

# REPORT: A REGION AT RISK — THE HUMAN DIMENSIONS OF CLIMATE CHANGE IN ASIA AND THE PACIFIC

## KEY FACTS AND FIGURES FOR SUBREGIONS/COUNTRIES

### EAST ASIA

#### 1. REGIONAL

- General Circulation Model projections show an increase in flooding hazards in most humid Asian monsoon regions, due to increase in high intensity precipitation in much of East Asia.
- The WHO models project that by the 2030s, climate change will cause up to 350 additional child deaths (<15 years) per year due to diarrheal disease in each of the subregions of Central Asia, **East Asia**, and Oceania.
- By the 2030s, climate change will cause approximately 30 additional dengue-related deaths per year in East Asia.
- In a study of exposed assets and population in 136 port cities of the world, the bulk of the projected coastal flood damage in 2050 will take place in **East Asia** and South Asia.

#### 2. PEOPLE'S REPUBLIC OF CHINA

- Climate change is expected to have severe impacts on the PRC, including outdoor air pollution.
- Under the business-as-usual scenario, the summer temperature increase in the northwest part of the PRC is projected to reach 8°C by the end of the century.
- The main concerns are protracted droughts and desertification in the country's northern and southwestern regions and water scarcity, which is already posing governance challenges today.
- The three regions most prone to climate-induced migration include: 1) the upper regions of the Yangtze and Yellow rivers, which face soil degradation and other challenges; 2) the northern and northwestern parts of the PRC, where desertification and droughts are threatening farmers' livelihoods; and 3) the southeastern coastal regions, where typhoons and flooding are likely to increase.
- The PRC government is relocating people in anticipation of climate change-related environmental changes, but many sites of relocation are in highly risk-prone areas.
- Research shows that out of 120 million domestic migrants in the PRC, at least 6 million did so because of declining crop yields.
- As most migrants move from rural, inland areas into particularly vulnerable coastal zones, it has led to the concentration of risk exposure to some extreme weather phenomena, such as storms and floods, in urban centers. Flood and storm-related displacement in the PRC mostly takes place in dense urban areas along the coast.

- Thirteen of the top 20 cities with the largest growth of annual flood losses from 2005-2050 are in Asia and the Pacific: **Guangzhou, Shenzhen, Tianjin, Zhanjiang, and Xiamen (PRC)**; Mumbai, Chennai-Madras, Surat, and Kolkata (India); Ho Chi Minh City (Viet Nam); Jakarta (Indonesia); Bangkok (Thailand); and Nagoya (Japan).

## **SOUTHEAST ASIA**

### **1. REGIONAL**

#### ***Heat and rainfall***

- Southeast Asia is projected to be one of the most affected regions by heat extremes. Under the business-as-usual scenario, it could enter entirely new climate regimes due to frequent occurrence of heat extremes that are unprecedented under current climate.

- Southeast Asia is particularly vulnerable to flooding, since there is a concentration of low-lying populated deltas. Already, the number of record-breaking rainfall events has significantly increased over the last decades. The frequency and intensity of heavy rainfall events may cause more severe flooding if the global temperature continues to rise.

- On the upside, tropical cyclone activity is expected to shift toward the central North Pacific, leading to less activity over Southeast Asia.

- The highest relative share of population and percentage of economy exposed to floods is found in **Cambodia**, Bangladesh, and **Viet Nam**. Thirteen of the top 20 cities with the largest growth of annual flood losses from 2005-2050 are in Asia and the Pacific: Guangzhou, Shenzhen, Tianjin, Zhanjiang, and Xiamen (PRC); Mumbai, Chennai-Madras, Surat, and Kolkata (India); **Ho Chi Minh City (Viet Nam)**; **Jakarta (Indonesia)**; **Bangkok (Thailand)**; and Nagoya (Japan).

#### ***Crop yield***

- Climate change will pose a serious threat to food security in Southeast Asia.

- A number of studies project a decrease in crop yields in the region and more specifically, in rice yields. ADB estimated that in the absence of any adaptation or technological improvements, rice yields could decline by up to 50% by 2100 from 1990 levels in Indonesia, the Philippines, Thailand, and Viet Nam. Climate change is also expected to reduce maize and wheat yield.

#### ***Coral Triangle***

- The Western Pacific coral reefs were identified as one of the most threatened marine ecosystems in the region under future climate change.

- Southeast Asia's coral reefs are one of the richest centers of marine biodiversity globally. The Coral Triangle — a marine region spanning the tropical waters of Indonesia, Malaysia, Papua New Guinea, the Philippines, Solomon Islands, and Timor-Leste — hosts around a third of the global coral stock and 76% of all known coral species. More than 100 million people living in the

region's coastal area directly rely on its ecosystem services such as coastal protection and food security.

- All coral reef systems in the Western Pacific will collapse due to mass coral bleaching if global warming increases by 4°C. Even with a 1.5°C temperature increase, 89% of coral reefs are expected to suffer from serious bleaching, severely affecting reef-related fisheries and tourism in Southeast Asia.

- The cumulative loss in value of reef-related fisheries in Southeast Asia for 2000-2050 is estimated at around \$57.98 billion under the business-as-usual scenario with an increasing annual loss rate of \$6 billion in 2050.

- In Southeast Asia, reef fish and seafood cover more than 35% of the coastal population's dietary animal protein demand. Under a number of emissions scenarios, the Coral Triangle's food provision capacity for coastal communities is projected to be halved by 2050.

### **Health**

- By the 2030s, WHO projects that climate change will cause up to 800 additional child deaths due to diarrheal disease per year in Southeast Asia.<sup>1</sup>

- Based on a statistical model for the geographical distribution of malaria, WHO projects that by the 2030s, up to 500 additional malaria-related deaths per year in Southeast Asia will be attributable to climate change.

## **2. INDONESIA**

- Assuming no adaptation and a relative sea-level rise of approximately 0.45 m at the end of the century, Indonesia is projected to be most affected by coastal flooding, with nearly 5.9 million people affected annually in 2100.

## **3. PHILIPPINES**

- Nineteen of the 25 cities globally most exposed to one-meter sea-level rise are located in the region, 7 of which are in the Philippines alone.

- Losses from tropical cyclones in Asia and the Pacific by 2085 include a 17-58% increase in direct housing damage in the Philippines if no adaptive measures are taken.

## **4. VIET NAM**

- Sea-level rise will worsen flooding in the Mekong River Delta in Viet Nam in the long term, in combination with a reduction in estuarine siltation resulting from the construction of dams. In terms of the urban areas affected by a 1-meter sea level rise, Viet Nam is the only Asian country among the top 10 most impacted countries.

<sup>1</sup> All World Health Organization (WHO) projections mentioned here are based on assumed global temperature rise of 1.1°C in the 2030s and a 1.7°C in the 2050s.

## **SOUTH ASIA**

### **1. REGIONAL**

#### ***Health***

- WHO projects that by the 2030s, up to 2,000 malaria deaths in South Asia will be attributable to climate change. By the 2050s, this number rises to almost 10,000 attributable deaths per year. For dengue, by the 2030s, climate change will cause about 200 additional deaths in South Asia.

- WHO models project that by the 2030s, climate change will cause up to 15,000 additional child deaths (<15 years) due to diarrheal disease per year in South Asia. The additional death burden from undernutrition in very small children (<5 years) due to climate change is estimated to be considerably higher, with 20,000 deaths annually in the 2030s.

- Per capita calorie availability could decrease by 7.6% in South Asia below 2000 levels by 2050. Consequently, it is projected that climate change could increase the number of malnourished children by 7 million compared to a no-climate-change scenario.

- In the Indus, Ganges, and Brahmaputra river basins, reduced water availability for agricultural production may result in more than 63 million people no longer being able to meet their caloric demand by the 2050s with a temperature increase of 2°C-2.5°C compared to pre-industrial levels.

#### ***Water***

- South Asia is particularly vulnerable to flooding since there is a concentration of low-lying, heavily populated deltas.

- Societies are likely to face aggravated water and food insecurity related to increasing droughts and the destabilization of the Himalayan water towers which supply water to 1.3 billion people living in the basins of the great Asian rivers. The Brahmaputra and Indus river basins would be most affected by the changes in the Himalayan hydrological system.

#### ***Agriculture***

- In South Asia, climate change is projected to strongly impact agricultural production, the development of the sector, and the economic benefits derived from it, even under a global mean warming of about 1.8°C–2°C above preindustrial levels by 2050.

- Cereal production is expected to decline by 4-10% under a regional warming of 3°C by the end of this century as climate-related losses would not be fully offset by CO<sub>2</sub> fertilization effects.<sup>2</sup> Studies have estimated a mean change in yield of all crops by about 8% by 2050 in South Asia, including a yield reduction of 16% for maize and 11% for sorghum.

2 Some studies suggest increased levels of CO<sub>2</sub> lead to increased plant cover in some warm, arid environments.

- Projected impacts of climate change on crop productivity could strongly influence the region's food prices and supply. As a consequence, future population displacement and conflict could be heightened.

### ***Flooding***

- Thirteen of the top 20 cities with the largest increase of annual flood losses between 2005 and 2050 are in Asia and the Pacific: Guangzhou, Shenzhen, Tianjin, Zhanjiang, and Xiamen (PRC); ***Mumbai, Chennai-Madras, Surat, and Kolkata (India)***; Ho Chi Minh City (Viet Nam); Jakarta (Indonesia); Bangkok (Thailand); and Nagoya (Japan).

- Asia has the highest number of people exposed to flooding from possible storm surge events, particularly in the PRC, ***India, Bangladesh***, and Indonesia. 130 million people in low-elevation coastal zones in ***Bangladesh, India, and Pakistan***, meanwhile, are at risk of being displaced by the end of the century in worst-case scenarios.

## **2. BANGLADESH**

- With an overall population of about 160 million people, Bangladesh is one of the world's most populous countries, but only ranks 94th in terms of surface area. With a 4°C increase, a rise in sea level of 62 cm by the 2080s could result in a loss of 13% of Bangladesh's coastal land area and lead to flooding of 20% more land than currently. A 15-cm sea level rise by 2030 would lead to a land loss of 3% and a 6% increase in total flooded area. This would likely lead to displacement of many people.

- The increase of floods and inundation as well as rising sea levels might cause an 80-million-ton cumulative reduction in rice production in 2005-2050, or about 3.9% annually.

- Not accounting for the potential impacts of CO<sub>2</sub> fertilization, overall rice production could decline by about 17% and wheat production by 61% compared with a no climate change scenario.

## **3. BHUTAN**

- Rice yields could decrease by 6.7% (mid-altitude) and 12.6% (low altitude) by 2050.

## **4. INDIA**

- While rice yields could potentially increase in the northern states of India, they may decline by 5.0% in the 2030s, 14.5% in the 2050s, and 17.0% in the 2080s in the southern states, under an increase in temperature by more than 1°C.

## **5. SRI LANKA**

- Rice yields could decline by 3.6% to 19.8% by 2050 across seasons and climatic zones.

## **CENTRAL AND WEST ASIA**

### **1. REGIONAL**

- With unabated climate change, hot spots of local summer temperature increases of up to 8°C are found over the mountain ranges in the triborder region of Tajikistan, Afghanistan, and Pakistan, as well as over the northwestern part of the PRC by the end of the century.
- Annual mean precipitation in countries such as Pakistan and Afghanistan could decline by 20-50% in the late 21<sup>st</sup> century.
- Without accounting for changes in irrigation water availability, wheat yields in Central Asia might increase by 12% across all periods and scenarios mostly due to higher winter and spring temperatures, less frost damage, and CO<sub>2</sub> fertilization.
- A different study projects that heat stress in a 3°C world will affect wheat, maize, rice, and soybeans in 2071-2100 in Central Asia, especially wheat production in Kazakhstan.
- Additional death burden from undernutrition in very small children (<5 years) due to climate change could reach approximately 500 per year in Central Asia by the 2030s.

## **2. INDUS DELTA, PAKISTAN**

- Climate change could impact the variability of the monsoon and lead to changes in the intensity and timing of precipitation. This might further aggravate the water stress already present in the Indus Delta region today. Over the past 3 decades, the region has experienced extreme rain, more frequent cyclones and related floods, prolonged heat waves, as well as severe droughts. Floods in 2010 in Pakistan caused temporary displacement of about 14 million people, with 200,000 moving to internal displacement camps. Moreover, agricultural losses accumulated to \$1 billion.

## **3. KYRGYZ REPUBLIC**

- The country is likely to suffer from desertification, which might affect 23-49% of the country's total territory by 2100 from 15% in 2000.

## **4. TAJIKISTAN**

- Climate-induced water stress could decrease agriculture yields by up to 30% by 2100.

## **5. TURKMENISTAN**

- Climate change is likely to impact river runoff, reducing the annual runoff of the Amu Darya by 10-15% and the Syr Darya by 2-5% by 2050, thus putting pressure on existing irrigation systems and crop production.

## **6. UZBEKISTAN**

- Yields of almost all crops in Uzbekistan are projected to decrease by 20-50% by 2050 with a 2°C temperature increase.

## **PACIFIC**

## **1. REGIONAL**

- Some small island countries in the Pacific are in danger of losing their territories due to sea-level rise. Their limited spatial capacity often makes internal relocation unfeasible, leaving only the option of migrating to other countries (such as Fiji, Australia, New Zealand, and the United States).
- One of the major threats to small Pacific island states like Tuvalu is severe storm surges and related flooding.
- Marine ecosystems in the Western Pacific are in serious danger in all scenarios by 2100:
  - i) 1.5 °C degree Celsius: 89% of coral reefs are expected to suffer from serious bleaching
  - ii) 2°C: around 100% of coral reefs are projected to experience severe bleaching, with coral communities declining to 10-30% of their current abundance
  - iii) 4°C: all coral reef systems are projected to collapse due to mass coral bleaching
- Crop yields (rainfed crops) in Papua New Guinea, Solomon Islands, and Fiji will all decline severely by 2050 under the business-as-usual scenario.

## **2. FIJI**

- Fiji may likely be a major point of destination of the probable climate-induced migration of other Pacific island people as the country provides safe refuge with higher elevation and a similar geographic setting.
- Government of Kiribati has already bought 20 km<sup>2</sup> of land in Vanua Levu, Fiji.

## **3. TUVALU**

- According to IPCC's fifth assessment report in 2013, Tuvalu's rate of relative sea-level rise is about three times higher than the global average.