

Resource-wise impacts in different regions of India

(Source: IPCC assessment report)

- **Water resources**

Studies of one large catchment in the western Himalayas (the Chenab, a tributary of the Indus) show that the average snowmelt and glacier-melt contribution to the annual flow is 49.1%; a significant proportion of runoff is derived from snow in the dry season, when water demand is highest (Singh et al., 1997). Climate change-related increases in temperature also could increase the rate of snowmelt and reduce the amount of snowfall, if the winter is shortened. If climate change does alter the rainfall pattern in the Himalayas, the impacts could be felt in the downstream countries-that is, India and Bangladesh. Catchments in Nepal supply about 70% of the dry-season flow of the Ganges River, and tributaries of the Brahmaputra River originating in Bhutan supply about 15% of the total annual flow of that river. If climate change disrupts these resources and alters mountain hydrological regimes, the effects will be felt not only in the montane core of Tropical Asia but also downstream, in countries that depend on this water resource.
<http://www.grida.no/climate/ipcc/regional/293.htm>

- **Forests and biodiversity**

Mangroves may be affected by climate change-related increases in temperature and sea-level rise. Although the temperature effect on growth and species diversity is not known, sea-level rise may pose a serious threat to these ecosystems. In Bangladesh, for instance, there is a threat to species in the three distinct ecological zones that make up the Sunderbans-the largest continuous mangrove area in the world. If the saline water front moves further inland, *Heritiera fomes* (the dominant species in the landward freshwater zone) could be threatened. Species in the other two ecological zones (*Excoecaria agallocha* in the moderately saltwater zone and *Ceriops decandra* in the saltwater zone) also could suffer. These changes could result in economic impacts: Direct employment supported by the Sunderbans is estimated to be in the range of 500,000-600,000 people for at least half of the year (ESCAP, 1987), and a large number of these people - who are directly employed in the industries that use raw materials from the Sunderbans (e.g., woodcutting; collection of thatching materials, honey, beeswax, and shells; fishing) - may lose their sources of income.
<http://www.grida.no/climate/ipcc/regional/292.htm#man>

Using climate scenarios generated by ECHAM3, Achanta and Kanetkar (1996) have linked the precipitation effectiveness index (PEI) to net primary productivity of teak plantations in Kerala State, India. They estimate that a projected depletion of soil moisture would likely cause teak productivity to decline from 5.40 m³/ha to 5.07 m³/ha. The productivity of moist deciduous forests also could decline, from 1.8 m³/ha to 1.5 m³/ha.
<http://www.grida.no/climate/ipcc/regional/298.htm>

The Ganges-Brahmaputra delta is one of the world's most densely populated areas, and the combined effects of subsidence and sea-level rise could cause serious drainage and sedimentation problems, in addition to coastal erosion and land loss.
<http://www.grida.no/climate/ipcc/regional/300.htm>

- **Wildlife**

The Rann of Kutch in India supports one of the largest Greater Flamingo colonies in Asia (Ali, 1985; Bapat, 1992). With sea-level rise, these salt marshes and mudflats are likely to be submerged (Bandyopadhyay, 1993), which would result in decreased habitat for breeding flamingoes and lesser floricans (Sankaran et al., 1992). In addition, about 2,000 Indian wild asses in the Rann of Kutch could lose their only habitat in India to rising sea level (Clark and Duncan, 1992).
http://www.grida.no/climate/ipcc_tar/wg2/432.htm

- **Agriculture**

In a study done in Madhya Pradesh by Lal et al., (1999) it was found that the yield of soyabean would vary from -22 % to + 18 %. This was done by assuming a scenario with no adaptation with +2,+4°C rise; ± 20 , $\pm 40\%$ precipitation and included the direct effect of CO₂.
http://www.grida.no/climate/ipcc_tar/wg2/212.htm

In a study in northwest India, Lal et al. (1996) also found that reductions in yield resulting from a rise in surface air temperature offset the effects of elevated CO₂ levels; the projected net effect is a considerable reduction in rice yield.
<http://www.grida.no/climate/ipcc/regional/297.htm>

- **Coastal areas**

Major delta areas of Asia are likely to be subjected to stresses associated with sea-level rise, changes in water regimes, saltwater intrusion, siltation, and land loss. Low-lying coastal cities will be at the forefront of impacts; these cities include Shanghai, Tianjin, Guangzhou, Jakarta, Tokyo, Manila, Bangkok, Karachi, Mumbai, and Dhaka, all of which have witnessed significant environmental stresses in recent years.
http://www.grida.no/climate/ipcc_tar/wg2/441.htm#11241

- **Health**

During 1987-1990, kala azar (black fever or visceral leishmaniasis) reached epidemic form in the Indian state of Bihar and spread rapidly to surrounding areas. WHO (1996a) estimated that about 110 million people were at risk from kala azar. Major endemic foci are reported in border areas between India (states of Bihar and West Bengal), Bangladesh, and Nepal. In Bangladesh, kala azar already has reached epidemic form; the most vulnerable populations are poor and rural cattlekeepers. In a warmer climate, the incidence of kala azar also may increase (IPCC 1996, WG II, Section 18.3; WHO, 1996b).
<http://www.grida.no/climate/ipcc/regional/302.htm>

- **Drought-affected areas**

In India, chronically drought-affected areas cover the western parts of Rajasthan and the Kutch region of Gujarat. However, drought conditions also have been reported in Bihar and Orissa. These drought disasters are more frequent during years following ENSO events. At least half of the severe failures of the Indian summer monsoon since 1871 have occurred during El Niño years. In the event of enhanced anomalous warming of the eastern equatorial Pacific Ocean, a higher frequency of intense extreme events across Asia is possible.
http://www.grida.no/climate/ipcc_tar/wg2/419.htm