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International Federation of Red Cross and Red Crescent Societies

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Asia climate trends and projections

Regional impacts (all of Asia)

- The number of reported disasters has increased in the past 50 years and so too has the number of affected individuals[4]
- Coastal areas, especially heavily-populated megadelta regions in South, East and South-East Asia, will be at greatest risk due to increased flooding from the sea and, in some megadeltas flooding from the rivers. [10]
- Climate change is projected to impinge on the sustainable development of most developing countries of Asia, as it compounds the pressures on natural resources and the environment associated with rapid urbanization, industrialization, and economic development. [10]
- Even under the most conservative scenario, the sea level will be about 40cm higher than today by the end of the 21st century and this is projected to increase the annual number of people flooded in coastal populations from 13 million to 94 million – 60% of this increase is likely to be in South Asia alone[2]
- It is projected that crop yields could increase up to 20% in East and South-East Asia while they could decrease up to 30% in Central and South Asia by the mid-21st century. Taken together, and considering the influence of rapid population growth and urbanization, the risk of hunger is projected to remain very high in several developing countries. [10]
- Endemic morbidity and mortality due to diarrhoeal disease primarily associated with floods and droughts are expected to rise in East, South and South-East Asia due to projected changes in the hydrological cycle associated with global warming. Increases in coastal water temperature would exacerbate the abundance and/or toxicity of cholera in South Asia.
- 70% of the world's fresh water is stored in glaciers[1]
- Freshwater availability in Central, South, East and South-East Asia, particularly in large river basins, is projected to decrease due to climate change which, along with population growth and increasing demand arising from higher standards of living, could adversely affect more than a billion people by the 2050s [10]
- The destructive effects of climate change (eg. coral bleaching) exacerbate human impacts on coral reefs[2]
- Worldwide, coral reefs feed around 1 billion people per year – from fishing and tourism industry;[6] acidification from the increase in CO_2 atmosphere will almost completely prevent coral reef existence by 2060[7]

South Asia - General

- Summer precipitation is likely to increase over South Asia, decrease likely in Dec-Feb[2]
- Increase in extreme weather events such as heatwaves and intense precipitation likely over South Asia[2]
- Stronger winds could result in larger impacts from storm surges and sea surface temperature increases are likely to increase the intensity of cyclones[2]
- Increased frequency of El Nino events could likely lead to measurable declines in fish larvae abundance in coastal waters of South Asia and a subsequent decline in fishery production[2]
- Bangladesh, India and Nepal already suffering the largest impacts of climate change on health via malnutrition and disease transmission and expected to continue to suffer the most[2]
- Water shortages in India, Pakistan, Nepal and Bangladesh are already exacerbated by climate change [2]
- Glacier melt in the Himalayas is projected to increase flooding, and rock avalanches from destabilised slopes, and to affect water resources within the next two to three decades. This will be followed by decreased river flows as the glaciers recede. [10]
- Projections for the Eastern Himalayas suggest an overall increase in rainfall of 18 percent by 2050 and by up to 34 percent by the end of the century. More monsoon rainfall is expected to occur at high elevations and less at low elevations. In general, the magnitudes of change for both temperature and rainfall are expected to be greater with increasing elevation, and are likely to continue to be greater than the global average.[i]

South Asia - Country-specific trends and projections

Country	Observed Climate Trends	Climate Projections
Nepal	▪ Higher temperature increases in Winter[2] ▪ Serious and frequent floods in '02, '03 & '04[2] ▪ Himalayan glaciers feed 7 of the Asia's great rivers[1] ▪ Changes to ice are some of the most visible impacts of global warming, rapid glacial retreat has been observed in recent years[1] ▪ High elevation sites are warming at up to double the global average[1] ▪ Glacial lakes are increasing in size, enhancing the risk of glacial lake outbursts; the number of which have been increasing in the past 50 years[1]	▪ Projections for future warming in Nepal estimate a temperature increase of 1.3 to 3.8°C by the 2060s and 1.8 to 5.8°C by the 2090s. [8] In general, the country can expect warming of up to 0.5°C per decade –this is likely to be most pronounced during the winter and pre-monsoon seasons, and in the western part of the country. ▪ Climate change related melting of glaciers could seriously affect half a billion people in the Himalaya- Hindu-Kush region[2] ▪ Initially higher river flows can be expected as melting accelerates. As the volume of ice available for melting recedes, this will be replaced with water shortages, especially in winter[1] Decreases in river flow over time will have dire consequences for the hydro-power dependency of the nation[1]

Pakistan	▪ The incidence of wildfire has increased in arid and semi-arid Asia in recent decades4 ▪ 0.6 – 1C rise in mean temperature along coastal areas since early 1900's[2] ▪ Consecutive droughts in '99 & '00 led to sharp decline in water tables[2] ▪ Glaciers in the Indus Valley may be expanding due to increased precipitation over western Himalayas over the past 40 years[2] ▪ 10 – 15% decrease in rainfall along coastal belt and hyper arid plains[2] ▪ Increase in summer and winter precipitation over the last 40 years in northern Pakistan[2]	▪ The overall impact of climate change on forest resources in Pakistan could be negative[2] ▪ Impacts from melting of glaciers might be similar to effects for Nepal (above)
India	▪ Decreasing rainfall trends in annual mean rainfall for north-east India[2] ▪ The incidence of wildfire has increased in arid and semi-arid Asia in recent decades4 ▪ Damage caused by more intense cyclones has risen significantly[2] ▪ 0.68C increase in mean temperature per century, warming more pronounced in post-monsoon and winter[2] ▪ Increase in extreme rainfall in north-west during summer monsoon[2] ▪ Lower number of rainy days along east coast[2] ▪ Frequency of hot days and multiple-day heatwaves has increased in past century; increase in deaths due to heat stress in recent years[2] ▪ Serious and frequent floods in '02, '03 & '04 in the northern states[2] ▪ Consecutive droughts in '00-'02 caused crop failures, mass starvation and affected approx 11million people in Orissa[2]	▪ A 0.5C rise in winter temperature would reduce wheat yield by 0.45 tonnes per hectare in India[2] ▪ India will reach a point of water stress by 2025[2] ▪ Increased frequency of floods is likely to result in decreased ground water recharge due to abrupt run off[2] ▪ In southern states there will be a likely reduction in transmission season for health related impacts[2] ▪ Energy and industrial potential derived from rivers may not be achieved due to overall reduction in river flow over time[1] ▪ Possible reduction in rainfall by 20-30% in Southern India by 2070[4] ▪ Reduced water availability for crop production, ultimately leading to potential impacts on nutrition level s[1]

Maldives	▪ Current global sea level rise 3.1mm per year, up from 1.7mm in the previous 2001 report ▪ New observations and re-analyses of temperatures averaged over land and ocean surfaces show consistent warming trends across small island regions[3] ▪ Water quality is just one of several health issues linked to climate variability and change and their potential effects on the well- being of the inhabitants of small islands[3]	▪ Deterioration in coastal conditions, for example through erosion of beaches and coral bleaching, is expected to affect local resources, e.g., fisheries, and reduce the value of these destinations for tourism [3] ▪ Sea-level rise is expected to exacerbate inundation, storm surge, erosion and other coastal hazards, thus threatening vital infrastructure, settlements and facilities that support the livelihood of island communities[3] ▪ It is also almost inevitable that the ecological systems of small islands, and the functions they perform, will be sensitive to the rate and magnitude of climate change and sea-level rise, especially where exacerbated by human activities[3]
Bangladesh	▪ Increasing temperature of 1C in May and 0.5C in November during the 14 year period from 1985-1998[2] ▪ Serious and recurrent floods in Bangladesh[2] ▪ Frequency of monsoon depressions and cyclones forming in the Bay of Bengal and Arabian sea on decline since 1970's, however intensity has been increasing, causing severe flooding and subsequent damage[2] ▪ Severe impacts on mangroves due to reduction in fresh water flows and salt water intrusion[2] ▪ Increasing annual rainfall in Bangladesh[2]	▪ Production of rice and wheat may drop by 8-32% by the year 2050[2] ▪ About 20 million people may be affected by sea level rise ▪ Warmer in all seasons. Higher average temperatures likely to be associated with higher extreme temperatures[16]. ▪ Given reductions in mean dry season rainfall it is likely that dry spells may increase/lengthen with negative consequences for water availability/soil moisture[16] ▪ Most models indicate wetter monsoon conditions[16]
Bhutan	▪ Existing data indicates an overall warming trend with the greatest warming occurring after 1998. This warming trend is consistent with that observed for the Asian continent.[9] ▪ Loss of life from frequent flash floods, glacier lake outburst floods; landslides; hunger and malnutrition[5] ▪ Spread of vector borne diseases into higher elevations; loss of water resources; risk of water borne diseases[5]	▪ Reductions in snow cover are expected, particularly in areas where the daily temperature is near the melting point making them more easily affected by minor changes.[ii] ▪ Increased glacier and snow melt due to temperature and rainfall changes will lead to earlier seasonal runoff and greater runoff quantity and variability.[iii] ▪ Decreased soil stability and greater threat of landslides with thawing permafrost[iv] ▪ Increases in landslides, floods and debris flows with greater glacial melt

		and runoff ▪ Increased threat of glacial lake outburst floods[v] ▪ Increased incidence of droughts and intense rainfall events with greater rainfall variability.[vi]
Sri Lanka	▪ Temperatures in Sri Lanka have increased by 0.3C in the past 3 decades[4] ▪ Increasing trend in precipitation in February and decreasing trend in June[2] ▪ 2003 floods in southern province were triggered by 730mm of rain[2]	▪ Global warming is expected to lead to a rise in sea level, higher temperatures, more frequent and prolonged droughts, high intensity rainfalls and increased thunder activity. These anticipated changes represent a significant threat to the coastal areas, the different sectors of the national economy and human health.[17]

South East Asia – General

- In general 0.1 to 0.3°C increase per decade reported between 1951 to 2000[10]
- Decreasing trend in precipitation between 1961-1998. The number of rainy days has declined throughout SE Asia[10].
- Increase in hot days and warm nights and decrease in cold days and nights between 1961-1998[10].
- Increased occurance of extreme rains causing flash floods in Vietnam, landslides and floods in 1990 and 2004 in the Philippines and floods in Cambodia in 2000[10]
- Winter and summer precipitation likely to increase[10].
- Extreme weather events associated with El Niño were reported to be more frequent and intense in the past 20 years[10]
- Worldwide, by 2100 sea level will be at minimum 40 cm higher than today (more likely 1m), increasing severe flood risk with rising sea levels[12]
- In the Mekong River Delta -Increased flooding risks in the wet season and increased risk of water shortage during the dry season[10].
- Future projections include more heatwaves and more extreme rainfall events[10]
- Increased storm surge heights could enhance risk of coastal disasters[10]

Country	Observed Climate Trends	Climate Projections
Indonesia	▪ Decline in rainfall in southern and increase in northern region[10] ▪ In Sumatra and Java the onset of the wet season is now 10 to 20 days later and the onset of the dry season is now 10 to 60 days earlier compared the period 1961-1990[11]	▪ A rise of about 1 metre could inundate around 405,000 hectares of coastal land, causing the disappearance of many low-lying islands along with coral reefs; when the coral reefs are gone much of the fish production will disappear too. ▪ Sea Level rise of about of 0.5 metres and continuing land subsidence would lead to the permanent inundation of six locations – 3 in Jakarta and 3 in Bekasi – with a total population of approximately 270,000 people[13]
Cambodia	▪ Increased occurrence of extreme rains causing floods in Cambodia[10] ▪ But mean (average) rainfall over Cambodia does not show any consistent increase or decrease since 1960[15] ▪ Floods have accounted for 70% of rice production losses between 1998 and 2002, while drought accounted for 20% of losses[18].	• The frequency and intensity of floods may increase with changing climate conditions, and cause severe damage to rice harvests[18]. • Sea level rise may also affect the 435-km long coastline, which already suffers from storm surges, high tide, beach erosion and seawater intrusion. Low-lying areas, including settlements, beach resorts, seaports, coastal fisheries, and mangroves forests, may become submerged with rises in sea levels[18].

Lao PDR	▪ From 1995-2005 drought conditions were characterised by higher and irregular increases in temperature.[20] ▪ Observed trends in Lao PDR include increased temperatures, increases in the number of extreme rainfall events and decreases in rainfall in some areas of the country[20].	▪ Hot days, defined as the no. of days above 33C, will increase by 2-3 weeks and the cool days, which are defined as days with a minimum temperature under 15C, will be reduced by 2-3 weeks throughout the region. In other words, the summer time or dry season in the Mekong Region will be significantly longer in the future. ▪ Models also predict that the magnitude and frequency of what are now considered extreme events are also expected to increase resulting in increased risk of flooding.
Viet Nam	▪ Increased occurrence of extreme rains causing flash floods in Vietnam[10] ▪ Rainfall in all parts of Vietnam is becoming less predictable and falling at different times of the year as the rainy season shifts towards September – November. In the Mekong Delta, the annual Mekong flooding has been affected with higher duration of inundation. Provinces of An Giang and Dong Thap has seen a different pattern of rainy season in recent years. This has affected the rice cultivation and fisheries.[21] ▪ The occurrence of typhoons in Vietnam is said to have shifted to later in the year, and will make landfall further south. This means that people in these areas are unfamiliar with this hazard which exposes them.[21]	▪ A 1 m rise in sea level would lead to a loss of almost half of the mangrove area in the Mekong river delta (2500 km^2), while approximately 100,000 ha of cultivated land and aquaculture would become salt marsh[15] ▪ Due to rainfall concentrating more in the rainy season, combined with higher temperatures and increased evapotranspiration, droughts are expected to occur more frequently in Vietnam. Vietnam's recent history counts several drought periods.[21]
Myanmar	• Temperatures in Myanmar show an increasing trend from 1950 to 2009[19] • Since 1980, Myanmar has seen an overall slight increase in years with above-average rainfall[19] • Sea level rise along Myanmar's southern coastlines, situated on the Bay of Bengal and the Andaman Sea, has been similar to the global average for the 20th century, between 0.12 and 0.22 m.[19]	▪ While the number of heavy rainfall events is expected to increase, the frequency of rainy days is expected to decrease over northeastern Myanmar. Such increases in rainfall intensity may lead to an increase in the number and strength of floods and landslides.[19] ▪ Sea level rise in the Bay of Bengal and the Sea of Andaman is projected to be 0.1 m above global projections.[19]

Philippines	▪ Damage caused by intense cyclones has risen significantly; an increase of 20% in the frequency of cyclones entering Philippine waters during the period of 1990-2003[10] ▪ Increase in mean annual, maximum and minimum temperatures by 0.14°C between 1971 to 2000[10] ▪ Increase in annual mean rainfall since 1980s and in number of rainy days since 1990s, increase in inter-annual variability of onset of rainfall ▪ Increased occurrence of extreme rains causing landslides and floods[10] ▪ Decrease of rice yield associated with increase of temperature[10]	Independent studies and the climate modelling of the Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA) projects the following climate changes in 2020 and 2050[vii]: ✓ A rise in the country's mean annual temperatures by about 0.9°C to 1.4°C for 2020 and 1.7°C to 2.4°C by 2050; ✓ The dry season of March-May will become drier and the wet season of July-August and September-November will become wetter with time; ✓ Reduction in rainfall in most areas in Mindanao is seen for all seasons by 2050; ✓ A much more active and stronger southwest monsoon season is projected; ✓ Increases in rainfall in June-August becoming greater with time; ✓ No significant trend in the number of tropical cyclone in Luzon; ✓ An increasing trend in the number of tropical cyclones in the Visayas;
Thailand	▪ Areas affected by flooding appear to be on the increase[22]	▪ Loss of land due to a sea-level rise of between 50 cm and 100 cm could decrease national GDP by 0. 6% to 0.69% per year, respectively[2]

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17: Sri Lanka Government National Communications to the UNFCCC 2000, page 64
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21: Source: World Bank (2007) working paper, The impact of sea level rise on developing countries: a comparative analysis,
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For further details, consult mainly the following key references:

- IPCC 4th assessment report (AR4) http://www.ipcc.ch/pdf/assessment-report/ar4/wg2/ar4-wg2-chapter10.pdf (and more chapters)
- UNDP Climate Change Country Profiles (52 countries by October 2010) for further details on technical climate trends and projections http://country-profiles.geog.ox.ac.uk)
- IPCC's 2012 *Special Report on Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation* (SREX report), and CDKN's regional SREX summary report for Asia

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