textiles, jute, frozen fish and seafood, tea processing, etc.), which is now becoming the lead contributor to the country's GDP. According to the IPCC, a 30- to 45-centimeter sea level rise could displace more than 35 million people from coastal districts in Bangladesh. A World Bank study showed 10 cm, 25cm, and 1 m rise in sea level by 2020, 2050, and 2100 in Bangladesh, affecting 2%, 4%, and 17.5% of total land mass, respectively.<sup>24</sup> Though there are disagreements among the various GCM model projections, a temperature increase of 4°C would have severe impact on food-grain production. The combined effects of temperatures and precipitation increase, CO<sup>2</sup> fertilization, flooding, occasional seasonal droughts, and loss of arable land in coastal areas resulting from salt water intrusion are expected to result in declines in rice production of 3.9 percent each year, or a cumulative total of 80 million tons over 2005-2050.<sup>25</sup> Under projected climate change scenarios, production of rice and wheat might drop by 8% and 32%, respectively, by the year 2050.<sup>26</sup> Out of 2.85 million hectares of the coastal and offshore areas about 1.2 million hectares of arable land are already affected by varying degrees of soil salinity. A SMRC (2003) study shows that the rate of sea level rise during the last 22 years at Char Changa and at Cox's Bazar is higher than the mean rate of global sea level rise over the last 100 years, but this could also be partly explained by tectonic subsidence. Increasing rainfall could further aggravate the problems facing Bangladesh's agriculture.

### COASTAL ZONES AND MARINE ECOSYSTEMS

Coastal areas, especially heavily populated mega-delta regions in South, East, and South-East Asia, will be at greatest risk due to increased flooding from the sea and, in some mega-deltas, flooding from the rivers.<sup>27</sup> With a 1 m rise in sea level, 2,500 km<sup>2</sup> of mangroves in Asia are likely to be lost; Bangladesh would be worst affected by the sea level rise in terms of loss of land – approximately 1,000 km<sup>2</sup> of cultivated land and sea-product culturing area is likely to become salt marsh. Four types of primary physical effects (i.e. saline water intrusion, drainage congestion, extreme events, and changes in coastal morphology) have been identified as key vulnerabilities in the coastal area of Bangladesh. Numerous aquatic plants, many of which are edible,

<sup>23</sup> Disaster Risk Management Programs for Priority Countries South Asia

<sup>24</sup> Strategic Program for Climate Resilience: Bangladesh, 2010

<sup>25</sup> Economics and Adaptation to Climate Change - Bangladesh available at [http://climatechange.worldbank.org/sites/default/files/documents/EACC\\_Bangladesh.pdf](http://climatechange.worldbank.org/sites/default/files/documents/EACC_Bangladesh.pdf)

<sup>26</sup> Faisal, I.M. and S. Parveen, 2004: Food security in the face of climate change, population growth and resource constraints: implications for Bangladesh. *Environmental Management*, **34**, 487-498.

<sup>27</sup> [http://www.ipcc.ch/publications\\_and\\_data/ar4/syr/en/spms3.html](http://www.ipcc.ch/publications_and_data/ar4/syr/en/spms3.html)

contribute to soil fertility during the dry season. Bangladesh contains the world's biggest tidal flat with the largest intact mangrove forest in the Sundarbans, which is a UNESCO World Heritage Site. It supports a very rich and diverse fish fauna of 400 species, 270 species of birds, and over 300 species of plants as well as the Royal Bengal Tiger. This rich biodiversity is however, threatened by forest conversion and encroachment, mismanagement of water resources, changes in water flows, surface water pollution and salinization, and poaching. Sundarbans mangrove forest is most likely to be severely affected by climate change. Due to a combination of high evapotranspiration and low flow in winter, the salinity of the soil would increase, which will lead to a decrease overall forest productivity. Evidence of the impacts of climate-related factors on mangroves remains limited to the severe destruction of mangroves due to a reduction of freshwater flows and salt-water intrusion in the Indus delta and Bangladesh.<sup>28</sup>

## HUMAN HEALTH

Life expectancy in Bangladesh is only 61 years, and 61% of children are malnourished.<sup>29</sup> Perhaps more illustrative of this point, though, is the low expenditure of US\$ 12 per person per year that the Bangladeshi government makes on health, well below the US\$ 21 spent in low income countries in general (World Bank, 2002). With increased climate variability and change, high summer temperatures could result in a greater number of deaths due to heat stress, but the extent of such impacts has not been quantitatively assessed yet. However, the combination of higher temperatures and potential increases in summer precipitation could create favorable conditions for greater intensity or spread of many infectious diseases. Global burden (mortality and morbidity) of climate-change-attributable diarrhea and malnutrition are already the largest in South-East Asian countries, including Bangladesh.<sup>30</sup> Still, the perceived risk to human health is low relative to those in other sectors (such as water resources), mainly because of the higher uncertainty about many of the possible health outcomes. Increased risk to human health from increased flooding and cyclones seems most likely. Changes in infectious disease are less certain as the causes of outbreaks of infectious disease are quite complex and often do not have a simple relationship with increasing temperature or change in precipitation. Coupled with its poor public health infrastructure and land transport system, which is fragmented by numerous ferry crossings and extensive river systems, health care accessibility will be further curtailed in the future.

## WATER AND ENERGY

During the monsoons, Bangladesh receives high amounts of rainfall and peak flows from the Padma, Brahmaputra, and Meghna rivers cause floods that can affect more than 55 percent of the total land area. In spite of the high amount of rainfall, there is lack of adequate infrastructure and water distribution system. Inadequate planning of flood control, drainage, and irrigation interventions is thought to have led to worsened off-site flooding, poor drainage of wetlands, and increased water logging and salinization. Bangladesh is also especially susceptible to increasing salinity of the groundwater as well as surface water resources, especially along the coast, due to increases in sea level as a direct impact of global warming.<sup>31</sup> Conflict and competition between various water using sectors also lead to water scarcity during the dry seasons. The country also struggles with many water-borne diseases during the flood season. Bangladesh is one of the lowest energy consuming countries in the world, with annual per capita energy consumption of approximately 100 kJ of energy. About 55 percent of the country's energy comes from traditional biomass sources such as fuel wood, crop residue, and animal waste; another 24 percent is met by its own reserves of natural gas; while hydroelectric power meets a further two percent of the energy requirement. The changes in climate patterns could also impact various biomass production systems and lead to an energy crisis for this country still heavily dependent on biomass sources.

<sup>28</sup> [www.iucn.org/themes/wani/flow/cases/Indus.pdf](http://www.iucn.org/themes/wani/flow/cases/Indus.pdf).

<sup>29</sup> World Bank, 2002

<sup>30</sup> McMichael, A.J., D. Campbell-Lendrum, S. Kovats, S. Edwards, P. Wilkinson, T. Wilson, R. Nicholls and Co-authors, 2004: Global climate change. Comparative Quantification of Health Risks: Global and Regional Burden of Disease due to Selected Major Risk Factors, M. Ezzati, A. Lopez, A. Rodgers and C. Murray, Eds., World Health Organization, Geneva, 1543-1649.

<sup>31</sup> Han, M., M.H. Zhao, D.G. Li and X.Y. Cao, 1999: Relationship between ancient channel and seawater intrusion in the south coastal plain of the Laizhou Bay. *Journal of Natural Disasters*, 8, 73-80.

## EXISTING ADAPTATION FRAMEWORK/STRATEGY/POLICY AND INSTITUTIONAL SET-UP

To address the critical issue of climate change and its impacts on the environment and society, the Government of Bangladesh (GOB), with active support from multilateral development agencies has taken several creditable initiatives placing emphasis on adaptation measures targeted at its key priority sectors—Agriculture and Food Security, Coastal Zones and Marine Ecosystems, Water and Energy, and Public Health. The country signed the United Nations Framework Convention on Climate Change (UNFCCC) in June 1992 and ratified it in April 1994. It ratified the Kyoto Protocol in October 2001. GOB has already adopted the Hyogo Framework for Action (HFA) and is working on its five areas of priority action, including guiding principles and practical means for achieving disaster resilience for vulnerable communities in the context of sustainable development. In response to the Bali Action Plan in December 2007, Bangladesh put an emphasis on ensuring the security of food, water, energy, and livelihoods. It actively took part in subsequent climate change talks in CoP 14 in Poznan in 2008, CoP 15 in Copenhagen in 2009, and CoP 16 in Cancun in 2010. As a member of the South Asian Association for Regional Cooperation (SAARC), it is working to collaboratively address the increasing vulnerability of the region.

The Government of Bangladesh has also devised a number of national plans and policies that address the new dimensions of climate change:

- ➔ National Water Policy (NWP), 1999
- ➔ National Agriculture Policy, 1999
- ➔ National Water Management Plan (NWMP), 2001
- ➔ Coastal Zone Policy, 2005, and Coastal Development Strategy, 2006
- ➔ Draft National Disaster Management Policy, 2008

Other national policies, including the Bangladesh Environmental Policy (1992), National Food Policy (2006), National Environmental Management Action Plan (1995), National Land Use Policy (2001), National Forest Policy (1994), Fisheries Policy (1998), National Energy Policy (1996), and National Health Policy (2000) do not explicitly address climate change issues but have the scope to do so.

Bangladesh has received funding support from a number of multilateral, bilateral, and non- governmental organizations for its climate change adaptation programs. The World Bank Group, Asian Development Bank, UNDP, European Commission, DFID, CIDA, USAID, Bangladesh Centre for Advanced Studies (BCAS), Centre for Natural Resource Management (CNRS), IUCN Bangladesh, Action Aid Bangladesh, CARE Bangladesh, Oxfam Bangladesh, Practical Action Bangladesh, Bangladesh Red Crescent Society, Concern Worldwide, and Caritas are prominent supporters of the country's efforts in the area of climate change adaptation.

## PRIORITY ADAPTATION MEASURES

Bangladesh launched its National Adaptation Program of Action (NAPA) in 2005. It identified 15 priority activities, which were subsequently updated to 45 measures with 18 immediate and medium-term adaptation measures in 2009. The revised 2009 NAPA was prepared by the Ministry of Environment and Forests (MOEF) in response to a decision of the Seventh Session of the Conference of the Parties (COP7) of the United Nations Framework Convention on Climate Change (UNFCCC). The report preparation involved relevant stakeholders in four sub-national and one national workshop and relied on prior research and background papers prepared by six Sectoral Working Groups (SWG) focusing on the following six priorities:

- ➔ Agriculture, Fisheries, and Livestock – coordinated by the Bangladesh Agricultural Research Council (BARC);
- ➔ Forestry, Biodiversity, and Land-use —coordinated by IUCN Bangladesh;

- ➔ Water, Coastal Zone, Natural Disaster, and Health – coordinated by the Water Resources Planning Organization (WARPO) ;
- ➔ Livelihood, Gender, Local Governance, and Food Security – coordinated by the Bangladesh Institute for Development Studies (BIDS) ;
- ➔ Industry and Infrastructure—coordinated by the Department of Environment (DoE); and
- ➔ Policies and Institutes —coordinated by the Bangladesh Centre for Advanced Studies (BCAS).

The GOB prepared the Bangladesh Climate Change Strategy and Action Plan (BCCSAP) in 2008 and revised it in 2009.<sup>32</sup> This comprehensive strategy addresses the climate change challenges in Bangladesh through six thematic areas:

- ➔ food security, social protection, and health;
- ➔ comprehensive disaster management;
- ➔ infrastructure development;
- ➔ research and knowledge management;
- ➔ mitigation and low-carbon development; and
- ➔ capacity building and institutional strengthening.

Forty four programs have been identified and prioritized within these six thematic areas.

**Table 1: Priority Intervention and Facilitation Measures**

Adapting agricultural systems in areas prone to enhanced flash flooding, increased salinity, and other climate-induced changes
Promoting adaptation to coastal fisheries through culturing of salt-tolerant fish species in coastal areas of Bangladesh
Enhancing resilience of urban infrastructure and industries, construction of flood shelter, and information and assistance center
Mainstreaming adaptation to climate change into policies and programs in different sectors (focusing on disaster management, water, agriculture, secondary and tertiary educational institutions, health, and industry).
Disseminating climate change and adaptation information to vulnerable communities for emergency preparedness measures and awareness raising of enhanced climatic disasters
Developing eco-specific knowledge (including indigenous knowledge) on adaptation to climate variability to enhance adaptive capacity for future climate change.

Source: Bangladesh NAPA/SPCR

## PILOT PROGRAM FOR CLIMATE RESILIENCE (PPCR) LINKS

The Strategic Program for Climate Resilience (SPCR) has been developed as a broad-based strategy for achieving climate resilience at the national level in the medium- and long-term, using as its basis the BCCSAP and the NAPA. It is the first step in the PPCR process (Phase 1: 2010) and is prepared by the Ministry of Environment and Forests in collaboration with other ministries and agencies in the government. The NAPA, BCCSAP, the CCAP (Climate Change Action Plan), and the 44 specific program recommendations in the CCAP, combined with all the other steps that the GOB has already initiated, essentially comprise the PPCR for Bangladesh.

<sup>32,29</sup> Strategic Program for Climate Resilience: Bangladesh, 2010

So Strategic Program for Climate Resilience operationalizes the priority adaptation measures through the following objectives:<sup>33</sup>

- ➔ assist GOB in the implementation of priority and selected activities identified under BCCSAP as they pertain to the southern coastal region of the country;
- ➔ pilot and demonstrate an integrated and multi-sector approach to planning and implementing a comprehensive set of hardware and software interventions in selected climate-vulnerable hotspots;
- ➔ pilot innovative approaches for investment to enhance climate resilience through appropriate and effective adaptation measures; and,
- ➔ build capacity, raise awareness, monitor results, and systematically disseminate lessons for addressing climate-related risks.

The Pilot Program for Climate Resilience (PPCR) of the Strategic Climate Funds (SCF) was established under the Multi-donor Climate Investment Fund (CIF). Bangladesh's commitment to climate change adaptation was recognized when the country was nominated to participate in the Pilot Program for Climate Resilience (PPCR) by the PPCR Expert Group in January 2009. The overall aim of the PPCR in Bangladesh is to help direct the country to a climate-resilient development path consistent with the Millennium Development Goals. The program aims to incorporate knowledge on integration of climate resilience into development; complement and provide incremental resources to support a programmatic approach to mainstreaming climate resilience in development planning, policies, and strategies; and enable a harmonized effort from all associated development partners under a common platform<sup>34</sup>. Led by the Government of Bangladesh, the Pilot Program on Climate Resilience (PPCR) is expected to be financed through the Government budget and the Multilateral Development Banks (MDBs). It is led by the MoEF, includes multi-ministry and multi-agency participants, enjoys UN agency and bi-lateral support, and works through multi-stakeholder consultations with CSO, private sector, academia, research institutes, and media.

In accordance with the PPCR Guidelines, The Government of Bangladesh, in consultation with Asian Development Bank and the World Bank, drafted the terms of reference (TOR) for launching a Joint Mission (JM) focused on the following objectives:<sup>35</sup>

- ➔ Strengthening country ownership process through consultations;
- ➔ Review of completed, ongoing and pipeline activities on adaptation;
- ➔ Identification of climate-vulnerable hotspots through rapid climate risk assessment, desk review, consultations and field visits;
- ➔ Identification of sector-specific adaptation needs and coordinated intervention options;
- ➔ Reaching consensus on the areas and scope of interventions needed for the PPCR and agreement on a TOR for Phase I (preparation); and
- ➔ Finalizing the SPCR with TOR for Preparation Funds.

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<sup>34</sup> Strategic Program for Climate Resilience: Bangladesh, 2010

<sup>35</sup> Ibid.

Adaptation Options by Sector		
Sectors	Sector impact & vulnerability	Adaptation options
Agriculture/Food Security	Higher temperature, saline water intrusion, and changing monsoon rainfall patterns impacting crop production	Development and dissemination of climate-resilient crop varieties and cropping systems for water-logging and salinity-affected coastal areas Cultivation of vegetable crops in floating gardens and raised beds
	Prolonged drought may increase the need for inputs like irrigation and fertilizers	Research and dissemination of drought-tolerant crop varieties; better storage mechanisms, and crop diversification. Improve knowledge and agricultural extension services
	Temperature increase would have severe impact on food production	Sugar crops and other high value crops (HVC) improvement for adverse climate condition through biotechnology
		Agronomic manipulations such as shifting planting dates, using short duration crop cultivars
Coastal Zones and Marine Ecosystems	Frequency and intensity of tropical cyclones and storm surge are increasing	Construction of Multi-purpose Cyclone Shelter Centers for people and of raised platforms for livestock Livelihood support and diversification to the coastal community Flood protection coastal defense structure
	Bay of Bengal more rough, making it difficult for fishermen and small craft to put to sea	Integrated project with promoting micro-finance in the vulnerable coastal areas; involvement of private sectors in the coastal areas through promoting micro-enterprise development
	Water Resource Management	Too much water in wet season, too little water in dry season; untimely water and saline water are all experienced in the country
Frequency of intense rainfall in the country increasing, causing severe floods, water logging, landslides, and mud flows		Protection of groundwater resources and water catchment areas
Sea Level Rise exacerbating drainage blockages & water logging; causes salt water intrusion		Rainwater harvesting, creation of water reservoir, low cost filter in salinity affected areas
Shortages of fresh water for drinking becoming acute		Increasing surface water storage and restoring natural water courses
Health, Migration and Social Protection	Water, air, and vector-borne diseases and outbreaks of cholera, diarrhea, and dengue increasing	Better irrigation water management to reduce mosquito breeding sites; improved diseases/vector surveillance and monitoring; education, training & awareness campaign on public health issues
	Children, women, elderly, and poor people suffering more from heat and cold waves	Improved housing and living condition in climate vulnerable zones
	People losing livelihood and getting displaced due to cyclone and storm surge, sea level rise, river erosion, etc. 'Climate migrants' becoming a key emerging issue in the country	Livelihood protection in ecologically fragile areas and protection of vulnerable socio-economic groups
		Monitoring of internal and external migration and providing support for rehabilitation Improving the education and work skills of migrants and financing of resettlement costs and rehabilitation
Multi-sector		Mainstreaming climate change in national, sector and spatial development programs
		Institutional strengthening and building of human resource capacity
		Improved capacity of Ministry of Environment and Forests (MOEF) to manage and coordinate investments in and knowledge on climate-resilient initiatives

Source: Strategic Program for Climate Resilience: Bangladesh, 2010

**RESEARCH, DATA, AND INFORMATION GAPS**

Bangladesh is at the forefront of addressing climate change. However, there are large data gaps in terms of the local and regional hydro-meteorological information as well as data on its biophysical and socioeconomic sectors.

The following are major data needs:

- ➔ To better inform disaster management response and for sub-national planning, improved baseline field data collection, analysis and dissemination is required. Coupled with the unpredictability of coarse GCMs, it becomes imperative to have fine-scale data to support decision making in agriculture, water, energy, and disaster management.
- ➔ There is need for data collection and analysis on various aspects of socio-economic vulnerability and resilience to climate change and other neglected sectors like health and manufacturing.
- ➔ A centralized climate change database, which includes hydro-meteorological data, forecasts and warnings and also archives, needs to be developed.

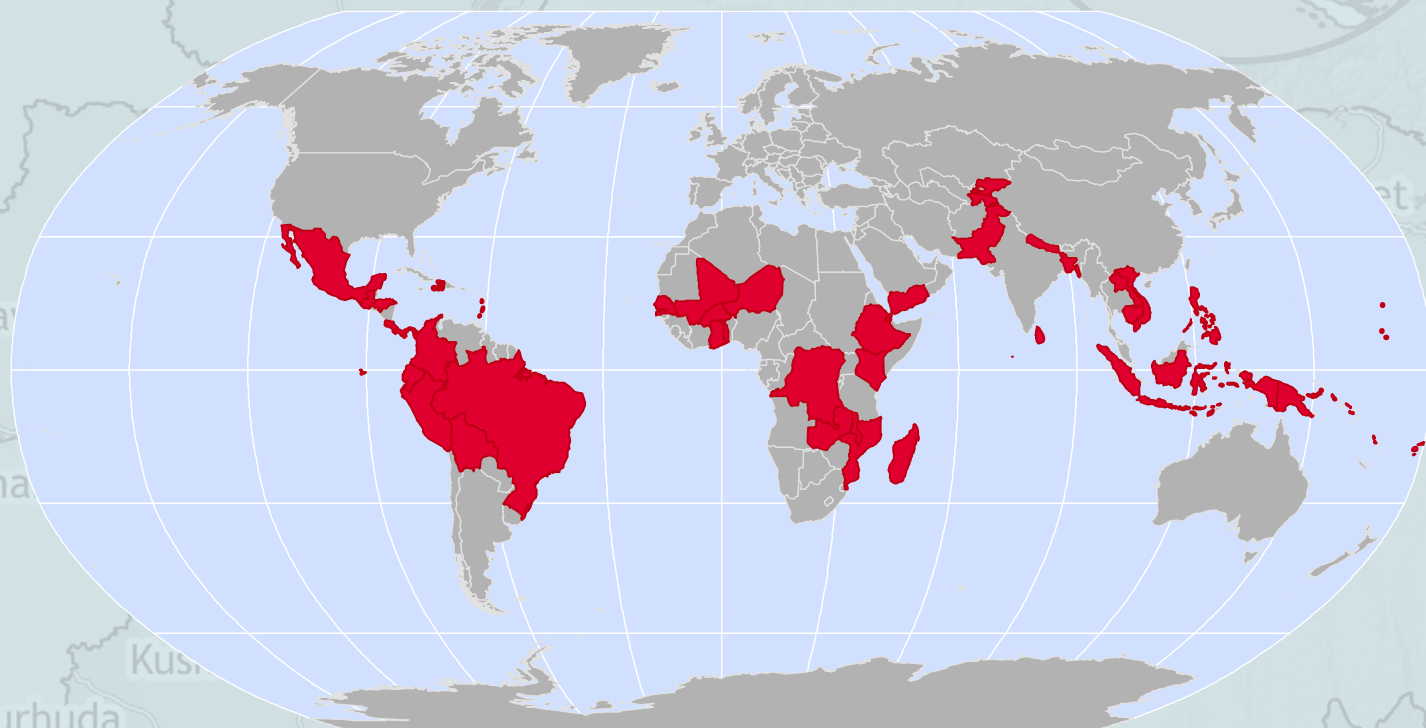
For decision making and institutional responses, the following needs exist:

- ➔ Enhanced efforts to disseminate forecast and meteorological data into information that can be translated into action at the local level.
- ➔ Strengthening of efforts to raise public awareness and reach remote inaccessible areas through better communication systems, especially during times of extreme events.
- ➔ Mainstreaming seismic risk awareness, mitigation, and reduction into the country's core disaster management agenda and strategy.
- ➔ Addressing existing knowledge gaps about climate change across sectors by mainstreaming climate change in development planning and implementation.



# Climate Risk and Adaptation Country Profile

This Country Profile (<http://countryadaptationprofiles.gfdr.org>) is part of a series of 49 priority country briefs developed by the Global Facility for Disaster Reduction and Recovery (GFDRR) and the Global Support Program of the Climate Investment Funds (CIF). The profile synthesizes most relevant data and information for Disaster Risk Reduction and Adaptation to Climate Change and is designed as a quick reference source for development practitioners to better integrate climate resilience in development planning and operations. Sources on climate and climate-related information are linked through the country profile's online dashboard, which is periodically updated to reflect the most recent publicly available climate analysis.



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