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REPORT

Climate change impacts in Bangladesh

*WHAT CLIMATE CHANGE MEANS FOR A
COUNTRY AND ITS PEOPLE.*

A scientific synthesis led by the International Centre for
Climate Change and Development (ICCCAD)

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This report is a scientific synthesis by the International Centre for Climate Change and Development (ICCCAD) in collaboration with Bangladesh University of Engineering and Technology (BUET). It is intended to inform policymakers, media, the private sector, civil society, academics and anyone looking for country-level information on the impacts of climate change in Bangladesh. It has been reviewed internally before publication.

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Dedication:

The authors, editors and design team wish to dedicate this report to Prof Saleemul Huq, whose insight and enthusiasm played a vital role in the project from the very beginning. We feel his loss every day, as do so many in the climate sector to whom he was a mentor, leader, friend, ally and constant source of inspiration. We send our heartfelt condolences to his family and loved ones, and we hope that this report can do justice to our friend's clear vision, bright light and towering legacy.

Climate change impacts in Bangladesh

Executive summary

With the Himalayas to the north and the Bay of Bengal to the south, Bangladesh sits on one of the world's largest and most densely populated deltas, where the Jamuna, Padma and Meghna rivers converge. Bangladesh's geography and low-lying delta topography make it particularly vulnerable to climate change, ranking highly on the list of countries most prone to climate devastation.

Bangladesh has been on the front line of climate change for decades, repeatedly confronting heatwaves, tropical cyclones, floods and droughts.

Between 2000 and 2019, Bangladesh experienced 185 extreme weather events, making it the seventh most vulnerable country to climate change.¹ In June 2023, temperatures surpassed 40°C during a prolonged heatwave.² Tropical cyclones have ripped through coastal communities,³ costing on average 0.7% of gross domestic product (GDP) per year.⁴

The Long-Term Climate Risk Index (CRI)

The 10 countries most affected from 2000 to 2019 (annual average)

CRI 2000-2019 (1999-2018)	Country	CRI Score	Fatalities	Fatalities per 100 000 inhabitants	Losses in million US\$ PPP	Losses per unit GDP in %	Number of events (2000-2019)
1 (1)	Puerto Rico	7.17	149.85	4.12	4 149.98	3.66	24
2 (2)	Myanmar	10.00	7 056.45	14.35	1 512.11	0.80	57
3 (3)	Haiti	13.67	274.05	2.78	392.54	2.30	80
4 (4)	Philippines	18.17	859.35	0.93	3 179.12	0.54	317
5 (14)	Mozambique	25.83	125.40	0.52	303.03	1.33	57
6 (20)	The Bahamas	27.67	5.35	1.56	426.88	3.81	13
7 (7)	Bangladesh	28.33	572.50	0.38	1 860.04	0.41	185
8 (5)	Pakistan	29.00	502.45	0.30	3 771.91	0.52	173
9 (8)	Thailand	29.83	137.75	0.21	7 719.15	0.82	146
10 (9)	Nepal	31.33	217.15	0.82	233.06	0.39	191

Note: Bangladesh experienced 185 extreme weather events between 2000 and 2019. GDP = gross domestic product. PPP = purchasing power parity. Source: Global Climate Risk Index.

Devastating floods are happening more often. Climate change made the pre-monsoon rain that destroyed the summer paddy crop in 2017 twice as likely.⁵ Alongside extreme weather, sea level in Bangladesh is rising by 3.8 to 5.8 mm per year – faster than the global average.⁶

Climate impacts are already damaging ecosystems, livelihoods, infrastructure and food security. Extreme heat exposes workers to heat stress, costing lives and reducing productivity.² Tropical cyclones – and associated storm surges – destroy homes and disrupt coastal livelihoods, such as fisheries.⁷ In 2017, floods made more likely by climate change contributed to a 30% hike in rice prices.⁵ Sea level rise is forcing people to leave their homes and has increased land affected by saline soils by 27% since the 1970s, with consequences for crops and livelihoods.⁸

Climate change made the pre-monsoon rain that destroyed the 2017 paddy crop twice as likely, contributing to a 30% hike in rice prices.

Government adaptation policy and local initiatives have saved many lives and, so far, averted the worst impacts of climate change.

Bangladesh is recognized as a global leader in adaptation and resilience. In 2005, Bangladesh was one of the first least developed countries to develop a national adaptation programme of action.⁹ This paved the way for other ambitious policy initiatives, including the Bangladesh Delta Plan,¹⁰ the Mujib Climate Prosperity Plan¹¹ and the National Adaptation Plan (2023–2050).⁸



A fisherman removes plants from the edge of the riverbank as a boy looks out from the window of a floating health clinic in Pabna, Bangladesh, in June 2019. Non-profit organization Shidhulai Swanirvar Sangstha has built floating schools, health clinics and farms in low-lying parts of the country. Credit: Jack Taylor / Climate Visuals Countdown.

In the last few decades, the number of people who have died during cyclones has fallen from six digits (e.g. 300,000+ from Cyclone Bhola in 1970) to double digits (e.g. 35 from Cyclone Sitrang in 2022), largely due to the success of the country's Cyclone Preparedness Programme.¹²

In the last few decades, the number of people who have died during cyclones has fallen from six digits to double digits, largely due to the success of the Cyclone Preparedness Programme.

Community-based early warning systems, strengthening of polders, coastal afforestation and elevated housing have also reduced the human cost and damage of extreme weather events. Research into saline-tolerant varieties of rice, floating agriculture in regions that suffer flooding, and water-saving technologies in drought-prone areas are examples of strategies to help safeguard food security in the face of increasingly extreme weather.⁸

In these and other national policies and plans, the government of Bangladesh is increasingly recognizing the vital importance of Indigenous and local knowledge, putting the lived experiences and priorities of communities at the forefront of adaptation activities.

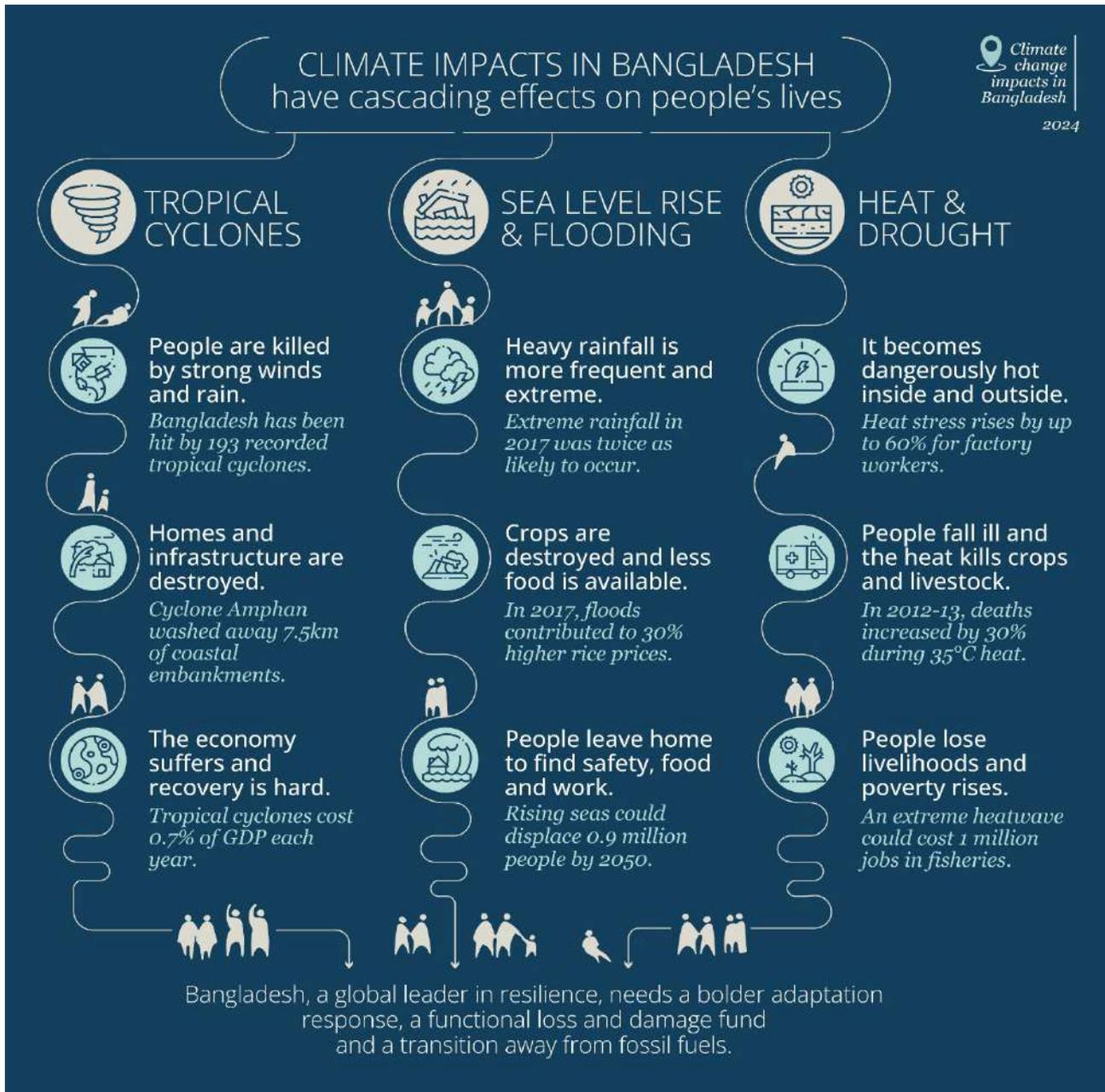
Climate impacts in Bangladesh are increasing at an alarming rate, and current safeguards soon won't be enough to protect people.

Even with accelerated climate action, continued warming and more extreme weather will stress adaptation efforts in Bangladesh, making it harder to protect lives and livelihoods. By the end of the century, even under a very low emissions scenario (SSP1-2.6 or RCP2.6; see box in Section 3.1), Bangladesh could see a further 0.8°C of warming compared with 1981–2010¹³ and heavier rainfall could increase peak river flow by 16% relative to 1971–2000,¹⁴ raising the risk of flooding.

Even with accelerated climate action, continued warming and more extreme weather will stress adaptation efforts in Bangladesh, making it harder to protect lives and livelihoods.

In southern Bangladesh, projected sea level rise could displace 0.9 million people by 2050¹⁵ and more saline waters could disrupt fisheries, disproportionately affecting coastal communities, for whom fish is an important source of protein.¹⁶ Sea level rise exacerbates the risk from tropical cyclones. If a cyclone the size of Amphan occurred in 2100, the number of people exposed to the storm surge would be 50–80% higher than when it made landfall in 2020. The exception would be if global temperature rise were limited to 2°C, in which case exposure would be unchanged.¹⁷

Current safeguards will face challenges in keeping pace with future changes. Under the highest emissions scenario (RCP8.5 or SSP5-8.5), sea level rise in Bangladesh is projected to breach the current system of coastal defences and embankments, potentially inundating 18% of the coastal zone.⁸ Coastal embankments were damaged and washed away during Cyclone Amphan, allowing the storm surge to flood up to 15 km inland and forcing 500,000 families from their homes.¹⁸



Signature figure. Climate impacts in Bangladesh have cascading effects on people's lives. GDP = gross domestic product. Credit: InfoDesignLab.

Bangladesh needs a bolder adaptation response, alongside a functional loss and damage mechanism and a transition away from fossil fuels.

Currently, the government of Bangladesh spends approximately 6–7% of its annual budget on climate adaptation, about 75% of which comes from domestic sources. However, scaling up adaptation measures as outlined in the National Adaptation Plan (2023–2050) will require seven times the current spending.⁸ Bangladesh may also wish to strategically partner with other South Asian and least developed countries to co-produce knowledge and strengthen adaptation efforts.

On the international stage, COP28 agreed on a loss and damage deal, with pledges totalling approximately \$655 million so far. There are concerns, however, about the size and volume of the

fund and about the funding mechanism being managed by the World Bank. Another of the main criticisms is that the pledges are in the form of loans rather than grants, which will add to vulnerable countries' already significant debt burdens. Additionally, the pledges are not clear on how the money will be distributed, with the potential that it will not reach the countries that need it most. Bangladesh supports a loss and damage mechanism that upholds principles of climate justice, collectively addresses the extensive adaptation finance needs of vulnerable countries, and follows participatory decision-making approaches, such that the voices of the intended beneficiaries are represented.

Bangladesh's ability to continue responding to climate change requires government investment, locally led adaptation, equitable loss and damage financing, and a large-scale shift to secure, low-carbon energy.

Finally, supporting the communities most at risk of climate impacts requires transitioning away from fossil fuels. Yet, despite some strengthening of climate policies and the falling costs of low-carbon energy, the world is headed for around 2.7°C warming by 2100.¹⁹ Bangladesh is itself still overwhelmingly reliant on fossil fuels, generating just 1% of electricity from wind and solar in 2022.²⁰

Overall, Bangladesh's ability to continue responding to climate change requires multiple strands of action: national coordination and government investment; locally led adaptation; equitable loss and damage financing; and a large-scale shift to secure, low-carbon energy.

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Climate change impacts in Bangladesh

Chapter 1 | Climate vulnerability

Bangladesh has been on the front line of climate change for decades, confronting heatwaves, tropical cyclones, floods and droughts.

Bangladesh's geography and low-lying delta topography make the country and its people especially vulnerable to climate disasters. The riverine and coastal environment is inherently dynamic, and communities have developed traditional practices to function, by and large, within these shifting landscapes. But climate change has amplified and altered the nature of these pressures and created new ones. Alongside more intense tropical cyclones, floods and droughts, sea level is rising faster than the global average, destroying people's health, lives and livelihoods.

1.1 National snapshot

With the Himalayas to the north and the Bay of Bengal to the south, Bangladesh sits on the world's largest delta, where three rivers converge and reach the sea: the Jamuna (the lower reaches of the Brahmaputra), the Padma (the main tributary of the Ganges) and the Meghna.

Bangladesh's climate is humid, wet and warm and revolves around the monsoon. Typically, the rainy season lasts from April to September, when the climate is warmest, while the winter season (December to February) is drier and colder. Rainfall is driven by the south-west monsoon from the Indian Ocean, and the country typically endures a tropical cyclone every two to three years.²¹

With an estimated population of 170 million and an area of 148,460 km², Bangladesh is one of the most densely populated countries in the world.²² Its towns and cities are growing rapidly, with 40% of Bangladesh residents now living in urban settings. About 20% of the population live in the coastal zone, which covers a third of the country's total land area.

About 20% of Bangladesh's population live in the coastal zone, which covers a third of the country's total land area.

Agriculture is a major economic activity, accounting for about 11% of gross domestic product (GDP) and employing 37% of the country's workforce.²³ Bangladesh produces a variety of products, including rice, wheat, corn, legumes, fruits, vegetables and dairy products. Fisheries and aquaculture are also a key part of the agricultural sector, providing the country with its primary source of protein and generating significant revenue through domestic and international sales. They also provide livelihoods for more than 17 million people.²¹

Major Hazards in Bangladesh



Figure 1. Bangladesh's geography and low-lying delta topography make the country and its people especially vulnerable to climate disasters. Such disasters include increasing salinity and tropical cyclones (green), river floods (blue, orange, pink stripes) and drought (red, orange, orange stripes). Source: Planning Commission, Ministry of Planning and Asian Development Bank, 2021.²⁴

1.2 Confronting climate change

Bangladesh ranks seventh on the list of countries most vulnerable to climate devastation, according to the Global Climate Risk Index. In just the past two decades (2000–2019), the population has faced 185 extreme weather events.¹ The most significant climate threats are tropical cyclones, sea level rise, heavy rain and floods, extreme heat, and droughts.

Tropical cyclones are deadly and have a huge impact on coastal communities through the severe damage caused to houses, property, livestock, crops and fisheries. Bangladesh's geographical position puts it at particular risk: the funnel shape of the Bay of Bengal (see Figure 1) directs tropical cyclones into the coastal zone and onward inland, where the low-lying and flat topography leaves residents vulnerable to storm surges.⁸ Although the number of cyclones has fallen over the satellite era (1970–2015), the proportion of intense events has increased.²⁵ Average losses per year from cyclone damage amount to an estimated \$1 billion (0.7% of GDP).²⁶

The funnel shape of the Bay of Bengal directs tropical cyclones into the coastal zone and onward inland, where the low-lying and flat topography leaves residents vulnerable to storm surges.

Slow-onset climate-related events also affect Bangladesh, primarily sea level rise. Almost a third of the population, 50 million people, live less than 5 m above sea level.²⁷ Over the satellite era (1970–2015), sea level in the coastal zone of Bangladesh has risen by 3.8–5.8 mm per year,⁶ which is faster than the global average of 2.1 mm per year.²⁸ There has been a 27% increase in salt-affected coastal areas since the 1970s, with consequences for crops and livelihoods.⁸

River floods are a known hazard for Bangladesh's riverside communities, occurring every couple of years, typically during monsoon season. Currently, about 3,000 ha of land alongside rivers is eroded each year, displacing about 25,000 people.⁸ Flash flooding after heavy rain damages infrastructure, agriculture and ecosystems. In March and April 2017, floods damaged 220,000 ha of summer paddy crop that were nearly ready to be harvested, contributing to a record 30% hike in rice prices compared with the previous year. An attribution study concluded that climate change had made the extreme rainfall that led to those floods twice as likely to occur.²⁹

Bangladesh also regularly experiences some of the highest temperatures in Asia, reaching above 35°C on 70 days of the year, on average. However, in June 2023, temperatures surpassed 40°C during the country's most prolonged heatwave in decades.²⁹ Droughts are a common occurrence, with the north-western parts of the country especially vulnerable (see Figure 1).²¹

Bangladesh regularly experiences some of the highest temperatures in Asia, reaching above 35°C on 70 days of the year.

Figure 1 shows the major climate risks facing Bangladesh, including increasing salinity and tropical cyclones (green), river floods (blue, orange, pink stripes) and drought (red, orange, orange stripes). Collectively, these events are causing crops to fail, altering fish species composition, destroying homes and reducing livelihood options in Bangladesh. As well as having severe human consequences, this places a huge economic burden on the country. The average annual loss due

to climate-related disasters is estimated at around \$3 billion, or 1–2% of GDP,²¹ though this figure can be much higher in individual years. In 2019, 4.1 million people were displaced because of climate disasters.³⁰



A family takes refuge from a flood on the roof of their house and in a small, round boat (coracle) in Sirajganj, Bangladesh, in July 2020. Credit: Moniruzzaman Sazal / Climate Visuals Countdown.

CHAPTER 2 looks at how Bangladesh has emerged as a global leader in building resilience, with a number of adaptation successes helping to avert the worst impacts of climate change.

Climate change impacts in Bangladesh

Chapter 2 | Adaptation champions

Government adaptation policy and local initiatives have saved many lives and, so far, averted the worst impacts of climate change.

Bangladesh is recognized as a global leader in adaptation and resilience, together with risk and disaster management. Over the last few decades, government and non-government initiatives across the country have amassed a wealth of knowledge and practice in how to support communities in adapting to a changing environment. National policies are increasingly supporting locally led adaptation in communities responding to the climate crisis.

2.1 National strategy

In 2005, Bangladesh was one of the first least developed countries to put forward a national adaptation programme of action.⁹ Updated in 2009, the programme includes 38 adaptation measures, of which 16 have already been implemented by government ministries and departments. This programme of action paved the way for other ambitious policy initiatives in the subsequent two decades.

In 2008, the Bangladesh Climate Change Strategy and Action Plan was adopted (further revised in 2009).³⁰ The plan consists of six thematic areas to build resilience to climate change over the next 20–25 years: food security, social protection and health; disaster management; infrastructure; research and knowledge management; mitigation and low-carbon development; and capacity building and institutional strengthening.

In 2013, the government of Bangladesh established the Climate Change and Gender Action Plan to ensure gender dimensions were represented in climate change-related policies, strategies and interventions.³¹ A year later, Bangladesh became one of the first least developed countries to establish a climate fiscal framework. Bangladesh's pioneering framework aims, among other goals, to incorporate climate change in government budget-setting processes and public financial management systems. In 2023–2024, climate-related expenditure accounted for 9% of the total budget of 25 relevant ministries.³²

In 2018, the government passed the Bangladesh Delta Plan 2100.¹⁰ This is a plan to “ensure long-term water and food security, economic growth and environmental sustainability while effectively

reducing vulnerability to natural disasters and building resilience to climate change and other delta challenges through robust, adaptive and integrated strategies, and equitable water governance”.

Increasingly, national policies are recognizing the vital importance of locally led adaptation. The concept refers to adaptation that is “controlled by local people, grounded in local realities, ensures equity and inclusivity, and is facilitated by local networks and institutions”.³³ In 2021, the International Institute for Environment and Development, together with researchers and civil society organizations, outlined eight key principles of locally led adaptation designed to give greater voice to local people – particularly women, young people, children, Indigenous Peoples, people who have been displaced, people with disabilities, and marginalized ethnic groups.³⁴

Increasingly, national policies are recognizing the vital importance of locally led adaptation, designed to give greater voice to local people.

In 2021, the Mujib Climate Prosperity Plan Decade 2030 shifted Bangladesh’s development trajectory “from vulnerability to resilience to prosperity” with a number of new and strengthened adaptation efforts and with minimizing loss and damage at its heart.¹¹ The plan aims to invest \$3.89 billion and mobilize an additional \$1 billion by 2030 to further locally led adaptation in climate vulnerable areas.



Students attend a class on the Chalk Lanka Boat School in Singra, Natore, Bangladesh, in July 2017. Floating schools help communities in flood-prone regions adapt to climate change. Credit: Abir Abdullah / Climate Visuals Countdown.

The National Adaptation Plan of Bangladesh (2023–2050), adopted in 2022, takes a medium- to long-term view of adaptation.⁸ As part of a gender-responsive, participatory process that considered science and Indigenous knowledge, the organizers held consultations with local people,

women, people with diverse gender identities, people with disabilities, young people, ethnic communities, children, elderly people, vulnerable communities, other disadvantaged groups, and the private sector. The plan's six goals align with those of the Bangladesh Delta Plan and include climate-resilient agriculture, ecosystem-based adaptation and climate finance.

The primary challenge for achieving overarching adaptation goals – such as those in the National Adaptation Plan (2023–2050) – is finance.

However, despite progress in adopting locally led adaptation as an approach, significant gaps remain in implementing these policies at the grassroots level and in monitoring their effectiveness.³³ A major hindrance to upscaling locally led adaptation interventions nationally and subnationally is the lack of coordination between ministries and the bodies responsible for adaptation interventions. However, the primary challenge for achieving overarching adaptation goals – such as those in the National Adaptation Plan (2023–2050) – is finance (see Chapter 4).

2.2 Success stories

Strengthening the country's resilience in the face of increasingly extreme weather has involved several strands of action: national coordination and investment in infrastructure; early warning systems and response plans; and the large-scale involvement of citizens in sharing localized information, enacting preventative measures and driving emergency responses.

Cyclone preparedness

Bangladesh's Cyclone Preparedness Programme (CPP) was jointly launched by Father of the Nation Bangabandhu Sheikh Mujibur Rahman and the Bangladesh Red Crescent Society in 1972, after Cyclone Bhola killed more than 300,000 people in 1970.¹² The CPP covers 13 coastal districts, including the Rohingya refugee camps in Cox's Bazar. Across these districts the programme's employees and volunteers conduct simulation drills, and wireless communication systems alert people to cyclone warnings. Volunteers also use megaphones, hand-cranked sirens, warning flags and mosque speakers to reach their communities, particularly in areas lacking strong wireless connections.³⁵

As of 2022, 4,530 cyclone shelters had been constructed in coastal areas.

In addition, the CPP constructs cyclone and flood shelters and operates rescue boats, ambulances, relief warehouses, and digital information centres. In the event of a cyclone, the shelters provide safe drinking water, sanitation systems and killas (raised areas where livestock can be tethered – a critical means of livelihood security). As of 2022, 4,530 cyclone shelters had been constructed in coastal areas.⁸

In the last few decades, the number of deaths from cyclones has fallen from six digits (e.g. 300,000+ from Cyclone Bhola in 1970) to double digits (e.g. 35 from Cyclone Sitrang in 2022), largely due to the success of the CPP.⁸ In May 2020, for example, when Cyclone Amphan hit Bangladesh, CPP services evacuated 2.4 million people within five days.³⁶

Adaptation to tidal floods and salinity in the coastal zone

Plots of land enclosed by embankments – known as polders – are integral to adapting to climate change in Bangladesh. Originally constructed in the 1960s, polders protect low-lying land from tidal floods and salinity intrusion. There are now 139 polders along Bangladesh's coastal zone, protecting around 1.2 million hectares (about 25%) of the coastal zone.

The government of Bangladesh has a long-term plan to upgrade coastal embankments in view of rising sea level and increasingly intense tropical cyclones. With \$400 million in funding from the World Bank, the ten-year Coastal Embankment Improvement Project was launched in July 2013, with the aim of rehabilitating 600 km of embankments in 17 polders across six coastal districts.³⁷

As of September 2023, just over 380 km of embankments had been upgraded (63% of the target), directly protecting more than 670,000 people. The project's efforts are revitalizing farming and non-farming activities in these polders. This has, in turn, strengthened households' agricultural development, employment and food security.

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Climate-smart agriculture

Alongside local and traditional farming practices, a number of advances in agriculture are helping to safeguard food security in the face of increasingly extreme weather. These advances allow year-round farming, rather than single-season cultivation.

At a national level, the government provides research grants to develop high-yielding rice varieties that are tolerant of saline water, inundation, heat and cold.⁸ Meanwhile, in southern Bangladesh, gher farming is a traditional practice offering resilience against floods and tropical cyclones: Ponds with wide and tall embankments provide an elevated platform on which to grow vegetables and other crops, while also serving as a bed for paddy rice and for harvesting prawns.³⁸

Smallholder farmers in the south-central, northern and north-eastern wetlands of Bangladesh practice floating agriculture: A sustainable, pollution-free practice, this decades-old tradition uses plant materials to make rafts in waterlogged areas to uplift seedlings and grow vegetables in monsoon months.³⁹ At the other extreme, water-saving technologies in drought-prone areas include harvesting rainwater, increasing irrigation efficiency, integrating rice farming and vegetables in waterlogged coastal areas, and using solar-powered portable irrigation systems.

CHAPTER 3 looks at how climate impacts in Bangladesh are projected to worsen, exceeding many households' ability to cope, as well as the government's ability to respond.

Climate change impacts in Bangladesh

Chapter 3 | Accelerating impacts

Climate impacts are increasing at an alarming rate in Bangladesh, and current safeguards soon won't be enough to protect people.

Bangladesh has already been on the front line of climate change for many decades (see Figure 2). But the country is projected to face worsening climate impacts. How much worse will depend on the extent to which global greenhouse gas emissions can be limited. The greater the rise in emissions, the greater the physical climate changes and the higher the likelihood of impacts exceeding many households' ability to cope, as well as the government's ability to respond.

3.1 Physical risks

By the end of the century, even under a very low emissions scenario (RCP2.6; see box later in this section), Bangladesh could see a further 0.8°C of warming compared with 1981–2010. Under a middle-of-the-road emissions scenario (RCP4.5) or a very high emissions scenario (RCP8.5), warming in Bangladesh increases to 1.2°C and 2.2°C, respectively, by 2071–2100.¹³ Heat extremes are very likely to become more intense and more frequent as a result, while cold spells will decrease. Even with ambitious climate action (RCP2.6), the number of days likely to exceed dangerous levels of heat stress is projected to rise in South Asia by up to 30 days per year.⁴⁰

Even with ambitious climate action (RCP2.6), the number of days likely to exceed dangerous levels of heat stress is projected to rise in South Asia by up to 30 days per year.

Further warming will increase the average annual rainfall and intensify the monsoon seasonal cycle in South Asia, meaning wetter wet seasons and drier dry seasons.⁴⁰ As a result, the risk of flash flooding during the monsoon will increase, as will the flood risk around Bangladesh's major rivers (the Ganges, the Brahmaputra and the Meghna). Even under a very low emissions scenario (SSP1-2.6), heavier rainfall is projected to increase peak river flow by 16% by 2070–2099, relative to 1971–2000. Under a very high emissions scenario (SSP5-8.5), this increase rises to 36%.¹⁴

Sea level around South Asia will continue to rise over the 21st century, increasing flooding in low-lying Bangladesh. By the end of the century, between 12% and 18% of Bangladesh's coastal area is projected to be submerged by rising seas.⁶ This will have devastating consequences for vital food crops, and more people will be forced to leave their homes (see Section 3.2).

Figure 2. Across South Asia (SAS), human influence has contributed to an increase in hot extremes (top). Heavy precipitation has increased, though the available evidence currently shows limited agreement in the human contribution to the observed change since the 1950s. There is low agreement in the observed change in drought (bottom). Source: Intergovernmental Panel on Climate Change (IPCC),⁴¹ adapted to emphasize Bangladesh.

Climate models and future scenarios

Climate models are mathematical representations of the physical and biogeochemical processes that occur in the atmosphere, land and oceans. They are one of the main tools that scientists have to examine how certain changes will affect Earth's future climate.

The Sixth Assessment Report from the IPCC featured a set of climate models from the Sixth Coupled Model Intercomparison Project (CMIP6). To allow comparison across the different models, the project developed a standard set of scenarios that each modelling group from around the world uses.

This set of scenarios, called Shared Socio-economic Pathways (SSPs), differ in their assumptions about future socioeconomic factors, such as population, economic growth and urbanization. They describe five very different "baseline" worlds. The IPCC's Sixth Assessment Report combined the SSPs with a separate set of scenarios that describe how concentrations of greenhouse gases and other factors that affect the climate could evolve. There are four of these Representative Concentration Pathways (RCPs) – RCP2.6, RCP4.5, RCP6.0 and RCP8.5 – with the names representing the total heating effect (or radiative forcing) by 2100.

Below is a summary of the combined SSP-RCP pathways referenced in the literature cited by this report (temperatures are relative to pre-industrial levels):

SSP1-2.6 An optimistic, sustainability-focused scenario in which global temperature rise is limited to 2°C by the end of the century.

SSP3-7.0 Regional rivalry means that efforts to reduce emissions are fragmented and temperature rise reaches 3.6°C by the end of the century.

SSP5-8.5 A worst case, no-mitigation scenario in which fossil fuels dominate economic growth and global temperature rises by 4.4°C by the end of the century.

Before the SSPs were available, model studies used the RCPs to describe possible future worlds in terms of greenhouse gases and warming. This report refers to RCP2.6 as an ambitious, very low emissions scenario, RCP4.5 as a middle-of-the-road scenario and RCP8.5 as a very high emissions scenario (higher than the world is currently tracking).

3.2 Cascading impacts on people

Even with accelerated climate action, continued warming and more extreme weather will strain adaptation efforts in Bangladesh, making it harder to protect lives and livelihoods.

Excessive heat poses a risk to human health, potentially leading to hyperthermia, heatstroke, headache and fatigue. It also poses a cost to the economy, since exposure to heat reduces the

productivity of the labour force, particularly those working outdoors. A global temperature rise of 3°C is projected to decrease labour productivity in Asia by 25 percentage points for those working outside in full sunlight and by 19 percentage points for those working in the shade or indoors.⁴² This will particularly affect Bangladesh, where 37% of employed people work in agriculture and a further 22% in the industrial sector (i.e. mining, quarrying, manufacturing and construction).⁴³ Excess heat is also a health risk for the millions of people – mostly women – who work indoors in poorly ventilated factories. The potential for heat stress is up to 60% higher among garment workers in Dhaka than would be expected for the average ambient temperature⁴⁴.

Exposure to heat reduces the productivity of the labour force and is a health risk for the millions of people – mostly women – who work indoors in poorly ventilated factories.

Increasingly, extreme heat and rainfall will hamper the growth of crops, potentially leading to food insecurity and to loss of livelihoods for farming households. The detrimental effects of these extreme conditions on agricultural production – which is the main income source for most people in rural Bangladesh – will put livelihoods at risk, increase food insecurity and raise the risk of falling into poverty.⁴² The wider population will be impacted by the knock-on effects that more variable growing conditions will have on food prices. In 2017, heavy rainfall and flooding during the pre-monsoon season damaged the harvestable rice crop to such an extent that rice prices rose by a record 30% the following year. One extreme heat event could result in an average loss of 2% of potential fisheries-related employment, equivalent to over 1 million jobs.⁴⁵

One extreme heat event could result in an average loss of 2% of potential fisheries-related employment, equivalent to over 1 million jobs.

Sea level rise will pose additional risks to food security in Bangladesh, directly submerging crops and reducing the area of land available for cultivation. Sea level rise this century is projected to lead to a 6–9% decline in the country's rice production, for example.⁶ Increasingly saline waters are also projected to disrupt fisheries, which will disproportionately affect poor coastal communities, for whom fish is an important source of protein.⁴⁵

Saline water can also infiltrate groundwater and surface water resources, affecting drinking water supplies and, potentially, human health. Consuming salty, contaminated water has been linked to, for example, increases in cardiovascular disease, hypertension and waterborne diseases such as diarrhoea and dysentery, primarily in children.⁴⁵ An often-overlooked effect of salinity intrusion is on the menstrual health and hygiene of women and adolescent girls in coastal regions of Bangladesh, a problem that serves to intensify wider social insecurities.⁴⁶

Sea level rise will pose additional risks to food security in Bangladesh, including a projected decline of 6–9% in rice production this century.

For people living in low-lying areas, the consequences of sea level rise are even more visceral than the availability of food. In southern Bangladesh, sea level rise is projected to displace around 900,000 people by 2050, forcing them to leave their homes in search of safety.

Case study: The Sundarbans

The Sundarbans in southern Bangladesh is the world's largest mangrove forest. It is shared between Bangladesh and India, has an area of about 10,263 km² and is home to the largest remaining tiger population in Asia.⁴⁷ The forest sustains the livelihoods of the local communities, is an important area of biodiversity and shields Bangladesh from the worst of the region's many cyclones. But the Sundarbans' unique geographic location in the world's largest delta places the forest at the forefront of climate change impacts.

With a mean elevation of less than 1 m above sea level, the mangroves are vulnerable to inundation from rising sea levels. Tropical cyclones and soil erosion, along with other human-caused disturbances, also worsen the effects of sea level rise. With current rates of subsidence, extreme sea level rise under a very high emissions scenario (RCP8.5, which is higher than the world is currently tracking) would see 918 km² (23%) of the Sundarbans flooded by 2100.

Conversely, with more ambitious climate action but still a middle-of-the-road emissions scenario (RCP4.5), the flooded area could be reduced to around 40 km² (1%).⁴⁸ The fate of the Sundarbans ultimately rests on the extent to which future emissions can be limited and how much of the area can be replanted to preserve this critical habitat and the protection it offers.⁴⁹



Two women watering small mango trees in the Sundarbans National Park, West Bengal, India, to support the replanting and protection of the habitat. Credit: Rosa Maria Vidal / Climate Visuals.

Sea level rise also exacerbates the future risk from tropical cyclones. Coastal plots of land enclosed by embankments, known as polders, are an integral adaptation measure in parts of Bangladesh (see Section 2.2). But current safeguards will likely struggle to keep pace with future climate change, since rising sea level increases the storm surge when tropical cyclones make landfall. Under the highest emissions scenario (SSP5-8.5), sea level rise and cyclone activity in Bangladesh may well breach the current system of coastal defences.⁸

During Cyclone Amphan in 2020, coastal embankments were damaged and washed away, allowing the storm surge to flood up to 15 km inland and forcing 500,000 families from their homes.¹⁸ If a cyclone the size of Amphan occurred in 2100, with the projected sea level rise, the number of people exposed to the storm surge would be 50–80% higher than in 2020. The exception would be if global temperature rise were limited to 2°C, in which case exposure would be unchanged.¹⁷ Inundations caused by cyclones and storm surges raise the salinity of soil and water, making extreme weather even more difficult for coastal communities to recover from.

CHAPTER 4 looks at how Bangladesh can continue responding to climate change, including national coordination and investment, locally led adaptation, equitable loss and damage financing, and a transition away from fossil fuels.

Climate change impacts in Bangladesh

Chapter 4 | A holistic response

Bangladesh needs a bolder adaptation response, alongside a functional loss and damage mechanism and a transition away from fossil fuels.

Bangladesh's ability to continue responding to climate change requires multiple strands of action: national coordination and government investment; locally led adaptation; equitable loss and damage financing; and a large-scale shift to secure, low-carbon energy.

4.1 A bolder domestic response

Bangladesh's economy is among the fastest growing in the Asia-Pacific region, and the country is on course to graduate from the United Nations least developed countries category in 2026. The potential prosperity of Bangladesh, however, will depend on how strategically and holistically the key risks from climate change can be dealt with to reduce the impacts on resources, water and food security, infrastructure, livelihoods, health, and biodiversity.

Bangladesh is ahead of several least developed countries in adopting instrumental climate change adaptation policies and plans. However, it has been suggested that current policies could be more effectively implemented with improved governance⁵⁰ and better integration of Indigenous knowledge and the needs of local communities into adaptation policy.⁵¹

Maintaining Bangladesh's status as an adaptation champion requires closing the gap between top-down government adaptation activities and bottom-up projects centred on local perspectives.

Enhanced community participation, consultation and representation could help Bangladesh maintain its status as an adaptation champion by closing the gap between top-down government adaptation activities and bottom-up projects centred on local perspectives.⁵⁰ Bangladesh may also wish to strategically partner with other South Asian and least developed countries to co-produce knowledge and further strengthen adaptation efforts.

At the national level, adequate and long-term domestic finance is required to support adaptation efforts. Currently, the government of Bangladesh spends approximately 6–7% of its annual budget on adaptation, about 75% of which comes from domestic sources. However, scaling up adaptation measures as outlined in the National Adaptation Plan (2023–2050) will require seven times the current spending.⁸

Scaling up adaptation measures as outlined in the National Adaptation Plan (2023–2050) will require seven times the current annual spending.

At the district level, local government could establish monitoring, evaluation and learning systems to ensure ownership, transparency and accountability for adaptation initiatives. Local non-governmental organizations could set up accessible feedback mechanisms that enable local communities to share their experiences of adaptation interventions with local government. This will help build trust between communities and local governments and improve the effectiveness of adaptation measures, such as local development and resilience plans.



A Rohingya refugee camp in Cox's Bazar with solar streetlights in Cittagong, Bangladesh, in 2019. Credit: Abir Abdullah / Climate Visuals Countdown.

Supporting the communities most at risk of climate impacts requires transitioning away from fossil fuels (see Section 4.2). Yet in Bangladesh, the transition to a climate-resilient and low-carbon economy could negatively impact some vulnerable individuals and communities whose livelihoods may be affected by changes in the practices of carbon-intensive sectors.

Dialogue between employers, trade unions, workers and government bodies can enable a just transition that upskills or reskills current employees in the garment and manufacturing industry, for example. In the agricultural sector, which employs a large proportion of the population, policies that reduce emissions and increase resilience must be planned carefully so as not to adversely affect vulnerable communities in rural parts of the country.⁵²

4.2 Ramping up international support

As Bangladesh continues to develop and employ adaptation initiatives across the country, the accelerating impacts of climate change (see Chapter 3) highlight an urgent need to scale up international action against climate change.

The accelerating impacts of climate change in Bangladesh highlight an urgent need to scale up international action against climate change.

“Loss and damage” is generally understood as the negative impact of climate change that exceeds people’s ability or capacity to adapt or that can no longer be avoided. These negative impacts can be caused by slow-onset events such as sea level rise or temperature increase or by rapid-onset events such as cyclones and floods.

Loss and damage is often categorized as economic or non-economic, though the two categories are interconnected. Economic loss and damage can be assigned a monetary value. What constitutes non-economic loss and damage depends on communities’ lived experiences, values and perspectives and can include negative impacts on cultural heritage, human health and mobility, Indigenous knowledge, and biodiversity.⁴²

What constitutes non-economic loss and damage depends on communities’ lived experiences, values and perspectives and can include negative impacts on culture, Indigenous knowledge, and biodiversity.

Developing countries have been advocating for a mechanism to pay for loss and damage since Vanuatu called for an insurance scheme for countries impacted by rising sea level to be included in the drafting of the United Nations Framework Convention on Climate Change in 1991.

More than three decades later, at COP27 in Sharm El-Sheikh, Egypt, negotiators agreed to establish a loss and damage fund. As part of this decision, a transitional committee was created to decide how to operationalize the fund by COP28. Two of the committee’s recommendations were that the mechanism should include direct access windows for communities and be funded primarily through grant-based public financing.⁵³

In December 2023, COP28 agreed on a loss and damage deal, with pledges totalling approximately \$655 million. There are concerns, however, about the size of the fund and whether the existing policies and procedures of the World Bank can be flexible enough to administer the fund effectively. Another of the main criticisms is that the pledges are in the form of loans rather than grants, which will likely add to vulnerable countries’ already significant debt burdens.

Bangladesh supports a loss and damage mechanism that upholds principles of climate justice and collectively addresses the extensive adaptation finance needs of vulnerable countries.

Additionally, the pledges are not clear on how the money will be distributed, with the potential that it will not reach the countries that need it most. As the seventh most vulnerable country to climate

change, Bangladesh supports a loss and damage mechanism that upholds principles of climate justice, collectively addresses the extensive adaptation finance needs of vulnerable countries, and follows participatory decision-making approaches, such that the voices of the intended beneficiaries are represented.

Tackling climate change in Bangladesh and supporting the communities most at risk of climate disasters requires transitioning away from fossil fuels to renewable sources of energy. Yet, despite some strengthening of climate policies and the falling costs of low-carbon energy, the world is headed for around 2.7°C warming by 2100.¹⁹

Bangladesh is itself overwhelmingly reliant on fossil fuels, generating just 1% of electricity from wind and solar in 2022.²⁰ In its updated nationally determined contribution, submitted in 2021, Bangladesh committed to reducing greenhouse gas emissions by 61.9 million tonnes (or 6.73%) below the business-as-usual scenario by 2030. Most of the reduction (95%) will come from the energy sector, with much smaller contributions from the agriculture, forestry and land use sector (2.3%) and the waste sector (2.2%). A more ambitious reduction in emissions of 15.12% below the business-as-usual scenario by 2030 is conditional on financial and technological support.⁵⁴

Bangladesh is itself still overwhelmingly reliant on fossil fuels, generating just 1% of electricity from wind and solar in 2022.

Access to international climate finance is a prime enabler for action in developing countries. Although the amount of mobilized climate finance dedicated to adaptation is far smaller in absolute terms than the amount dedicated to mitigation, its proportion has increased – from 20% in the fiscal year 2017/2018 to 28% in 2019/2020 – and is growing faster than mitigation finance.

Yet the adaptation finance needs of developing countries are 10–18 times higher than current international finance flows.⁵⁵ At COP26 in 2021, developed countries pledged to double adaptation finance from 2019 levels by 2025, to approximately \$40 billion. COP28 in December 2023 only marginally built on this commitment, recognizing in the final text of the global stocktake that adaptation finance will have to be “significantly scaled up beyond the doubling”.

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