A Billion Indians in a Changing Climate

By

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Introduction

Climate change is seen worldwide as a serious and urgent issue. The Earth has warmed by 0.7°C since 1900 and will be subject to further warming over coming decades simply due to past emissions. Average global temperatures are estimated on current trends to rise by 2–3°C within the next fifty years, with several degrees more by the end of the century if emissions continue to grow (Stern 2006: 56).

Climate change will affect people around the world, threatening basic elements of life: access to water, food, health, and use of land and the environment. According to the Intergovernmental Panel on Climate Change (IPCC) with temperatures continuing to rise globally in the future, sea levels will rise, snow and ice coverage will decrease, and precipitation will increase in certain areas while droughts increase elsewhere. Also heat waves and cyclone activities will increase (IPCC 2007a: 2.).

In climate change discussions, much attention has been paid to the meteorological impacts of climate change. This is understandable as to appreciate the impacts of climate change, one must comprehend the scientific data, which is in itself complicated as precise scenarios cannot be made.

Oli Brown (2008b) has stated that while much time and energy has gone in determining the meteorological impacts of climate change, much less time and resources have been spent on empirical analysis on the impacts of climate change on human population. As the science of climate change is complex enough, its impact on societies with differing resources and varied capacity to adapt to external shocks, is even more unpredictable than the science. One of the significant consequences of climate change will be the question of human displacement. Climate change will have a significant impact on migration by reducing agricultural potential, increasing extreme weather events and destroying low-lying coastal areas. Poverty, falling ecosystems,

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Refugee Watch, 34, December 2009

vulnerability to natural hazards and environmental changes driven by gradual climate change are all linked to environmental migration. At the moment, majority of environmental migrants originate in rural areas of least developed countries and move and settle in urban centres within their home countries. From the point of view of India, a major concern is the vulnerable area of the Bay of Bengal (Brown 2008b: 12; Morton, Boncour & Laczko et al. 2008: 5–6).

The concept of so-called "environmental/climate migration" is problematic because nobody really knows precisely what climate change will mean for human population distribution. In the absence of concrete figures, it becomes difficult to persuade policymakers of its importance. In addition, isolating environmental factors from other drivers of migration is difficult. Defining environmental migration too widely can be damaging for those most in need of protection. However, nine out of ten disasters are now climate-related, so it is increasingly crucial to pay attention to rising natural disasters and their impacts to human population (Brown 2008b: X; Dun & Gemenne 2008: 10; Kirsch-Wood, Korreborg & Linde et al. 2008: 40).

The research focuses on the question: what are most serious climate change risks to human population in India? The focus of social impacts is especially on the question of human displacement. In addition to the main research question, emphasis is on identifying geographical hot spots and vulnerable groups in India as well as main policies and actions needed to protect vulnerable people.

The main methods and data collection techniques are literature review and interviews.[1] The interviewees represented 8 different organizations such as non-governmental organizations (4 interviewees), universities (4 interviewees), media (1 interviewee) as well as authorities of West Bengal State (2 interviewees). Due to the interviewee's organizations, the views are mainly reflected from a West Bengal perspective.

The structure of the essay is as follows. Section 2 goes through the climate change phenomenon, climate change policy and climate change migration. Section 3 discusses climate-related natural disasters in India so far, future impacts of climate change and potential future impacts on human displacement. Present and needed Indian climate policies according to the interviews are discussed in section 4. Finally, section 5 concludes the essay.

Climate Change

Reasons and Impacts

Climate change is due to the increased greenhouse effect. Greenhouse effect itself is a natural process, which enables life on the Planet Earth. Certain atmosphere gases allow sunlight through the atmosphere but simultaneously trap some of the Sun's energy, warming the Earth enough to support life (ilmasto.org 2008a). Thus, atmospheric gases act as a glass in a greenhouse. Without the greenhouse effect, the world's average temperature would be

approximately -18 °C while due to the greenhouse effect it is actually +14 °C (FMI 2008a).

Human activities produce a significant amount of greenhouse gases such as carbon dioxide, methane and nitrous oxide, which strengthen the natural greenhouse effect and as a consequence climate changes. Especially the use of fossil fuels such as coal, oil and natural gas, causes significant emissions. Fossil fuels are used most in energy production and transport. Greenhouse gas emissions are also created in agriculture, industrial processes, landfills, land-use change (e.g. deforestation) and forest fires (ilmasto.org 2008a).

In 1988 the IPCC was established. The IPCC has since produced climate change reports for political decision making and has been chaired by Indian Rajendra Pachauri. IPCC's climate change reports are prepared in research groups who collect and evaluate published scientific data on climate change. Therefore, IPCC does not do research itself but gathers and analyses scientific information for national and international decision making (FMI 2008b). IPCC's newest report is from the year 2007. The report pointed out that global warming is an undisputable fact. On the basis of findings, it can be seen that Earth's average temperature has risen 0.74 degrees during the last 100 years, oceans have become warmer, the rate of ice and snow melting has accelerated and sea level has risen 10 centimetres since 1961. In addition, carbon dioxide concentrations in the atmosphere have increased by 31 per cent. The report especially emphasized the impacts of human activities on global warming. Global greenhouse gas emissions due to human activities have grown since pre-industrial times, with an increase of 70 per cent between 1970 and 2004 (Figure 1). (ilmasto.org 2008b; IPCC 2007 ENG: 2-6.)

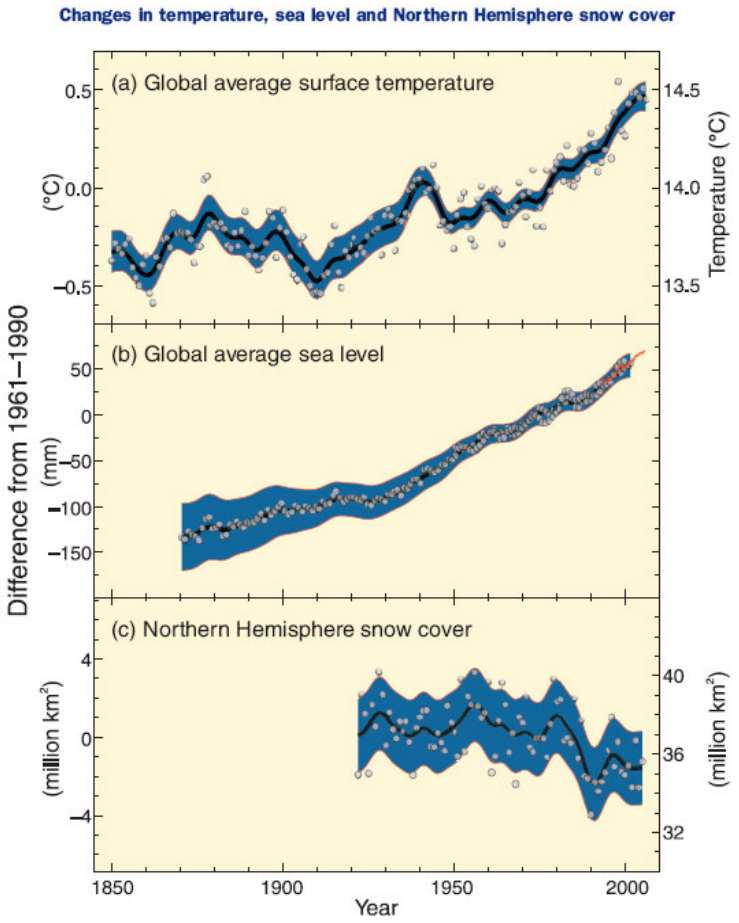


Figure 1. Observed changes in (a) global average surface temperature; (b) global average sea level from tide gauge (blue) and satellite (red) data and (c) Northern Hemisphere snow cover for March-April (IPCC 2007b, 3).

IPCC assesses the scientific, technical and socio-economic information relevant for the understanding of the risk of human-induced climate change. In the case of Asia, the impacts have been projected to be among others as follows (IPCC 2007b):

- By the 2050s, freshwater availability in Central, South, East and South-East Asia, particularly in large river basins, is projected to decrease.
- Coastal areas, especially heavily populated mega delta regions in South, East and South-East Asia, will be at greatest risk due to increased flooding from the sea and, in some mega deltas, flooding from the rivers.
- Climate change is projected to compound the pressures on natural resources and the environment associated with rapid urbanization, industrialization and economic development.

- 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.

IPCC has projected that by the end of this century the global average temperature will rise by 1.1–6.4 degrees and sea level will rise 17 centimetres. Droughts will increase in already dry areas while floods will increase in coastal areas, low-lying lands and river deltas. Heavy rains and cloud bursts will also increase (ilmasto.org 2008b). Snow covered areas will also decrease. Very high temperature heat waves and tropical hurricanes are also among the impacts of climate change in different regional areas (IPCC 2007b: 12.).

Climate change does not only occur from global greenhouse gases but also regionally from local pollution. Atmospheric brown clouds (ABCs) are formed by regional pollution and consist of tiny particles of soot, sulphates, nitrates, fly ash and other pollutants. The main sources of ABCs are fossil fuel combustion, bio fuel cooking and biomass burning. Therefore traffic and small-scale combustion especially contribute to ABCs. Regional emissions have been noticed to have an impact on the greenhouse gas effect when air pollution forms a brown surface on glaciers and snow packs and results in surface dimming. The "darker" surface thus reduces solar radiation and contributes to global warming. From a global perspective, aerosol particles in ABCs may have masked as much as 25–75 per cent of global warming due to greenhouse gases. The reduced solar radiation could lead to droughts in Africa and Asia. Locally ABCs have been shown to diminish the formation of rain clouds. Therefore ABCs can lead to a reduction and redistribution in monsoon precipitation. The combined effect of greenhouse gases and ABCs are especially damaging to global water budget and food security. Air pollution is also a major cause of health problems. The role of ABCs is increasingly crucial in Asia, which is the home to more than half of the world's population and accounts for almost 70 per cent of the world's poor. Asia has fast growing economies and high rates of industrialization. Moreover 40 per cent of the Asian population are living in cities and the rate is expected to increase. The number of motor vehicles and consumption of energy are also on the rise. At the same time when ABCs sources are increasing, they accelerate the impacts to, for example, agricultural productivity and water stress. (UNEP 2008: III-VI, 4.)

International Climate Change Policy

The starting point of climate policy can be seen as began in 1988 when the United Nations Environment Programme (UNEP) and the World Meteorological Organization (WMO) established IPCC. In 1990 IPCC published its first report, which notified that greenhouse gases strengthen the natural greenhouse effect. After a series of governmental meetings, over 160 countries signed the United Nations Framework Convention on Climate Change (UNFCCC)[2] at the UN's 1992 Rio de Janeiro Conference on Environment and Development (UNCED). The UNFCCC was designed to set industrialized countries on the path of emission reductions. The UNFCCC is still the most

important climate policy negotiation forum and system (*Financial Times* 2008: 8; Godrej 2006: 97-98).

Despite climate policy actions and IPCC's reports in 1990 and 1995, the climate change issue did not gather great interest in the United States. Especially the oil and coal lobby were strongly opposing research results on climate change. In 1997 before the Climate Convention in Kyoto, Japan, a US resolution proposed that the US would rule out any action on climate change if such actions would harm the US economy and unless developing countries also participated in greenhouse gas emission reductions. During the 1997 Climate Convention in Kyoto, the Kyoto Protocol was signed. The protocol was a supplement to the UNFCCC and set targets and timelines for industrialized countries for the 2008–2012 Kyoto Protocol period. The average emission reduction target was 5 per cent below 1990 levels. The Kyoto Protocol set tighter and more detailed reporting obligations than the UNFCCC. Most developed countries apart from the US ratified the Kyoto Protocol during 1997–2001. In 2001 US President George W. Bush delivered a speech in which he rejected the Kyoto Protocol and doubted the science on climate change. As a turning point for the Kyoto Protocol, Russia agreed to ratify the protocol in 2004, which guaranteed the treaty to come into force after the number of countries ratifying the protocol passed the 55 per cent needed (*Financial Times* 2008: 8-9; Godrej 2006: 98-103; Ministry of Environment 2008).

In 2007 President Bush changed his position on climate change and for the first time agreed to enter international negotiations on a successor to the Kyoto Protocol. At Bali in December 2007, a Bali Action Plan was agreed on. The plan stated that climate convention negotiations must be concluded by the Copenhagen Climate Conference by December 2009. In 2008 at a G8 meeting, the US agreed to sign long-term goals on emissions cuts. However, India, Brazil, South Africa, Mexico and China drafted a statement at the G8 summit calling for rich countries to take a more ambitious goal of cutting emissions by 80-95 per cent by 2050 compared to 1990 levels. This would allow developing countries to continue to increase their emissions longer. Developing countries do not however form a homogenous group for which reason especially the US requires India and China to join in emission reduction targets. India remains strongly opposed to emission obligations (*Financial Times* 2008: 6-8; Kaskinen et al 2009: 19).

In 2008, the US citizens elected Barack Obama as their new president. President Obama has taken a new line on climate policy and has pledged an 80 per cent emission reduction target by 2050.[3] The Kyoto Treaty period ends at the end of 2012 and a new climate agreement should be negotiated at Copenhagen in December 2009. It will be a challenge for the new Obama administration to prepare their climate strategy by December.

One of the most difficult topics in the international climate negotiations has been the fact of different greenhouse gas emission amounts in various countries. Figure 2 presents cumulative carbon dioxide emissions during 1840–2004. The United States of America has clearly been the major emitter of carbon dioxide. Rich countries mostly dominate the overall emission accounts

but due to their huge populations, China and India also have their own share of emissions. Rich countries account for 45 per cent of CO_2 emissions although they account for just 15 per cent of the world population. Sub-Saharan Africa also accounts for around 11 per cent of the world population, but represents 2 per cent of global emissions. Low income countries as a group account for one-third of the world's population but for just 7 per cent of emissions (UNDP 2007: 40-42).

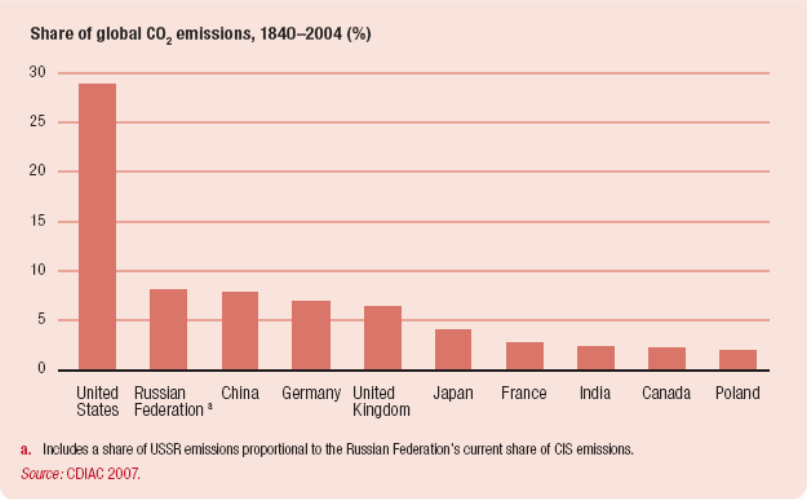


Figure 2. Cumulative CO_2 emissions 1840-2004 (UNDP 2007:40).

With countries such as the United States, while contributing to large portion of global emissions, having previously objected to measures on emission reductions, it is no surprise that developing countries have opposed obligatory emission reductions. The latter have especially referred to their low emissions per capita. Calculating and reporting green house gas emissions are also a complex task. In developing countries there are few organizations that are capable of doing this and the quality of emission data varies. Developing countries have also not been willing to develop accounting measures. Exact figures could encourage industrialized countries to gradually demand emission reduction measures and targets from developing countries. They have also stated that they need technology transfer and funding to be able to reduce emissions (Kaskinen et al 2009: 19-20). Developing countries however form a versatile group and there are huge differences in released emissions among different countries. Also the issue of Atmospheric Brown Clouds (ABCs) mentioned earlier, demonstrates the additional effect of industrialization especially in India and China and their contribution to regional climate change.

However, India has not been willing to commit to greenhouse gas emission reductions in international climate negotiations. India has emphasized equity and its low emissions per capita. India has, above all, emphasized "development first" policy; actions taken by developing countries should be development actions with climate co-benefits but not vice versa (Vihma 2009: 50). More on Indian national climate policy is presented in section 5.

Climate Change and Migration

Migration due to environmental change is not a new issue. Scarce resources have driven people to escape throughout history. What distinguishes the climate change we talk about now from previous climate changes is the magnitude of the impact. In addition, the global scale of environmental changes and the potential of human agency to respond to it are new phenomena (Boano & Morris 2008: 5).

Already in 1990 the IPCC noted that one of the greatest single impacts of climate change might be on human migration due to shoreline erosion, coastal flooding and agricultural disruption. In the mid-1990s 25 million people were considered to have been forced out from their homes and land because of serious environmental pressures such as pollution land degradation, droughts and natural disasters. This figure exceeded refugee figures from war and political persecution together (Brown 2008a: 11).

Professor Norman Myers from Oxford University has estimated that climate change could displace 200 million people by 2050.[4] The figure would mean in practice that one in every 45 people in the world would be displaced by climate change in 2050. However, there are no certainties of exact figures because climate change impacts on human populations are not clearly known. Climate migrants will occur both from climate processes, which are slow-onset changes such as sea-level rise, salinisation of agricultural land, desertification, growing water scarcity and food insecurity, as well as climate events, which are sudden and dramatic hazards such as monsoon floods, storms, hurricanes and typhoons. In addition non-climate drivers are equally important. Vulnerability to, for example, natural disasters depend vastly on the communities' potentials to protect themselves from the impacts. Poor built houses, lack of warning systems and peoples' ignorance of needed actions in the event of a storm, all increase vulnerability. Therefore, a community's vulnerability depends on its exposure to climatic conditions such as a coastal location as well as the community's adaptive capacity. (Brown 2008a: 11-18.)

Adaptive capacity varies by regions, countries and communities. Also national and individual wealth determines vulnerability and can enable better disaster risk reduction, disaster education and prompter responses. Richer countries have better potentials to protect their citizens and richer citizens have more options than poorer people. Climate change will primarily have an impact on already existing problems such as food security questions and water scarcity. But the impacts of climate change and amount of people displaced by climate change will depend on the temperature rise in the future. At the moment, there are only different kinds of scenarios available as the future is impossible to predict precisely. Impacts on forced migration will depend on the following issues:

- The quantity of future greenhouse gas emissions.
- The rate of future population growth and distribution.
- The meteorological evolution of climate change.

- The effectiveness of local and national adaptation strategies (Brown 2008a:18, 27).

Several scholars emphasize that it must be kept in mind that migration is always due to several reasons: environmental, economic and social. When climate stresses coincide with economic and/or social stresses, potential for forced migration increases significantly. Thus, environmental processes are hard to separate from other processes. Migration is typically not the first adaptive measure for households. Only when immediate needs cannot be met and communities and governments have failed in giving assistance, people will consider migration as an option. Especially migration related to gradual climate processes requires access to money, family networks and contacts, if people have any choice. Most people displaced by climate change will look for new homes within their own country where they have existing cultural or ethnic bonds. Intercontinental migration is likely to follow pre-existing paths and old colonial relationships. South and East Asia are considered to be especially vulnerable to large-scale forced migration because of their low-lying mega cities (Jakarta, Shanghai, Tokyo, Manila, Bangkok and Mumbai). In addition small islands states are particularly vulnerable (Boano 2008: 9, 31; Brown 2008a:22-24).

People's vulnerability to environmental change reflects a combination of their exposure, sensitivity and adaptive capacity. As a result, degree of vulnerability varies widely within countries, communities and even households. For instance, poor people's exposure to the impacts of climate change is often higher than others because economic and political forces confine them to living in high-risk landscapes. Meanwhile, one of the most important factors shaping adaptive capacity is people's access to and control over natural, human, social, physical, political and financial resources. Women are especially in risk as gendered roles, as well as cultural prescriptions and prohibitions, make it far more difficult for most women and female-headed households to migrate in response to environmental change (Warner et al 2009: 21).

The problem with climate migrants is their "invisibility" in the refugee framework. The term environmental refugee is not a legal term in the sense of the 1951 Convention or the 1967 Protocol on refugee definitions. The term forced migrant has been suggested to be more appropriate as it characterizes people fleeing their place of residence due to environmental stress, whether they are internally displaced or have crossed international borders. There is also little international interest in extending the refugee regime to applying to environmental or climate refugees. Rather receiving states are willing to restrict the refugee regime than extend it (Boano 2008: 12). Brown (2008b: 41) states that despite this, the international community will have to deal with the large-scale displacement of climate change and rethink current policies.

Climate Change and Impacts on India

This section presents some examples on on-going gradual climate processes and climate events in India as well as expected impacts for the coming years.

Impacts So Far

People in India, especially the poorest, are vulnerable to the impacts of climate change because India's economy is highly dependent on natural resources. Over 55 per cent of workers are engaged in agriculture and related sectors and many others receive their living in coastal areas through tourism or fishing. Most of India's poorest people live in rural areas and rely totally on natural resources for their food, shelter and income. People, especially in rural areas, are already experiencing the impacts of climate change such as diminishing water resources and natural disasters and are trying to cope with scarce resources (UNDP 2009).

Several interviewees mentioned that due to climate change monsoon and precipitation patterns have changed. Especially winter and monsoon have experienced delays. There has been only a minor increase in total rainfall itself but heavy rainfall has increased. The temperature data in Kolkata shows an increasing trend in annual minimum temperatures indicating that the winters are disappearing. Other impacts derive from the melting of the Himalayas, which affects rivers even all the way to the Sundarbans.[5] Coastal erosion has also occurred and reduced coastal tourism. Interviewees mentioned that there have also been flash and sudden floods. Floods are often followed by droughts. In Mumbai there have been sudden cloud bursts. Especially in risk are those dependent on agriculture and fisheries. According to interviewees pattern of rainfall and seasonal changes are affecting crops. A late monsoon can spell agricultural loss for crops to be sown in June. Also the increasing salinity of soil is reducing agricultural productivity. According to a professor interviewed, in a study concerning families that are dependent of high altitude animals, people have moved further north and some are changing their livelihoods to agriculture.

Almost 60 per cent of India's mangrove habitat is located in the Sundarbans region. However, the region is in increasing risk because of rise in sea level. Some of the islands have been already submerged and 15 per cent are expected to lose their landmass by 2020. Satellite imagery shows that the sea level in the Sundarbans has risen at an average rate of 3.14 centimetres a year over the past two decades, which is much higher than the global average of two millimetres a year (Bhaumik 2003; Sen & Danda 2007: 6–7). The Sundarbans' ecosystems and biodiversity are also being heavily affected by impacts of climate change.

According to the interviewees, flooding in the Sundarbans region is problematic. The embankments are built to protect people from flooding and to protect agricultural land. In the Sundarbans region people plant two crops a

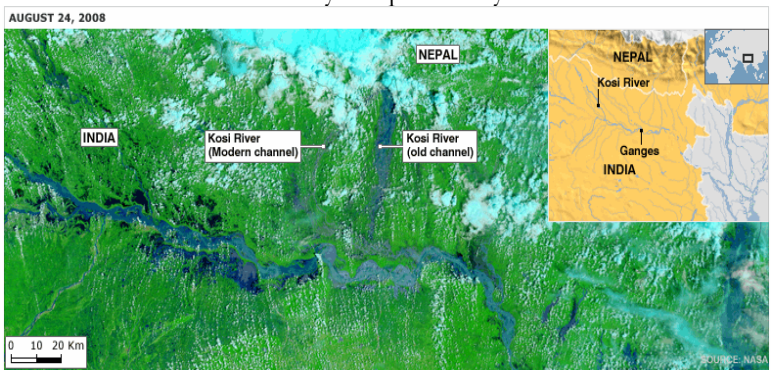
year, one in January and another in June–July. Usually when floods strike, people lose a standing crop. Cultivation and harvesting are the most vulnerable times for flooding. Embankments are built but they also trap water in. In the Sundarbans region, 85 per cent of the people are dependent on cultivation. Also there is a problem when embankments are built by the governments. There have been flaws in construction and material choices. As construction companies are interested in getting construction agreements, they might build them badly wilfully to receive a new agreement later. According to the interviewees, if local people were involved, they would build the embankments properly to safeguard their own interests. However, there have also been problems in engaging local people as they expect the government to take care of the issue.

In coastal areas, important adaptation measures include finding salt tolerant plant species when sea water intrudes agricultural land. According to interviewees, in some areas of the Sundarbans old salt tolerant plant varieties have been re-planted. Inland fisheries are also important in the Sundarbans but they suffer from saltwater intrusion after storms. Therefore freshwater fish suffer. Together with NGOs and research institutes efforts are being made to select fish species that survive both in freshwater and salt water. Also utilising people's traditional knowledge is important. Old best practices and traditional knowledge can be used to modify solutions to new circumstances instead of creating completely new ones.

Interviewees mentioned the flooding in Bihar in 2008 as an example of climate events. Heavy monsoon rain caused the river to change its course and flooded vast areas in India and Nepal causing displacement (Box 1).

Box1: Bihar River Changes Course

In 2008 monsoon rains caused the Kosi river, a tributary of the Ganges to change its course. The areas affected are not normally prone to floods. Normally the Kosi curved westwards out of Nepal in a C-shape. But in the heavy rains that hit the region, the river burst its banks and diverted southwards through the state of Bihar sending huge waves into an old, previously abandoned channel it had followed 200 years previously.



The disaster began when a dam burst on the Saptakoshi river in Nepal. The Saptakoshi, which becomes the Kosi when it enters India, subsequently broke its banks in Bihar. Severe flooding in the state of Bihar caused 100 villages to be completely submerged and displaced a million people in India and Nepal. People had to flee to unsanitary relief camps lacking of adequate emergency supplies. Bihar is one of India's poorest states. Limited supplies of safe drinking water and poor hygiene conditions posed a threat of diseases such as cholera. Officials said the flooding was the worst in 50 years in the region.

References and photos: BBC
http://news.bbc.co.uk/2/hi/south_asia/7591006.stm

Intensifying Climate Change Risks

South Asia will also suffer from problems relating to water availability, reductions in yields of wheat and maize and increases in disease, flooding in particular areas and drought in others as well as disruptions in the monsoon cycle. The specific impacts on the monsoon by climate change are still, however, unknown. By the end of the century, climate models suggest that the Indian region will receive generally more precipitation in average. Timing of the monsoon could change as well as its spatial distribution and there could be breaks within the monsoon. Water availability reductions are especially possible for areas of North India where majority of water needs are met by Himalayan snow-pack melt during the dry summer months. The loss of this water resource due to climate change will affect water management and irrigated crop production and increase unsustainable groundwater pumping. Highland communities will again be affected by snow and glacier melt by the terrain becoming unstable (Rajan 2008: 5, 8).

Climate change represents additional stress to India's ecological and socioeconomic systems that are already facing severe pressure caused by rapid urbanisation, industrialisation and economic development. One fourth of the Indian population lives by the country's long coast and is strongly dependent on coastal livelihoods. Coastal regions will suffer most from sea level rising and storm surges. Especially India's east coast is vulnerable to cyclones in the Bay of Bengal (DEFRA 2005). Below are presented expected climate change impacts on India.

Changes in Precipitation, Floods, Water Supply

Several areas suffer already from water scarcity. Even though the Indian population represents 16 per cent of the world population, it has only 4 per cent of the world's freshwater resources. Water supply will vary in different areas. Annual precipitation will increase but at the same the number of rainy days will decrease. This means that regional distribution is large and also the number of heavy rainfall days will increase. Especially India's western coast and central parts will suffer from heavy rainfall. Extreme precipitation has already occurred in Mumbai in 2005 and caused floods in Gujarat in 2005 and 2006. These changes are expected to increase the vulnerability of Indian agriculture and natural resource-linked livelihoods as well as agricultural productivity. In urban areas the poor, who typically reside in areas prone to flooding, are the most vulnerable to water scarcity especially as they largely depend on informal water sources (Revi 2008: 212–213).

Impact of climate change on monsoon system is not yet certain. The timing of monsoon may change as well as its regional distribution. There may also be in breaks during the monsoon. North India is expected to face most water shortages as the area it heavily dependent during dry summer months on water from snow-melting streams from the Himalayas. The loss of this water resource will affect substantially water supply, irrigation of agricultural land as well as would increase the use of ground water (DEFRA 2005; Rajan 2008: 8; Revi 2008: 212–213).

Drought

One of the most serious climate change risks to the Indian economy and its people is the increased intensity, frequency and geographical coverage of drought. Especially in rural areas droughts have a heavy impact on agriculture, animal husbandry, forestry and fishing. Drought can lead to cycles of seasonal and distress migration and increase rural debt and farmer suicides, some of which already exist as problems from before. In cities drought has impacts on drinking water shortages and increases food and biomass fuel prices. It can also have second-order impact such as depress demand for urban-produced secondary goods and services due to depressed agricultural demand and increase seasonal and distress migration from rural areas. Climate change is expected to increase drought in western India where five river basins are expected to be affected leading to acute to severe water shortages to several cities in Gujarat (Revi 2008: 213).

Cyclonic Storms, Storm Surge and Coastal Flooding

Cyclone intensity is expected to increase but the intensity will depend on how much the sea surface temperature will rise. India's east coast is clearly at risk as the frequency of cyclones in the Bay of Bengal is high. Also the high concentration of population on India's and Bangladesh's eastern coasts

increases the vulnerability of the region. There have already been several devastating cyclones in the area such as in Orissa, India in 1999 and in Bangladesh in 1991 causing serious damage and loss of life and property. Cyclones and storm surges are a particular risk for large cities such as Mumbai and Chennai. These areas are also, among others, at risk of sea-level rise. Other areas at risk are Khambhat and Kutch in Gujarat and part of the Konkan coast and south Kerala. The deltas of the Ganga, Krishna, Godavari, Cauvery and Mahanadi are expected to be lost as well as settlement areas, irrigated land and urban settlements situated there. Losing these economic and cultural regions could have a serious impact on the states of West Bengal, Orissa, Andhra Pradesh and Tamil Nadu. Impact of climate change on saltwater intrusion in the coastal zone and on coastal agriculture and fisheries are also expected to be significant (Revi 2008: 216).

Health Risks

Climate change is expected to increase environmental health risks in India such as water-borne diseases (diarrhoea, cholera and typhoid). Malaria is also a major concern. Malaria is expected to expand to new areas in western and southern India, which places a large population in risk. As Indian cities have already become major reservoirs of vector-borne diseases such as malaria and dengue fever, morbidity risks are expected to increase in the future (DEFRA 2005; Revi 2008: 217).

Climate impacts mentioned by the interviewees were in line with impacts mentioned in literature. Interviewees mentioned also changes in precipitation, increase of heavy rainfall and other extreme weather events as well as increase in diseases such as malaria and diarrhoea. Also the interviewees emphasized the social impacts of climatic events and processes such as loss of livelihoods, houses and cattle as well as the increase of debt traps through agricultural pattern changes. According to them, climate change could have a severe impact on the Ganga River. The river is considered to be mother river of India because many depend on it. Impact on Ganga could affect agricultural lands, irrigation as well as cause famines and drought and have severe impact on the Indian economy. Interviewees warned that while all environmental impacts should not be related to climate change, at the same time it is important to understand how different processes and human activities interlink.

Interviewees mentioned trans-boundary water disputes as an example of the role of climate change to potentially increasing political risks. As water sources are becoming increasingly scarce, China has considered plans to divert water from the Brahmaputra River to northern part of China and thus cut off Brahmaputra's river flows to India. Conflicts may also occur between states and districts because of use of water and especially due to crops demanding high amounts of water.

Impacts on Displacement in India

The IPCC even in its most conservative scenario estimates that sea level with rise in 2100 by 40 centimetres than today. This will cause coastal flooding affecting 80 million people in Asia. Majority of those affected will be in India and Bangladesh. Sudhir Chella Rajan (2008) is one of the few scholars who have done research on future climate migration in India and tried to estimate rough figures of the amount of people affected. According to Rajan's study, if global temperatures rise as much as 4–5 degrees Celsius following business-as-usual growth in greenhouse gas emissions, about 125 million people could be homeless in India and Bangladesh by the end of the century due to sea level rise and drought, associated with shrinking water supplies and monsoon variability. In this estimate, 75 million would be from Bangladesh and the rest from India's coastal and vulnerable areas. Majority of the Bangladeshi migrants are expected to immigrate to India despite the fact that India is already trying to restrict illegal immigrants from Bangladesh with a fence along their border.[6] With a 4–5 degree rise in global temperatures, sea levels could rise 3–5 metres. Such an increase would imply the breaking-up of Greenland and Antarctica ice sheets. The level of sea rise is still being debated due to the complexity of climate modelling (Rajan 2008: 1–4).

Bangladesh, Pakistan and India share a coastal region called Low Elevation Coastal Zone (LECZ). The LECZ is within 10 metres above average sea level. The size of the area is 160 000 m^2 with a population of 130 million people. Almost 97 per cent of its population resides in equal numbers in Bangladesh and India. Bangladesh is as a whole a low-lying delta region and India has a long coast line with large cities along it. In Bangladesh, rural population will be most vulnerable whereas in India, rural and urban groups will be equally affected. Figure 3 illustrates the population density of India within the LECZ. At risk are expected to be cities such as Mumbai and Kolkata, which are at average elevations of 2–10 metres. Migration is likely to focus from these cities and other coastal cities such as Chennai to other large urban settlements in the inner country rather than to smaller cities in the coastline. Thus cities coping with growing populations already such as Delhi, Bangalore, Ahmedabad, Pune and Hyderabad will have to prepare for large numbers of migrants from the coast (Rajan 2008: 1, 6).

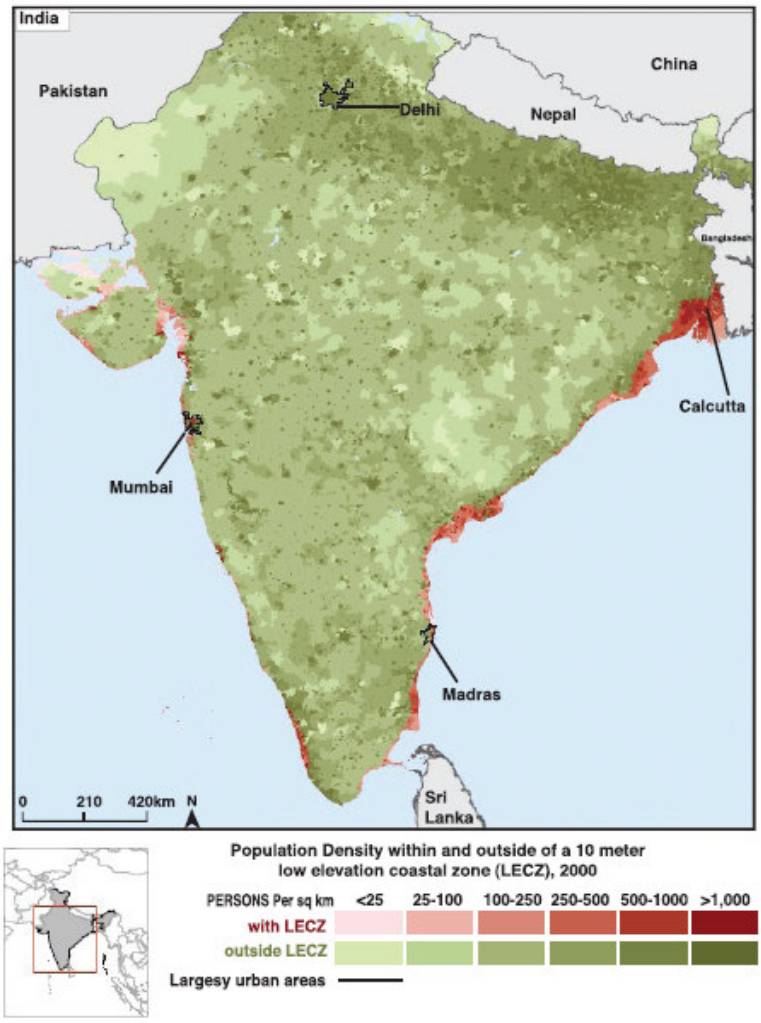


Figure 3. Population density within and outside a 10 meter low elevation coastal zone (Rajan 2008: 6)

Coastal population will face storm surges and coastal erosion. Most vulnerable communities will be those most exposed to these stresses and those with least capacity to respond and recover. When the point of ability to cope with the impact has been reached, mass movements of large coastal groups, villages, towns and even cities could occur. Historical evidence has shown that migration as such takes place in waves, often towards areas where there are family or community contracts, job opportunities and cultural affinities. Especially younger people tend to migrate first and urban areas are the largest recipients (Rajan 2008: 7).

But interior parts of India can also generate climate migrants. Vulnerable areas have been identified within India that will be most vulnerable to climate change as well as to negative trade effects of globalization. These

areas include among others western Rajasthan, southern Gujarat, Maharashtra and Madhya Pradesh. These migrants as well as sea level rise migrants will likely migrate in waves. Agricultural workers will become landless and suffer a serious threat to their livelihoods. Many of the migrants will head to urban areas and even to largest cities on the coast and be twice vulnerable to climate change but this time to sea level rise (Rajan 2008: 8).

Information on internal displacement caused by climate-derived processes and events is not widely available. Interviewees emphasized especially the Sundarbans region as an example of gradual climate-related displacement. According to the interviewees as a result of submerging islands in the Sundarbans, people have had to move to local islands due to loss of land but have remained in coastal areas. If they do not find livelihoods in coastal regions they tend to move further. One of the problems is that many do not speak several languages[7] and therefore tend to stay in local regions. Some may migrate to Kolkata or other areas. People in the Sundarbans have low level of education, so their possibilities are limited. Migrants' possibilities can be especially diminished if they are perceived as a threat to locals. Mainly, however, people are not willing to leave their homes unless there are no other alternatives. Interviewees mentioned that people try to manage as long as possible in their home areas.

According to several interviewees, in the case of both temporary and permanent displacement the question of addressing people's needs is vital. Sanitation, food, water, housing and livelihoods are the main necessities. Interviewees also emphasized that people will need to know where to get information from and who will help them. At the moment there are no particular mechanisms, and information passes from person to person. Interviewees mentioned that there has been some assistance to people who have had to migrate due to erosion but most people do not have enough resources to take care of their own destiny. Some non-governmental organizations have built schools and resource centres in the Sundarbans region in higher points of the islands. The resource centres provide information on, among others, disaster management. Interviewees mentioned that it is vital to identify vulnerable groups and create disaster response teams accordingly. Interviewees predicted that as people are not willing to leave their home areas even though circumstances worsen, people would only leave once their situation has become very bad. At that point many will have nothing and will have a tough time finding a livelihood for themselves. People's reluctance to leave is, according to the interviewees, due to the fact that people are very apprehensive of uncertainty and fear the unknown. They are also concerned of what kind of assistance package they will receive from the government.

Indian Policies and Actions on Climate Change

In India environmental and climate policy issues are dealt within the central and state governments. In general, some issues are handled only at central government level, some only at state government level and some are

overlapping. In the central government there is a Ministry of Environment, which is the highest policy making body. State government ministers and departments can also make political decisions but never beyond the central government. In climate issues mitigation policies are set mainly by the central government and adaptation measures by the states.[8]

Policies So Far

Climate change is a rather recent topic in Indian policy. India signed the United Nations Framework Convention on Climate Change on 10 June 1992 and ratified it on 1 November 1993. It ratified the Kyoto Protocol in on 26 August 2002 and hosted the eighth Conference of the Parties to the UNFCCC in October 2002 in Delhi. In 2004, India submitted its first national communication to the UNFCCC (McKibbin 2004: 8).

An Indian report from 2005 stated that climate change remains relatively a low priority issue in India for policymakings and the general public. The issue was considered distant in comparison to developmental needs such as reducing poverty, generating employment and providing basic services and infrastructure. The Indian industry has been exempt from mandatory requirements to reduce greenhouse gas emissions but has, however, been active in developing Clean Development Mechanism (CDM)[9] projects (TERI 2005: 10).

In 2007, the Indian Government created the Advisory Council on Climate Change, which is chaired by the Prime Minister. The Council has broad based representation from different key stakeholders. It held its first meeting on 13 July 2007. The plan was India's first step towards taking action on a national scale towards tackling impacts of climate change. In his opening remarks at the first meeting of the Council of Climate Change, Prime Minister Manmohan Singh acknowledged the findings of IPCC that climate change is a validated fact. He also pointed out the need to act on climate change, as India is dependent and vulnerable of the monsoons and the Himalayan snow-fed rivers as well as having a long coastline. In addition, growing needs of the economy puts pressure on natural resources. Singh emphasized on the importance of documenting work India has done in following a less-energy intensive path to developing new CDM projects and that climate change should be made a critical parameter in plan formulation and investment decisions. He also pointed out the challenge in addressing the global issue of climate change without compromising the imperatives of poverty alleviation. Other actions considered important were focusing on understanding and mapping the monsoon at sub-regional levels, technology development to respond to climate variability in agriculture to ensure food security and economic modelling in Indian circumstances as well as preparing a road map for energy efficiency and sustainable development in major sectors like agriculture, forestry, industry, transport, power, housing and environment infrastructure (Majumder 2007; Prime Minister's Office 2007).

The National Action Plan on Climate Change itself extends to the year 2017. It includes 8 national "missions" for solar energy, energy efficiency, water

conservation, more public transport, sustainable agriculture, sustaining the Himalayas and scientific research. The National Action Plan on Climate Change does not directly discuss the matter of impact of climate change to human displacement. The main targets of the national missions are as follows (Prime Minister's Council on Climate Change 2007: 3–5):

1. National Solar Mission: Aim to promote the development and use of solar energy for power generation and other uses with the ultimate objective of making solar competitive with fossil-based energy options.
2. National Mission for Enhanced Energy Efficiency: Current initiatives are expected to yield savings of 10,000 MW by 2012.
3. National Mission on Sustainable Habitat: To promote energy efficiency as a core component of urban planning, in building, urban waste management and recycling, efficient vehicles and incentives for public transportation.
4. National Water Mission: With water scarcity projected to worsen as a result of climate change, the plan sets a goal of a 20 per cent improvement in water use efficiency through pricing and other measures.
5. National Mission for Sustaining the Himalayan Ecosystem: The plan aims to conserve biodiversity, forest cover, and other ecological values in the Himalayan region, where glaciers that are a major source of India's water supply are projected to recede as a result of global warming.
6. National Mission for a "Green India": Goals include the afforestation of 6 million hectares of degraded forest lands and expanding forest cover from 23 per cent to 33 per cent of India's territory.
7. National Mission for Sustainable Agriculture: The plan aims to support climate adaptation in agriculture through the development of climate-resilient crops, expansion of weather insurance mechanisms, and agricultural practices.
8. National Mission on Strategic Knowledge for Climate Change: To gain a better understanding of climate science, impacts and challenges, the plan envisions a new Climate Science Research Fund, improved climate modelling, and increased international collaboration. It also encourages private sector initiatives to develop adaptation and mitigation technologies through venture capital funds.

According to an interviewee from West Bengal, the national action plan was prepared entirely by the central government. The central government requested suggestions from the state governments and they have responded accordingly. For example, the West Bengal Government emphasized the need for an action plan for the Sundarbans area as well as more actions on non-conventional energy. There was also a commission established between the central and state governments to come together on climate change. According to the interviewee these kinds of commissions are set up when the government feels there is a large gap in perception. At the time of the interviews (January 2009), the state of West Bengal was also planning to establish a climate change institute together with The Energy Resources Institute (TERI) to make climate change information such as how best practices can be multiplied, climate change

projections, vulnerability assessments and climate modelling available under one roof.

Some interviewees emphasized that there is increasingly more actions on climate change and natural disasters, keeping in mind how recent the subject of climate change is in Indian policy. Non-governmental organizations have raised climate change as one of their biggest issues and are increasingly working on it by awareness raising campaigns and lobbying to the government and private sector. Also there have been gradual improvements in disaster management plans and warning systems. Cyclone shelters in coastal areas as well as GPS[10] warning systems for fishermen at deep oceans are some of the examples of these efforts.

Actions Needed

Climate change will have a powerful impact on India causing migration to urban areas and making people homeless. According to Rajan (2008: 1–3), even if global warming contained below 2 degree Celsius, the number of migrants would still be approximately 5 million people. The estimation of 125 million people displaced in the case of 4–5 degree Celsius global temperature rise, would be an overwhelming burden for India and be impossible to adapt to. Therefore, India should seek policy options that lead to sustainable development such as an economic growth that moves towards de-carbonization and climate change mitigation, as adaptation costs will be too high to bear. Rajan claims that India has been not been active enough in reducing greenhouse gas emissions and has rather settled to be a beneficiary of project investments through the Clean Development Mechanism (CDM) (Rajan 2008: 1–3).

The interviewees had, assumedly due to their different background organizations, different views on how India has succeeded in climate issues. One common view raised in several interviews was that the Indian Government is not doing enough on its part of tackling climate change. Issues such as energy efficiency and transferring to liquefied petroleum gas (LPG) and renewable energy sources are not being adequately dealt with. Climate change was not considered to be a priority for India because development was rated higher on the political agenda. However, interviewees underlined that the people suffering most through climate change are poor people. Among those people especially vulnerable were considered to be marginalized people living in coastal areas who have no education and few health facilities.

Opinions of the National Action Plan on Climate Change also varied among the interviewees. Some considered it to be more words then actions. Many agreed that it was a good basis and outline but there were several issues to be added and more emphasized in practice. The plan should be implemented by research and complemented by a goal-oriented, systematic plan. Interviewees emphasized that mention of the vulnerable coastal areas were especially lacking in the National Action Plan. This was also an issue the West Bengal State Government was requesting the central government to include due to the vulnerability of the Sundarbans area.[11]

One issue raised was that the government was giving an impression that "everything is in control" even though things were not. Some interviewees stated that the government is scared of anything negative and is therefore not thinking proactively. On the other hand, the government noted that climate change is a common responsibility. It was not just the government that received criticism but the overall mood among people and organizations in India. For example, the previously mentioned attitude of denial and understatements was considered to have started among the people, not the government. Ordinary people, who are also suffering from climatic impacts such as sea level rising and salinity, are pushing the responsibility of acting on the government even though, according to one interviewee, "they are the ones getting drowned." Also the private sector has not, even among international companies operating in India, taken enough social responsibility. India was considered an economically strong and sound country. However, it is not advantageous to spend money on social and environmental issues if they do not produce profit.

"Planning is not Part of this Country." – Interviewee, 13.1.2009

The interviewees called for a change in mindset in different levels of the society. Different interviewees put their emphasis on different actors, together covering a wide range: central government, local governments, private sector, common people and communities. The Indian mentality of accepting ones faith was considered damaging in the case of climate change. Because people tend to think one cannot change his/her own faith, people consider that climatic processes and events are non-avoidable. People take them as they come and are not, therefore, willing to act proactively. This mindset is reflected in different actors' opinions. Some interviewees pointed out that people are setting entrapping themselves by neglecting, for example, natural disaster reduction and prediction measures or even warnings; people unnecessarily pay with their lives when they could be saved. In addition, interviewees pointed out that many people argue that climate change is not a new issue. This kind of argument is based on the opinion that climate change has always been here. Despite the scientific results related to climate change, many consider it to be a bigger issue now because people are talking more about it.

"There is a Hangover Over Colonial Powers" – Interviewee, 13.1.2009

An issue reflecting the attitude towards climate change in India is the feeling that climate change is created by the West and the "white people". Reason behind this is the scepticism of the colonial period and western actions, which still persist strongly among the Indian people. According to the interviewees, the West is commonly considered, as trying to limit India's growth by trying to commit India to emission reductions. The United States especially should first act on climate change as it has contributed so vastly to the problem and has not signed the Kyoto Protocol. This sort of attitude was considered partly harmful because it diminishes proactive measures on climate change.

Interviewees mentioned that also the industrial lobby use this kind of mentality as an argument to emphasize that it is the West who should act. Climate change is therefore partly overlooked as a scientific and political issue due to denial and anti-colonial sentiments as well as growing nationalism and middle class. Interviewees believed India will take an active role only if there is strong international pressure. Some interviewees criticized the Indian Government for not wanting to do anything voluntarily and only reacting on the matter. There are differences in climate change attitudes between governmental representatives and climate scientists and others who are a minority. The other side of the picture is, according to the interviewees, the large impacts of not-acting. Even in the case of vast migration caused by climate change, interviewees mentioned that people will tend to think that just as climate change, migration has always taken place.

Another challenge, according to the interviewees, will be convincing the larger public of the needs of action. This will be achieved only by a powerful commitment and motivation deriving from the government in cooperation with other actors. Interviewees mentioned that when people are not aware of the objectives and understand why something should be done, they are unwilling to change their habits. Especially in rural areas people are not aware of issues such as climate change where emphasis is more on short term than long-term benefits. Capacity building and raising awareness were thus emphasized in making people understand and then try to implement policies. Some non-governmental organizations have tried to demonstrate to people that even if agricultural productivity is reduced in a short term, in the long run future benefits can be guaranteed. But, according to the interviewees, there is still a strong need to pass information deeper into rural areas and offer better information overall. In addition local people should be consulted, for example, in embankment construction because they are aware of good materials. Also using local workforce creates jobs for the communities concerned.

In addition to a mindset change, interviewees called for actors to work together on climate change. Non-governmental organizations, states and government bodies, private sector and communities should seek for a common goal. The common goal and motivation is however yet to be created. There are differences among states in mitigation actions for which a strong national agenda is needed. There is also the financial challenge for different actors to work on climate change. Interviewees mentioned that financing climate adaptation such as desalination is very expensive and therefore India should commit to mitigating its emissions. Technology is expensive and it is impossible for India to find funds for all the technology needed. Therefore technology transfer is considered a must. In addition, in view of India's different geographical and socio-economic conditions, multi-layered strategies should be planned.

Interviewees also mentioned that to adapt to climate change, Indians should adapt new food patterns. As an example, one university professor mentioned the potential in eating oysters and seaweed. So far they have not been consumed as food and people have not been aware that they are edible. Also

less water intensive crops should be selected. As mentioned previously such fish and plant species, which can tolerate salt water, will be needed.

Of course, interviewees emphasized on the need for a global solution and the responsibility of the global community. All interviewees were well aware of the impact of climate change to human development in India but there were variations on whether India should commit to legally binding emission reduction targets or reduce emissions voluntarily. Many interviewees felt that India's stand on climate change is conditioned by what other countries do. For that and other reasons mentioned above, with the current economic situation, also mentioned by interviewees, and with a new US President, it will be more than interesting to see, what stand India will take in the climate negotiations in Copenhagen in December 2009.

Environmental NGO interviewees also emphasized that climate change policy should not be seen merely as a burden but also as an opportunity. There could be several jobs created in the renewable energy sector. But at the same time interviewees mentioned that there is a powerful energy industry lobby in the fossil fuel sector diminishing these potentials.

The interviewees pointed out that the severe challenges brought about by climate change should be the rationale why India should act proactively. The huge costs of 'not acting', the impact on wildlife and prospect of extinction of species, human displacement, livelihoods and development could all crumble the economic growth and development achieved so far.

Conclusions

Climate change is a process that is caused by industrialization and has intensified significantly during the latter part of the twentieth century and the beginning of the new millennium. India will be amongst the countries suffering most from impact of climate change. Most severe impact on India will be changes in precipitation, floods, water scarcity, drought, cyclonic storms and storm surges as well as health risks. These will, among others, affect people's livelihoods, economy, increase poverty and displace people. India is already now suffering from intensifying natural disasters.

India sees climate change as an environmental problem created by the unsustainable part of the first world, but in the eyes of other countries, India is also contributing to the problem. India's international climate policy is partly formed by anti-West and anti-colonialist sentiments. India also refers to its huge number of poor people, which limits its potentials to legally bind to any international climate agreement. Climate change policy is also a rather new area in Indian politics. The National Action Plan was introduced in 2007 and therefore India still needs time to find best and cost-efficient practices.

India is in a difficult situation, as it should at the same time reduce emissions, and improve the economical situation of its people through development, and thus reduce poverty. There are variations between countries in adapting to climate change. Richer countries have better financial opportunities to protect their citizens from, for example, natural disasters

whereas similar natural disasters may cause severe consequences in poorer countries. Poor people, also in India, are worst hit by impacts of natural disasters and climate change itself. The better the economical situation of the country—the better capability of financing climate changes adaptation. Therefore, also international financial aid is needed for adaptation.

A culture of information sharing and capacity building should be created between different organizations and stakeholders to work together and find suitable solutions to mitigate and adapt to climate change. Above all, India should take a firm position on climate change and implement effectively the missions of the National Action Plan. Climate change is a ticking time bomb where all actions not taken today, will multiply the problems for tomorrow. The international community as well as individual countries should commit to actions on climate change to especially protect the poor and the vulnerable. With a billion people population and continually growing, India has a lot at stake.

Notes

1 I conducted interviews with 11 persons in Kolkata during a research fellowship at Mahanirban Calcutta Research Group (CRG) in January 2009.

2 The Convention on Climate Change sets an overall framework for intergovernmental efforts to tackle the challenge posed by climate change. It recognizes that the climate system is a shared resource whose stability can be affected by industrial and other emissions of carbon dioxide and other greenhouse gases. The Convention enjoys near universal membership, with 192 countries having ratified. The Convention entered into force on 21 March 1994 (unfccc.int).

3 http://my.barackobama.com/page/content/newenergy

4 Myers has been since cited in IPCC publications and the *Stern Review on the Economics of Climate Change*.

5 The Sundarbans is an area shared by India and Bangladesh and is the world's largest delta and mangrove forest. The region consists of 102 islands. The Sundarbans are located at an area below Kolkata in India and Dhaka in Bangladesh where the Ganges and Brahmaputra rivers join and flow in the Bay of Bengal.

6 India has a 4000 kilometre long fence along the Bangladeshi border. The fence initially tried to stop smuggling, trafficking and illegal immigration (estimated 20 million people annually). Construction started in 2002. The 3.6 metre high, double wire fence serves also the purpose of controlling the flow of future forced climate migrants (Brown 2008b, 40).

7 In India, 29 languages have more than a million native speakers.

8 State official interviewee.

9 A mechanism under the Kyoto Protocol through which developed countries may finance greenhouse-gas emission reduction or removal projects in developing countries, and receive credits for doing so which they may apply towards meeting mandatory limits on their own emissions (http://unfccc.int)

10 The Global Positioning System (GPS) is a global navigation satellite system (GNSS) developed by the United States Department of Defense. It can be used freely, and is often used by civilians for navigation purposes.

11 "If glaciers melt, the Sundarbans and West Bengal will be heavily affected. [Indian Government] have good reasons to do something, but will they? Or only when get slapped?" – Interviewee, 13.1.2009

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Abbreviations

ABC	Atmospheric brown cloud
CDM	Clean Development Mechanism
CRG	Mahanirban Calcutta Research Group
IPCC	Intergovernmental Panel on Climate Change
LECZ	Low Elevation Coastal Zone
LPG	Liquefied petroleum gas
NGO	Non-governmental Organization
UNCED	United Nations Conference on Environment and Development
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
WMO	World Meteorological Organization