

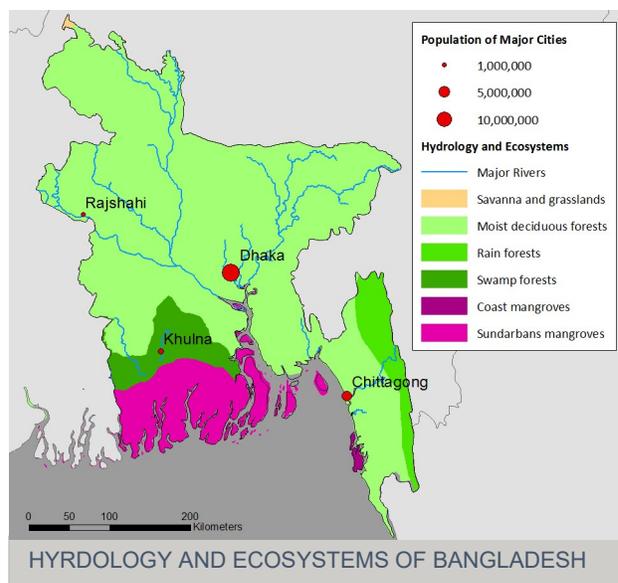


# CLIMATE RISK PROFILE BANGLADESH

## COUNTRY OVERVIEW

Sitting in a predominantly low-lying region at the intersections of the Ganga, Meghna, and Brahmaputra rivers and the Ganga-Brahmaputra delta, Bangladesh is one of the most vulnerable countries in the world to a changing climate. The eighth most populous country in the world, Bangladesh has a population of approximately 165 million people, of which nearly one in three live in poverty. Many of the country's densely populated urban centers are susceptible to increased flooding related to storm surge and sea level rise, and Bangladesh is acutely exposed to tropical cyclones with one hitting, on average, every three years. Most recently, Cyclone Mora struck Bangladesh in May 2017, displacing 500,000 Bangladeshis in coastal areas and damaging 20,000 homes in refugee camps. Strong economic growth, with an average annual increase in gross domestic product (GDP) of 6.2

percent since 2010, is expected to continue and in turn drive an increase in the urban population from its current 36 percent to 56 percent by 2050. The service sector comprises more than half of total GDP and the garment industry also significantly contributes, generating \$28.7 billion in exports in 2016. Meanwhile agriculture employs nearly half the population, while making up 15 percent of GDP. The combination of high and increasing population density, geography, poverty, and weak infrastructure make Bangladesh especially vulnerable to the adverse impacts of climate change. (1,3,4,19,20)



## CLIMATE PROJECTIONS



0.5–2.8°C increase in temperatures by 2060



Increase in rainfall intensity, flood incidence, and cyclone intensity and incidence



Rising sea levels and increase in incidence of storm surge

## KEY CLIMATE IMPACTS

### Agriculture and Food Security

Reduced crop yields  
Fisheries and livestock losses  
Increased food insecurity



### Water Resources

Decreased potable water supplies  
Changes to river flows  
Decreased irrigation water



### Health

Increased heat stress  
Higher prevalence of infectious diseases  
Injury and death from cyclones and floods



### Ecosystems

Biodiversity loss  
Loss of livelihoods  
Reduced natural flood protection



### Energy

Increased energy demand for energy  
Damaged energy infrastructure  
Decreased hydropower capability



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## CLIMATE SUMMARY

Floodplains comprise 80 percent of Bangladesh's area, with the remaining areas primarily made up of hills and terraced land. The seasonal monsoon patterns dominate the Bangladesh climate and significantly affect ecosystems and livelihoods. June to early October, characterized as Bangladesh's monsoon season, sees temperatures average around 28°C and the country receive approximately 80 percent of its annual rainfall. Late October and November are characterized as post-monsoon season, with decreasing rainfall as well as decreasing minimum temperatures. December to February are typically dry and are the coldest months of the year, with temperature averages around 20°C. The pre-monsoon season (March through May), brings warmer temperatures, with averages around 25-28°C, and erratic, occasionally heavy rainfall. *Kalbaishakhi* storms are intense thunderstorms that sometimes occur prior to the monsoon. Bangladesh is also significantly affected by tropical cyclones and floods. The northwestern and western parts of the country are drought prone. (3,4,13,14,19)

### HISTORICAL CLIMATE

Climate trends since 1960 include the following:<sup>1</sup>

- Average temperature increased by around 0.3°C during the warmest months, June through August, and around 0.5°C from September through November.
- While total rainfall across the country has not changed significantly, the west and northwest have experienced increases in average rainfall.
- Rainfall between March and May has increased by 3.4 percent, while rainfall between June and August has decreased by 1.7 percent.
- The frequency of "hot days" increased by 26 days per year.<sup>2</sup> (10,12,19)

### FUTURE CLIMATE

Projected changes include the following:

- Increase in average annual temperature by between 0.5°C and 2.8°C by 2060, with the north experiencing somewhat larger increases than the south.
- Projected changes throughout the country in average annual rainfall range from a decrease of around 14 percent to an increase of around 24 percent by 2060.
- Projections on the extent of sea level rise differ, ranging from an increase of 27 centimeters by 2050 to an increase of between 30 and 100 centimeters by 2100. Resulting land loss projections range from 10 to 18 percent based on potential sea level rise of 45 to 95 centimeters, respectively.
- Increase in the frequency of "hot days" to between 17 to 39 percent of days each year by 2060. (12,16,18)

## SECTOR IMPACTS AND VULNERABILITIES

### AGRICULTURE AND FOOD SECURITY

The agriculture sector is extremely vulnerable to increasing temperatures, changes in rainfall patterns, drought, flooding and cyclones. Rising salinity from intruding sea water in coastal areas limits crop yields and production. Irrigation, which supports around half the agricultural land, draws predominantly from aquifers, leaving agriculture threatened by increasing salinization. Changing river flows are expected to affect surface water-based irrigation (see discussion of water resources below). The impacts of climate change are expected to decrease agricultural GDP by 3.1 percent each year, which equates to an overall loss in added value of USD 36 billion between 2005 and 2050. Of the

Climate Stressors and Climate Risks AGRICULTURE AND FOOD SECURITY	
Stressors	Risks
Increased temperatures	Decreased yield of rainfed crops
Increased drought and flooding due to shifting rainfall patterns	Food shortages, leading to increased grain prices and increased dependence on imports
Increased intensity and frequency of heavy rainfall events	Damage to agricultural land, livestock, and infrastructure
Increased saline intrusion due to sea level rise and storm surge	Damaged and degraded fisheries

<sup>1</sup> Climate trends are from 1960 to 2003.

<sup>2</sup> A "hot day" is defined as a day when the daily maximum temperature exceeds the 90th percentile of daily maximum temperatures over the 1960 – 2003 period for the country.

1.2 million hectares of arable land used for agriculture in Bangladesh, 77 percent is used for rice production. Rice makes up 71 percent of daily caloric intake for rural consumers and 63 percent for urban consumers. Increasing temperatures, prolonged and more frequent droughts and flooding, and losses caused by increasing soil salinity are projected to decrease rice production<sup>3</sup> by 8 percent by 2050, thus reducing a key source of nutrition. Other important crops, such as wheat, potato, maize, sugarcane and soybeans are also expected to suffer yield decreases due to climate change. Changing climatic conditions have also likely contributed to the growth of wheat blast, an aggressive fungus first found in Bangladesh in 2016 that can devastate wheat crops in a matter of days. Worsening riverbank erosion, floods, storm surges, and saline intrusion threaten the country's fisheries, which make up 23 percent of the agricultural sector and provide 80 percent of the total animal protein consumed in Bangladesh. Such climate change stressors, along with drought and heat waves, are also expected to negatively affect livestock, an important source of income and food for the rural poor in the country. Cyclones can also severely impact all aspects of agriculture. In 2007, Cyclone Sidr damaged over 647,000 hectares of cropland, destroyed nearly 3,000 fishing boats, affected USD 18 million in livestock, and contributed to over USD 415 million in crop production losses. In the agricultural sector, women and girls are disproportionately more vulnerable to climate change due to their limited access to resources and exclusion from decision-making processes. (3,7,8,19,20)

## WATER RESOURCES

Two-thirds of Bangladesh sits less than 5 meters above sea level, leaving these areas highly susceptible to river and tidal flooding. Flooding, loss of livelihood, and death serve as persistent threats for the millions living in the vast floodplains, the low-lying coastal areas and delta, and along the dense network of tributaries of the Ganga, Meghna, and Brahmaputra rivers, as well as for those who depend on navigable waterways as a means of transportation. River flows are expected to be affected by increased glacial melt, increased

temperatures, extended periods of drought, and changes in precipitation patterns causing inconsistent water availability and flooding. Glacial melt outside of Bangladesh, in the Himalayas, may already be contributing to catastrophic flooding in the Ganga/Brahmaputra/Meghna Basin, though other factors, such as vegetation loss, likewise contribute. Extreme climate events such as flooding, drought, sea level rise, and cyclones are also likely to significantly impact the functionality and accessibility of water supply and sanitation infrastructure. In response to worsening drought conditions and rising agricultural demand, groundwater extraction for drinking water and irrigation is increasing. This additional extraction presents potential health risks as 25 percent of Bangladesh's 4 million wells are contaminated with naturally occurring arsenic, particularly those in the south and west. Potable water is further threatened by sea level rise and worsening storm surges, which contribute to increasing aquifer salinization in the coastal regions. This diminishing accessibility of quality drinking water, coupled with the poor state of sanitation infrastructure and slowed adoption of improved sanitation practices, presents increased risk of water- and vector-borne diseases, including diarrhea, cholera, malaria, dengue, and salinity related diseases, especially during the summer months. (1,8,11,20)

Climate Stressors and Climate Risks WATER RESOURCES	
Stressors	Risks
Sea level rise	Reduced availability of potable water
Glacial melt	Increased burden and resources necessary to secure potable and irrigation water
Saline intrusion	
More frequent and extreme weather events	Less reliable river flows and navigation

<sup>3</sup> Aman rice production will be primarily affected by more frequent flooding whereas boro rice is most likely to be impacted by limited water availability.

## ECOSYSTEMS

With natural resources providing livelihoods for more than 75 percent of Bangladeshis and offering essential sources of food and water, ecosystem services are critical for Bangladesh. More than 25 percent (4 million hectares) of Bangladesh’s total land surface is comprised of freshwater ecosystems, and 11 percent (1.4 million hectares) is forested. Southern Bangladesh is home to the Sundarbans, the largest continuous mangrove forest in the world, which covers 580,000 hectares of land and harbors 334 plant species and 269 animal species. A potential 45-centimeter sea level rise by 2050 could inundate the Sundarbans, causing an extreme imbalance to the saltwater and freshwater composition, destroying habitat, and ultimately reducing biodiversity. These natural coastal forests also serve as an important source of protection against high winds associated with the *kalbaishakhi* storms and cyclones, as well as storm surges and coastal flooding. In 2007, Cyclone Sidr affected over 40,000 hectares of forest resources both in and outside the Sundarbans, resulting in estimated damages of around USD 145 million. Drier conditions from increased temperatures and prolonged drought have increased the prevalence of forest fires, contributing to Bangladesh’s declining tree canopy, which has likewise been significantly impacted by human encroachment into protected areas and infrastructure development. Importantly, there is evidence that forest loss in the Sundarbans has been minimal since 2000 as a result of concerted conservation efforts. Continued natural resource management and land use planning initiatives will be essential to both support biodiversity and forest-based livelihoods and preserve ecosystems such as the Sundarbans that play essential functions in climate risk reduction. (6,7,19,20)

Climate Stressors and Climate Risks ECOSYSTEMS	
Stressors	Risks
Sea level rise	Alteration or loss of coastal wetlands and mangrove forests through salinity intrusion and storm surge, reducing biodiversity and increasing risk from flooding and high winds
More intense and/or frequent extreme weather events	
Rising temperatures and prolonged drought	Higher water temperature will harm aquatic ecosystems
Erratic rainfall	Intense or shifting monsoons impacting rural livelihoods
	Loss in tree cover

## ENERGY

Climate change is expected to increase demand for energy while reducing the ability to meet that demand. Prolonged heat waves and higher average temperatures are expected to drive users to consume more energy for greater lengths of time throughout the year. At the same time, increased frequency and intensity of extreme weather events are also likely to reduce energy supply. Storms, flooding, and high winds can damage power plants, electricity, transmission lines and other energy infrastructure. More extensive or frequent droughts, in addition to changing river flows from increased glacial melt and increased temperatures, are expected to decrease hydropower generation. Bangladesh is currently challenged to meet increased energy demand due to inadequate power production and less efficient power, transmission, and distribution network. Sustained economic growth has further driven an increase in energy demand, yet more than half of households were found to not have access to electricity in 2015 and per capita energy consumption in Bangladesh remains among the lowest in the world. The combination of rising energy demand and increasing risks to supply due to climate change are likely to result in higher energy prices, affecting access for the poor. (1,9,10,19,20)

Climate Stressors and Climate Risks ENERGY	
Stressors	Risks
Increased temperatures	Increased energy demand
More intense and/or frequent extreme weather events	Damaged energy infrastructure
Increased drought	Reduced generation and transmission efficiency

## HEALTH

The extent to which increased climate variability and change will impact human health in Bangladesh is not well understood due to a lack of quantitative studies. However, higher temperatures may lead to increased heat stress, particularly for vulnerable populations such as older persons, women, and children. Increased heat stress may also put additional strain on maintaining or operating essential health infrastructure, such as cold chain facilities. Other extreme weather events, particularly cyclones, droughts, and floods, pose direct threats to life and safety, opportunities for training and capacity building of healthcare service providers, and management and oversight of healthcare service delivery. While cyclone mortality has significantly decreased in recent years as early warning systems have improved, more than half of the cyclones that have hit Bangladesh since the early 1900s have claimed more than 5,000 lives. Cyclones and other extreme weather events can also directly impact health facilities, with Cyclone Sidr causing over USD 17.5 million in damages to these structures. Projected increases in flooding can also be expected to worsen the overall disease burden. Such flooding, in combination with higher temperatures and changing rainfall patterns, creates favorable conditions for water- and vector-borne diseases to both intensify and spread more widely. These include malaria, dengue, cholera and other diarrheal diseases. During extreme weather events, such as Cyclone Sidr, these diseases can become even more prevalent and the capacity of health service providers is often insufficient to support all affected persons. Climatic events such as drought or flooding may force displacement of individuals or communities, risking increased spread of communicable diseases and further strain on limited food or water resources as well as health service providers. In coastal areas where flooding is also a concern, saline intrusion is expected to significantly limit available potable water, contributing to water scarcity. Increased salinity is also linked to higher rates of hypertension, a risk particularly problematic for pregnant women. Decreases in food security and nutrition may have both immediate and long-term health effects, particularly for the rural poor. Impacts of health-related climate risks may be compounded by inequities in the Bangladeshi health care system. Inadequate infrastructure within and beyond the sector, such as health facilities, roads, and electricity transmission, is prone to extreme weather events, increasing the health system’s vulnerability to climate risks. Improving this infrastructure, supporting provision of reliable drinking water supply and improved sanitation, building capacity of health service professionals to respond during emergency situations, and strengthening existing emergency response systems, can all help reduce the vulnerability of this sector. (1,3,7,14,20)

Climate Stressors and Climate Risks	
HEALTH	
Stressors	Risks
Increased temperatures	Increased heat stress
More intense and/or frequent extreme weather events	Potential increases in water- and vector-borne diseases
	Decreased nutrition and food security
Saline intrusion	Reduced access to health services and potable water

## POLICY CONTEXT

Released in 2012, Vision 2021 outlines a strategic plan to achieve the government's development vision, mission and goals in advance of the 50<sup>th</sup> anniversary of Bangladesh's independence. Under Vision 2021, the Seventh Five Year Plan (FY2016-FY2020) currently in effect, stresses that while national capacity and expertise to address environment, climate change, and disaster management concerns have increased, the challenge remains to effectively implement policies and integrate lessons learnt (9,10).

### INSTITUTIONAL FRAMEWORK

The Ministry of Environment and Forests (MoEF) was established after the Government of Bangladesh signed and ratified the United Nations Framework Convention on Climate Change. MoEF is mandated to ensure that environmental matters are considered in development programming. MoEF is also required to review and monitor the impact of development initiatives on the environment across all sectors. To achieve the goals outlined in the Climate Change Strategy and Action Plan, the Bangladesh Climate Change Trust Fund was established, which is chaired and managed by the MoEF (10,21).

### NATIONAL STRATEGIES AND PLANS

- [Vision 2021](#) (2012)
- [Seventh Five-Year Plan](#) (2015)
- [Bangladesh Climate Change Strategy and Action Plan](#) (2009)
- [Bangladesh National Adaptation Programme of Action](#) (2005; updated 2009)
- [National Sustainable Development Strategy](#) (2013)
- [Bangladesh Delta Plan 2100](#) (2017) (still receiving comments)
- [Bangladesh's Intended National Determined Contributions](#) (2015)
- [Bangladesh Environment, Forestry and Climate Change Country Investment Plan](#) (2017) (in press)

### KEY RESOURCES

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**Data for map sourced from:** USGS Hydrosheds Cities (<https://hydrosheds.cr.usgs.gov/dataavail.php>), Natural Earth Populated Places (<http://www.naturalearthdata.com/downloads/10m-cultural-vectors/10m-populated-places/>), and World Wildlife Fund Terrestrial Ecoregions of the World (<https://www.worldwildlife.org/pages/conservation-science-data-and-tools>)

## SELECTED ONGOING EXPERIENCES<sup>4</sup>

The previous and ongoing projects and programs listed in the table below are illustrative of work related to climate variability and change in Bangladesh. Projects were selected through review of USAID, other donors', and implementing partners' project databases.

Selected Program	Amount	Donor	Year	Implementer
<a href="#">Building Resilience of the Urban Poor</a>	USD 2 million	C&A Foundation	2014-2017	CARE Bangladesh
<a href="#">Catalyzing Clean Energy in Bangladesh</a>	USD 15 million	USAID	2012-2017	Deloitte Consulting LLP
<a href="#">Climate Resilient Ecosystems and Livelihoods (CREL)</a>	USD 35.5 million	USAID	2012-2017	Winrock International
<a href="#">Enhanced Coastal Fisheries (ECOFISH-BD)</a>	USD 15 million	USAID	2014-2019	Bangladesh Department of Fisheries and WorldFish
<a href="#">Expanding the Protected Area System to Incorporate Important Aquatic Ecosystems</a>	USD 1.6 million	World Bank Global Environment Facility	2015-2019	Bangladesh Ministry of Environment and Forests
Promoting Climate Resilient Agriculture and Food Security	USD 3.7 million	World Bank Climate Investment Fund	2013-2017	Government of Bangladesh
<a href="#">Safe Aqua Farming for Economic and Trade Improvement (SAFETI)</a>	USD 16.5 million	USDA	2016-2021	Winrock International
<a href="#">Scaling Up Inclusive Resilience Amongst Water Logged Communities in South Western Bangladesh</a>	USD 0.5 million	ECHO/CARE International UK	2016-2017	CARE Bangladesh
<a href="#">Strengthening the Environment, Forestry and Climate Change Capacities of the MoEF and its Agencies</a>	USD 5 million	USAID	2013-2016	FAO and MoEF
<a href="#">Supporting Bangladesh Rapid Needs Assessment</a>	USD 4 million	DFID	2017-2020	CARE Bangladesh
<a href="#">Water Management Improvement Project</a>	USD 136 million	The World Bank	2007-2016	Bangladesh Water Development Board and WARPO
<a href="#">Where the Rain Falls</a>	USD 0.5 million	Prince Albert II Foundation	2017-2018	CARE Bangladesh

<sup>4</sup> This "Selected Ongoing Experiences" section lists a selection of ongoing development projects and interventions directly or indirectly relevant to climate risk management and adaptation in Bangladesh. Experiences were identified primarily via desk review of USAID, multilateral development bank, and other international donor programming. Experiences listed are not meant to be comprehensive.