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FACT SHEET

Climate Change Information Fact Sheet BANGLADESH

Definitions
Ensemble: A collection of model simulations characterizing a climate prediction or projection. [IPCC AR5]
Representative Concentration Pathway (RCP): Scenarios that include time series of emissions and concentrations of the full suite of greenhouse gases and aerosols and chemically active gases, as well as land use/land cover. RCPs usually refer to the portion of the concentration pathway extending up to 2100, for which Integrated Assessment Models produced corresponding emission scenarios. [IPCC AR5]
RCP8.5: Generally, high emissions. One high pathway for which radiative forcing reaches >8.5 W m^{-2} by 2100 and continues to rise for some amount of time. [IPCC AR5]
RCP4.5: Generally, moderate emissions. One of two intermediate stabilization pathways in which radiative forcing is stabilized at approximately 4.5 W m^{-2} after 2100. [IPCC AR5]

CLIMATE IMPACTS AND VULNERABILITIES

TEMPERATURE

Current (based on historical climate conditions and recent trends, generally over the past few decades)
Average annual temperatures in Bangladesh are about 25°C, with a low of 18.4°C in January, and highs of 28°C in May and June [CCKP]. Surface air temperature in Bangladesh has increased since 1960, particularly June through August and September through November (rainy summer) seasons by about 0.3°C and 0.5°C, respectively [UNDP]. Daily temperature observations show significantly increasing trends in the frequency of hot days and hot nights. The average number of hot days increased by 26 per year (an additional 7.2% of days) between 1960 and 2003. The rate of increase is seen most strongly June through August when the average number of hot days increased by 9.9 days per month (an additional 32% of days) over this period.

Future: 2030 (generally 2020-2049)
Overall, there is high confidence of a projected rise in temperature [IPCC AR5, Ch 14]. By 2030, the mean annual temperature in the country is projected to increase by 0.23°C, 0.79°C, and 1.69°C for the 10th, 50th, and 90th percentiles for the RCP4.5 model ensemble runs and 0.23°C, 0.79°C, and 1.45°C for the 10th, 50th, and 90th percentiles for the RCP8.5 model ensemble runs [CCKP]. All projections suggest increases in the frequency of days and nights that are considered hot and decreases in frequency of cold days and nights [UNDP]. Simple linear interpolation of projections indicate that annually, "hot" days will occur on 11–24% of days by the 2030s.

Future: 2050 (generally 2040-2059)
Overall, there is high confidence of a projected rise in temperature [IPCC AR5, Ch 14]. By mid-century, the mean annual temperature in the country is projected to increase by 0.54°C, 1.23°C, and 2.16°C for the 10th, 50th, and 90th percentiles for the RCP4.5 model ensemble runs and 0.91°C, 1.69°C, and 2.76°C for the 10th, 50th, and

90th percentiles for the RCP8.5 model ensemble runs [CCKP]. All projections indicate substantial increases in the frequency of days and nights that are considered "hot" in current climate [UNDP]. Annually, projections indicate that "hot" days will occur on 17–39% of days by the 2060s.

PRECIPITATION AND FLOODING

Current (based on historical climate conditions and recent trends, generally over the past few decades)
Bangladesh is one of the wettest countries in the world. Some parts receive over 2000 mm of rainfall a year, and 80% of rain falls during the monsoon season (June-September) [UNDP]. Northeastern Bangladesh receives the greatest average precipitation. Mean rainfall over Bangladesh has decreased by 0.5% between 1960 and 2003, but this decrease is not statistically significant. The country has experienced an increase in March-May rainfall by 3.4% and a decrease in June-August rainfall by 1.7% between 1960 and 2003. The proportion of rainfall falling in heavy events has decreased slightly (by 1.1%) between 1960 and 2003. The magnitude of one-day maxima rainfall shows statistically significant decreases (4.47 mm per decade) between 1960 and 2003. Five-day annual rainfall maxima show a negative trend but is not statistically significant. Most of Bangladesh lies in the delta of three of the largest rivers in the world—the Brahmaputra, the Ganges, and the Meghna [MOEF]. The topography of the country is mostly low and flat. Two-thirds of the country is less than 5 meters above sea level and is susceptible to river and rainwater flooding. As a result, approximately one-quarter of the country is inundated in an "average" year.

Future: 2030 (generally 2020-2049)
Projections of mean annual rainfall averaged over the country from different models in the ensemble project a wide range of changes in precipitation for Bangladesh in 2030 [CCKP]. The projections of mean annual rainfall range from -16.17%, 0.44%, and 19.45% for the RCP4.5 10th, 50th, and 90th percentile ensemble respectively and -14.78%, 2.07%, and 21.43% for the RCP8.5 10th, 50th, and 90th percentile ensemble. The projected increases or decreases in rainfall are greatest during the monsoon season (June-September). The median ensemble runs for RCP4.5 and 8.5 indicate an average annual rainfall increase of 0.2 mm/day by the middle of the 2030s [USGS].

Future: 2050 (generally 2040-2059)
The projections of mean annual rainfall range from -13.79%, 3.40%, and 23.40% for the RCP4.5 10th, 50th, and 90th percentile ensemble respectively and -14.97%, 3.64%, and 24.58% for the RCP8.5 10th, 50th, and 90th percentile ensemble [CCKP]. The median ensemble runs for RCP4.5 and 8.5 indicate an average annual rainfall increase of 0.2 mm/day and 0.4mm/day, respectively by around 2060 [USGS]. The models broadly suggest increases in the magnitude of five-day maxima rainfall. The CMIP3 multi-model ensemble shows an increase in precipitation during summer months, and there is medium confidence in an increase in summer monsoon precipitation amounts in the future over Southern Asia [IPCC AR5, Ch 14]. However, it is still difficult to project rainfall changes for the Ganges River floodplain, with some models projecting wetter and others projecting drier conditions [CCKP]. An analysis of four models indicates that the largest changes in the mean flooded areas occur between a 0° and 2°C rise in temperature, which correlate with the increases in the peak discharges of the Ganges, Brahmaputra, and Meghna rivers [Mirza]. In the Ganges, an increase in river runoff could offset large increases in water demand due to population growth under conditions with a 4°C or higher temperature increase [IPCC AR5, Ch 24].

DROUGHT

Current (based on historical climate conditions and recent trends, generally over the past few decades)
Droughts are seasonal and most commonly affect the northwestern region, which generally experiences less rainfall than the rest of the country [MOEF].

Future: 2030 (generally 2020-2049)
Estimates are highly uncertain and information is not readily available. Consider future drought conditions based on the most extreme past experience.

Future: 2050 (generally 2040-2059)
Projected climate changes include more erratic rainfall resulting in increasing droughts, especially in drier northern and western regions of the country [MOEF].

SEA LEVEL RISE AND STORM SURGE

Current (based on historical climate conditions and recent trends, generally over the past few decades)
An analysis of tidal water levels of the Rupsa-Pasur River at Khulna from 1937 to 2010 indicates with high confidence that the annual maximum high tidal water levels are increasing at a rate of 18 mm per year and the annual minimum low tidal water levels are decreasing at a rate of 8 mm per year [Mondal]. The possible reasons for the decreasing trends in annual minimum water levels could be the reduction of fresh water flow from upstream areas, the reduction in storage areas of saline tidal water, or both. The increasing trends in annual maximum water levels could result either from silting up of the rivers, reduction in flood tide propagation areas, a rise in the sea level, or a combination of these factors. However, if sea level rise had any effect on these observed trends, the effect would be much lower than that of human interventions. [CCKP]. Analysis of the low flows of the Gorai River (main tributary of Ganges River in Bangladesh) finds that the upstream Farakka dam has reduced low flows to nearly zero, increasing salinity during the months of February to May [Mondal et al.].

Future: 2030 (generally 2020-2049)
Global sea level could rise by 0.13 meters [RCP4.5] up to 0.4 meters [RCP8.5] by 2030 (from a reference time period of 1971-2010) [IPCC WG1AR5, Ch. 13]. Cyclone-induced storm surges are likely to be exacerbated by a potential rise in sea level [CCKP].

Future: 2050 (generally 2040-2059)
Cyclone-induced storm surges are likely to be exacerbated by a potential rise in sea level of over 27 cm by 2050 [CCKP]. 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 to 100 cm by 2100, while the IPCC Fourth Assessment gives a global average range with slightly lower values of 26 to 98 cm [IPCC WG1 AR5, Ch13]. Bangladesh could lose 10% of its area due to a sea level rise of 45 cm [Mirza], and another analysis has estimated a loss of about 18% of land area for a sea level rise of 95 cm [World Bank]. By mid-century, salinization of river water in coastal Bangladesh could become a major risk in the southwest coastal area of Bangladesh during dry season (October to May). Bagerhat, Barguna, Barisal, Bhola, Khulna, Jhalokati, Pirojpur, and Satkhira Districts will be most adversely affected by the increase in river salinity in a changing climate [CCKP].

WINDS AND OTHER STORMS

Current (based on historical climate conditions and recent trends, generally over the past few decades)
Bangladesh is subject to devastating cyclones, originating over the Bay of Bengal, in the periods of April to May and September to November [UNDP]. Significant increasing trends in the cyclone frequency over the Bay of Bengal during November and May have been observed historically [CCKP]. At least 70 major cyclones hit the coastal belt of Bangladesh over the past 200 years [Minar et al.].

Future: 2030 (generally 2020-2049)
Estimates are highly uncertain and information is not readily available. Consider future winds and storms based on the most extreme past experience.

Future: 2050 (generally 2040-2059)
Future increases in precipitation extremes related to the monsoon season is very likely in South Asia by 2100. Due to a disagreement among models, there is only medium confidence that monsoon-related interannual precipitation variability will increase by centuries end [IPCC AR5, Ch. 14]. 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%" by 2100 [IPCC 2001]. This is consistent with IPCC AR5 results that precipitation

will likely be more extreme near the centers of tropical cyclones making landfall in West, East, South, and Southeast Asia [IPCC AR5, Ch. 14].

Climate information sources	CCKP = World Bank Climate Change Knowledge Portal
	CW = Climate Wizard
	IPCC AR5, Ch 14 = IPCC WG I, 2014. Climate Phenomena and their Relevance for Future Regional Climate Change, Chapter 14 (South Asia)
	IPCC AR5, Ch 24 = IPCC WG II, 2014. Climate Change 2014: Impacts, Adaptation, and Vulnerability, Chapter 24 (Asia)
	IPCC SREX = IPCC, 2012. Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation
	Minar et al. = Minar, M. H, M. Belal Hossain, and M.D. Shamsuddin, 2013. Climate Change and Coastal Zone of Bangladesh: Vulnerability, Resilience and Adaptability. Middle-East Journal of Scientific Research 13 (1): 114-120, 2013
	Mirza = Mirza, M. M. Q., 2011. Climate change, flooding in South Asia and implications. Regional Environmental Change 11:95-107.
	MOEF = MoEF, 2008. Bangladesh Climate Change Strategy and Action Plan 2008. Ministry of Environment and Forests, Government of the People's Republic of Bangladesh, Dhaka, Bangladesh. xvi + 68 pp.
	Mondal et al. = Mondal, M. Shahjahan, Mohammad Rashed Jalal, M. Shah Alam Khan, Uthpal Kumar, Rezaur Rahman, Hamidul Huq, 2013. Hydro-Meteorological Trends in Southwest Coastal Bangladesh: Perspectives of Climate Change and Human Interventions. American Journal of Climate Change, 2013, 2, 62-70
	UNDP = Karmalkar, A., C. McSweeney, M. New, and G. Lizcano, 2012. UNDP Climate Change Country Profiles: Bangladesh.
	USGS = Alder, J.R. and Hostetler, S.W., 2013. CMIP5 Global Climate Change Viewer. US Geological Survey.