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Climate Change and India: Impacts, Policy Reponses and a Framework for EU-India Cooperation

Note

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Summary

The purpose of this note is to provide a brief overview of:

- the impacts that climate change is having on the Indian economy (section 1)
- government policies that are in place that assist in adaptation to climate change (section 2)
- India's contribution to global greenhouse gases and mitigation efforts currently underway. (section 3)
- indicative areas for collaboration between the EU and India on adaptation to climate change as well as on mitigation efforts.(section 4)

It is important to bear in mind that the Indian Government has set up an expert committee under the aegis of the Prime Minister's office to develop a climate strategy for India that is integrated into the 11th five year development plan for the country as a whole. Since the climate change strategy is currently being elaborated, the contents of this briefing note should be read keeping in mind that policies and priorities may change.

Recent reports of the IPCC have shown that the most vulnerable sectors to climate change are water and agriculture, both of which are necessary for improving livelihoods. The melting of Himalyan glaciers will have a direct impact on the availability of water resources in India. Rainfall patterns will also be affected, resulting in disruptions to crop production and agricultural patters—a sector that impacts the low income groups the most.

It is in India's self interest to reduce its carbon emissions. There are number of domestic initiatives underway that have kept the Indian economy as a whole on a low energy intensity growth path. India's energy intensity has reduced from 0.30 kg of Co₂ e per \$GDP in 1972 to 0.19 kg of CO₂e per \$ of GDP in 2003. India has adopted an Integrated Energy policy whose corner stone is resource efficiency, energy conservation and, increasingly, the promotion of renewables. The shift from manufacturing to services; the enhanced participation of private, new and efficient capital stock in the infrastructure sector; and, decentralised energy provision, will contribute to low carbon growth. However a great deal more can be done to reduce carbon emissions and some of these areas are highlighted in the paper.

Section 1: India's Vulnerability to Climate Change

With an economy closely tied to its natural-resource-base and climate-sensitive sectors such as agriculture, water, and forestry, India faces a major threat because of the projected changes in climate. Crucial sectors in India like agriculture, water resources, health, sanitation, and rural development are likely to be affected by climate change. India's large population primarily depends on climate-sensitive sectors like agriculture and forestry for livelihood. The majority of the vulnerable population of India is poorly equipped to cope effectively with the adversities of climate change due to low capabilities, weak institutional mechanisms, and lack of access to adequate resources.

The following impacts have been identified by the Government of India's initial National Communications (NATCOM I) in 2004.

1.1 Surface Temperature

At the national level, increase of c. 0.4° C has been observed in surface air temperatures over the past century. A warming trend has been observed along the west coast, in central India, the interior peninsula, and north-eastern India. However, cooling trends have been observed in north-west India and parts of south India.

1.2 Precipitation Patterns

While the observed monsoon rainfall at the all-India level does not show any significant trend, regional monsoon variations have been recorded. A trend of increasing monsoon seasonal rainfall has been found along the west coast, northern Andhra Pradesh and north-western India (+10% to +12% of the normal over the 100 years) while a trend of decreasing monsoon seasonal rainfall has been observed over eastern Madhya Pradesh, north-eastern India, and some parts of Gujarat and Kerala (–6% to –8% of the normal the 100 years).

1.3 Sea Level Rise

Sea level rise has been observed to increase by 0.4–2 mm/year along the Gulf of Kutch and the coast of West Bengal. However, relative decrease along the Karnataka coast has also been observed.

1.4 Impact on water resources

Changes in key climate variables, namely temperature, precipitation, and humidity, may have significant long-term implications for the quality and quantity of water. The most significant changes are likely to occur in the glacier fed river systems, due to the melting of the Himalayan glaciers. Changes are likely in the long-term lean-season water flows of large snow- and glacier-fed river systems of the Brahmaputra, the Ganga, and the Indus.

A decline in total run-off for all river basins, except Narmada and Tapi, is projected in India's NATCOM I. A decline in run-off by more than two-thirds is projected for the Sabarmati and Luni basins.

1.5 Impact on agriculture and livelihoods

The outputs of the NATCOM I study have been used to assess the spatial and temporal distribution of drought and floods in the country. Concentration of droughts is projected in Gujarat and Rajasthan, which are already drought-prone, and in Orissa, which is currently flood-prone.

Wheat production for the country as a whole may decline after 2020 and rice production may be adversely impacted in the eastern states. Boundary changes in the growth of crops are also expected.

Studies by the Indian Agricultural Research Institute (IARI) indicate the possibility of a loss of 4–5 million tonnes in annual wheat production with every 1 °C rise in temperature¹ even after considering the carbon fertilization effect. However, yield losses associated with frost damage in north-western India may decrease. Small changes in temperature and rainfall have significant effects on the quality of fruits, vegetables, tea, coffee, aromatic and medicinal plants, and basmati rice. Pathogens and insect populations are strongly dependent upon temperature and humidity, and changes in these parameters may change their population dynamics. Other impacts on agricultural and related sectors include lower yields from dairy cattle and decline in fish breeding, migration, and harvests. Coral reefs may decline owing to rise in sea surface temperatures.

1.6 Health impacts of climate change

Changes in climate may alter the distribution of important vector species (for example, malarial mosquitoes) and may increase the spread of such diseases to new areas.

An increase of 3.8 °C in temperature and a 7% increase in relative humidity by 2050 over present levels is projected to lead to the transmission windows being open for all 12 months in 9 states in India. The transmission windows in the states of Jammu and Kashmir and Rajasthan may increase by 3–5 months. However, in Orissa and some southern states, a further increase in temperature is likely to cut the transmission window by 2–3 months.

1.7 Vulnerability to extreme events

Heavily populated regions such as coastal areas are exposed to climatic extremes and large falls in sown areas in arid and semi-arid zones, of which nearly two-thirds are drought-prone. Large areas in Rajasthan, Andhra Pradesh, Gujarat, and Maharashtra and comparatively small areas in Karnataka, Orissa, Madhya Pradesh, Tamil Nadu, Bihar, West Bengal, and Uttar Pradesh are frequented by drought. About 40 million hectares of land is flood-prone, including most of the river basins in the north and the north-eastern belt affecting about 30 million people on an average each year.

A mean sea level rise of 15–38 cm is projected along India's coast by the mid- 21st century and of 46–59 cm by 2100. India's NATCOM I assessed the vulnerability of coastal districts based on physical exposure to SLR, social exposure based on population affected, and economic impacts. In addition, a projected increase in the intensity of tropical cyclones by 15% poses a threat to the heavily populated coastal zones in the country (GoI, 2004).

1.8 Projected Impacts on forests and biodiversity:

India's NATCOM I projects an increase in the area under xeric² shrub lands and xeric woodlands in central India, replacing dry savanna in these regions.

A study carried out by Indian Institute of Science (Ravindranath et al., 2006) assessed the impact of projected climate change on forest ecosystems in India. The main conclusion is that in 2085, between 68% and 77% of the forested grids in India are likely to experience shift in forest types depending upon projected climate change scenarios.

¹ 1 °C increase in temperature in India may roughly coincide with the 2020–2030 period.

² Biome characterized by dry climate. Receives an average annual rainfall of 10 inches or less and have an arid or hyperarid climate characterized by strong moisture deficit, where annual potential loss through evapotranspiration exceeds the moisture received as rainfall.

Biodiversity is likely to be impacted under the projected climate scenarios due to the changes or shifts in forest or vegetation types in 57% to 60% of forested grids, forest dieback during the transient phase, and different species responding differently to climate change without change in forest type.

The net primary productivity (NPP) of biomass from tropical evergreen forests may, however, increase 1.5 times under the scenarios. Generally the rate of increase is higher for warmer vegetation types.

Section 2: Government Actions on Adaptation

For developing countries like India, adaptation requires assisting the vulnerable population during adverse climate events and empowering them to build their lives and to cope with climate risks in the long term. In this context, several of India's social-sector schemes emphasize livelihood security and welfare of the weaker sections. India implements a series of central and centrally sponsored schemes under different ministries and departments aimed at achieving social and economic development. At present, while none of the schemes is explicitly referred to as an Adaptation schemes, many contain elements (objectives and targets) that clearly relate to risks from climate variability.

The effort of the Indian government is to mainstream the climate impacts outlined above into its sectoral policies. Several ongoing efforts address some of these vulnerability concerns, although they are primarily driven by the objective of sustainable livelihoods and poverty alleviation.

Outlined in the sections below are some of the policies, programmes, and regulations implemented by the Government of India that have the potential to enhance the resilience of communities to cope with extreme weather conditions and climatic variability.

2.1 Initiatives in the agriculture sector

With a large population dependent on it, agriculture has always been vital to India's development policies. The National Policy on Agriculture seeks to realize the vast untapped growth potential of the agricultural sector, strengthen rural infrastructure to support faster agricultural development, promote value addition, accelerate the growth of agro-business, create employment in rural areas, secure a fair standard of living for the farmers, agricultural workers, and their families, discourage migration to urban areas, and face the challenges arising out of economic liberalization and globalization. The policy seeks to promote technically sound, economically viable, and environmentally non-degrading use of the country's natural resources, including land, water, and genetic endowment to promote sustainable development of agriculture. The policy promotes the use of biotechnology for evolving plants that use water more efficiently, resist drought and pests, give higher yields, and are richer in nutrients and environmentally safe. Also, conservation of bio-resources through their *ex situ* preservation in gene banks and *in situ* conservation in their natural habitats has been prioritized to prevent depletion of biodiversity. A major thrust has been given to promote areas with rainfed agriculture along with identifying the need to foster irrigation. The policy mentions the need to promote alternative livelihood practices like dairy and poultry farming. Assistance through outreach of Kisan Credit Cards has also been outlined.

Some of the programmes promoted by the government that assist the communities in coping with climatic variability include

- Developing watersheds in rainfed areas
- implementing drought-proofing measures
- developing drought-resistant varieties
- promoting crop diversification
- promoting on-farm water-efficient technologies
- introducing a system of credits and loans to farmers
- promoting the National Agricultural Insurance Scheme
- encouraging RCTs (resource conserving technologies) for crop production.

Considering the possible impacts of climate change on Indian agriculture, the Indian Council of Agricultural Research (ICAR) had introduced a countrywide network on impacts, adaptation, and vulnerability of Indian agriculture to climate change. The major objectives are to quantify the sensitivity of crops (including horticultural crops and plantations), soils, water, fish and livestock to global climatic changes.

2.2 Initiatives in the water sector

Water resource conservation is the backbone of the government's programme on agriculture and rural development. Several initiatives have been targeted towards watershed development and management. Promotion of water-harvesting measures including rejuvenation and revival of traditional water storage systems is high on the water conservation agenda. The National Water Policy (2002) stresses that non-conventional methods for utilization of water, including inter-basin transfers, artificial recharge of groundwater, and desalination of brackish or sea water, as well as traditional water conservation practices like rainwater harvesting, including roof-top rainwater harvesting, should be practised to increase the utilizable water resources. The Government of India has also circulated a model bill to state governments for regulating the extraction of groundwater. The government has also urged state governments to pass appropriate legislation to enable regulatory measures to protect sources of drinking water in rural areas, thereby restricting overexploitation of groundwater.

Involvement of the community in management of water resources is also being increasingly realized and encouraged. To be able to cope effectively with floods, the government has outlined several initiatives that promote the implementation of flood-proofing measures including repairs and protection of embankments and prevention of settlements in the flood zones.

Programmes such as the Drought Prone Areas Development Programme and its precursors have addressed issues of agricultural productivity in rainfed areas. Watershed-based programmes for agriculture, forests, and rural development to conserve soil and water, improve productivity, and enhance ecosystem resilience have now been implemented for several years.

2.3 Initiatives in coastal regions

In coastal regions, coastal regulation zones have been formulated that indicate the sensitivities of coastal ecosystems and prevent their exploitation for development as well as for their natural resources including groundwater. Restrictions have been imposed in the area between 200 m and 500 m of the HTL (high tide line) while the area up to 200 m has been declared as a 'no development zone'. The coastal zone regulations are under major review, which will also take into account the vulnerability to sea-level rise.

2.4 Initiatives in the forestry and biodiversity sector

The National Forest Policy (1988) has an important focus on developing coping capacities of forest-dependent communities. One of the major initiatives has been the introduction of the Participatory Forest Management Programme of the Government of India, which has shown remarkable success. Involvement of local stakeholders in the management and protection of local forest resources not only ensures their sustainable management but also prepares communities dependent on them to strengthen their coping practices in the context of uncertainties. India has a strong and rapidly growing afforestation programme. The afforestation process was accelerated by the enactment of the Forest Conservation Act of 1980, which aimed at stopping the clearing and degradation of forests through a strict, centralized control of the rights to use forest land.

Some of the measures implemented to foster this include

- adoption of the Forest Conservation Act of 1980
- preparation of environmental impact assessments for significant development projects
- reduction of subsidies to forest-based industries beginning in the late 1970s
- increased industry–farmer links, which have encouraged production of tree crops
- decentralized political decision-making by empowering village- and district-level authorities
- biomass fuel conservation programmes.

A body of legislation has also developed over time to deal with the protection and conservation of natural resources. The legislation focuses on strict regulation of diversification of forest land for non-forest activities, measures to protect wildlife and plant biodiversity, and implementation of the Convention on Biodiversity. Overall, the policies and regulations aim to strengthen the capacities of forest-dependent communities, enabling them to be self-sustaining and thereby enhancing their resilience to climatic shocks and stresses.

The Biological Diversity Act was adopted in 2002 to conserve biodiversity as a whole, apart from specific laws on forests, wildlife, water, and pollution. A National Biodiversity Authority (NBA) has been established that regulates access to genetic resources and associated traditional knowledge and promotes conservation.

2.5 Response to extreme climate events

The Government of India has formulated detailed plans for dealing with contingencies that arise in the wake of natural calamities including droughts, floods, and cyclones. The Ministry of Home Affairs and UNDP have introduced a programme that aims to build community-level awareness and strengthen capacity to address risks of disasters. A high-level National Disaster Management Authority (NDMA), headed by the Prime Minister, has been set up to coordinate actions by all concerned agencies in warnings, evacuation measures, and management of disasters, both natural and man-made, such as chemical accidents. The Disaster Management Act, 2005, provides for setting up state disaster management authorities (SDMAs) headed by the respective chief ministers. The act also provides for national disaster mitigation funds and state-level mitigation funds. Some states have formed their own disaster management authorities that seek to integrate the risks associated with disasters into the state planning processes. The approach has moved from a relief-centric approach to an all-encompassing approach of prevention, mitigation, and preparedness for all disasters, including recurring natural disasters like floods, droughts, and cyclones. The mandate of such authorities is to build synergy between government institutions and non-government initiatives, enhance people's potential capacities to be better prepared for disasters, and reduce the risk of destruction and loss. The vision is to use a number of existing policies, plans, and delivery systems of the government for drought-proofing, afforestation, and safe drinking water to prevent such disasters and to mitigate their impacts.

Section 3: Mitigation of greenhouse gases

India's per capita carbon dioxide emissions are currently only a fraction of those of developed countries. International Energy Agency (IEA) statistics indicate that in 2004, India's per capita carbon dioxide emissions amounted to only 1.02 tonnes compared to 19.73 tonnes for USA, 8.46 tonnes for the EU, and 9.52 tonnes for Japan. (IEA, CO2 Emissions from Fuel Combustion, 2006 edition.) Indeed, India's per capita emissions are only about a quarter of the global average of approximately 4 tonnes. As the UN framework convention on climate change recognizes, emissions originating in developing countries will inevitably increase as a result of economic and social development.

However, the rate of increase of emissions can be moderated to a certain extent without slowing development. Many measures designed primarily to promote development goals (including health-related local environmental goals) also have important co-benefits for moderating greenhouse gas emissions.

A number of India's current policies are primarily geared towards energy efficiency and resource conservation while at the same time addressing climate change concerns on adaptation and mitigation. Formal references to climate change concerns are contained in several documents, such as the National Environment Policy, the Integrated Energy Policy, and the Tenth Five-Year Plan. Further, the Government of India adopted in 2006 an Integrated Energy Policy (IEP, 2006) that focuses on meeting the country's energy demand in a technically efficient, economically viable, and environmentally sustainable manner.

As indicated in Figure 1, both energy intensity and emissions intensity of the economy have exhibited a decreasing trend in the last two decades. This trend is on account of the Government's policies focused on sustainable development, such as adoption of renewable energy technologies, energy efficiency, and use of cleaner fuels such as natural gas.

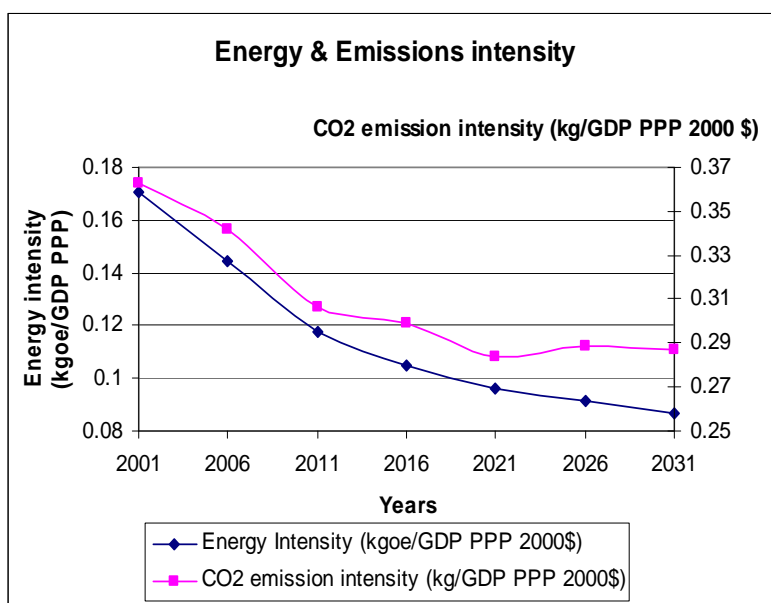


Figure 1 : Energy and CO₂ emissions intensity in the BAU scenario (2001-2031)

3.1 Policies and measures relevant to GHG mitigation

India's national policies, laws, regulations, and programmes cover a wide range of themes and lead to climate change benefits. One of the most important policy measures has been to price energy at a high level in PPP terms through taxes, duties, and cess. Because of these levies Indian energy prices are the highest in the world in PPP terms. If one takes the taxes into account, there is no net subsidy in the energy sector.

In addition, there are many ongoing programmes that stress low energy-intensive growth. India accords high priority to energy efficiency and conservation, diversifying its fuel mix, and increasing the penetration of cleaner and more efficient technology choices. Some recent policies and programmes³ in this regard are mentioned below.

The Energy Conservation Act (2001) empowers the government to prescribe and ensure compliance with standards and norms for energy consumers, prescribe energy conservation building codes, and require energy audits. The act requires major commercial consumers to submit energy audits (verification, monitoring and analysis of energy use; technical reports and cost-benefit analysis; and action plans to reduce consumption) prepared by accredited energy auditors.

Standards and labelling programme for manufacturers of electrical appliances is expected to lead to savings of 11,689 million kW annually in the first 5 years of its operation.

Energy efficiency and conservation programmes being implemented by the Bureau of Energy Efficiency (BEE) and the Central Public Works Department (CPWD) include energy efficiency performance contracting projects in nine government buildings with an estimated annual savings of approximately 30 GWh with a simple payback of less than two years.

Green rating of buildings is covered by several schemes including the Indian chapter of the Leadership in Energy and Environmental Design (LEED) **and** the indigenous systems, namely green rating for integrated habitat assessment (GRIHA), The Ministry of Environment & Forests (MoEF) technical manual for environmental appraisal of buildings, and the Energy Conservation Building Code (ECBC). The Ministry of New and Renewable Resources (MN&RE) has also taken up development of an indigenous rating system for green buildings.

The National Electricity Policy (2001) requires the government to supply electricity to all areas including villages and hamlets by 2012 primarily through decentralized RE (renewable energy) technologies. Accordingly, the Rajiv Gandhi Grameen Vidyutikaran Yojana (RGGVY) scheme, with an outlay of Rs 180 billion, aims to electrify about 1, 25,000 unelectrified villages across the country, targeting poor households through 90% subsidies.

Promotion of renewable energy is ensured by the Ministry of New & Renewable Sources (MNRE), together with a specialized financial institution, namely Indian Renewable Energy Development Agency Ltd (IREDA), and other institutions by implementing a broad programme covering the entire range of new and renewable energies. The 11th Five-Year Plan aims to increase the installed capacity for renewable power (excluding large hydropower) by 14,500 MW, i.e. 20% of the overall increase in installed utility-based capacity (78,577 MW).

National Mission on Bio-diesel aims in the first (demonstration) phase to establish biodiesel (jatropha) plantations in 26 states, while the second phase will lead to the production of sufficient biodiesel to enable a 20% blend in vehicle diesel in 2011/12. Recent increase in petroleum prices may help accelerate the biodiesel programme.

National Urban Transport Policy emphasizes extensive public transport facilities and non-motorized modes over personal vehicles. The Delhi MRTS expansion and other mass transit systems, such as the MetroBus project in Bangalore, are steps in its implementation. The policy also favours cleaner fuels like CNG and encourages R&D for commercialization of cleaner technologies.

Use of beneficiated coal is mandatory for coal-based thermal power plants located beyond 1000 km from pit-heads or in urban or ecologically sensitive or critically polluted areas by a notification under The Environment Protection Act unless the plants are based on clean-coal technologies.

Reforms in the power sector seek to mobilize private-sector resources for additions to power-generating capacity. As part of the reforms, the Central Electricity Regulatory Commission (CERC) and the state electricity regulatory commissions (SERCs) were constituted, which has led to improvements in plant load factors, heat rates, reduction in transmission and distribution losses, etc.

Section 4: Framework for EU-India Cooperation

The following paragraphs provide an indication of areas where cooperation between the EU and India may be explored. It should be borne in mind however that these are only tentative suggestions, and that any framework for cooperation should be finalised only after the official climate change strategy currently under elaboration by the Prime Minister's office is finalized.

4.1 Adaptation

The main challenge for India is to integrate adaptation efforts with sustainable development and poverty reduction. Cooperation with partners such as the EU needs to focus on this theme. Following are areas where cooperation may be explored:

- *Management of water resources*

Rainfed and unirrigated land accounts for as much as 60 per cent of India's cultivable area. The importance of water conservation and groundwater management will increase as additional stresses occur as a result of climate change. There is a need to set up and develop concerted action plans for watershed management, rainwater harvesting and groundwater recharge.

- *Flood control*

During the latter half of the 20th century, the extent of flood prone areas in India increased from approximately 19 million hectares to about 36 million hectares – or almost one-eighth of the country. In future, climate change may exacerbate this trend. Flood control measures are, therefore, required to strengthen adaptive capacity. Flood protection works – i.e. embankments and reservoirs – can provide only a partial solution to the problem. They must be supplemented by non-structural measures, including efficient management of flood plains, flood proofing, and disaster management.

- *Health*

Climate Change, by altering weather patterns and by disturbing life-supporting natural systems and processes affects the human health. Broadly the health outcomes under consideration for climate change include vector-borne and diarrhoeal diseases. The increase in vector and water-borne diseases, resulting from occurrence of extreme events, increases the probability of impacts on human health.

There is a need to explore collaboration in research control programmes relating vector borne and diarrhoeal diseases. A number of legislative, technical, educational and behavioural options can be exploited in the current programs, thus serving as indirect adaptation options.

- *Agriculture*

There is a need to rethink agricultural policies to deal with the consequences of temperature rise and changing rainfall patterns.

The revitalization of the moribund extension services system is needed to bridge the knowledge gap that prevents farmers from reaping the full benefits of improved fertilizers, seeds and pesticides. Farmers are often not fully aware of the consequences of unbalanced fertilizer use. They are often unable to derive the full benefits of new varieties of seeds and pesticides as they are supplied sub-standard inputs by unscrupulous dealers. Reliable advice is not available for such contingencies as pest attacks.

The revitalization of extension services would overcome these deficiencies. It would also enhance the capacity to adapt to future climate change by providing farmers with reliable information regarding new initiatives that may be required to address climate change, such as new agricultural practices, new drought-resistant or pest-resistant seeds, options for crop diversification, etc.

Other areas where some form of collaboration with the EU could be investigated relate to enhancing livestock extension services, promotion of appropriate crossbreeds, establishing an improved livestock marketing system, a cooperative marketing system for rural backyard poultry, etc. By diversifying livelihood opportunities in rural areas, the planned expansion of animal husbandry and poultry would facilitate adaptation to climate change impacts on agriculture.

- *Insurance*

Farmers require insurance to protect themselves against risks involved in adopting new and untried technologies to improve yields. At present, only 4 per cent of farmers are covered by crop insurance. It is proposed to appropriately expand this coverage in a financially viable manner. Weather insurance also needs to be expanded to provide protection against atypical adverse weather conditions. Insurance companies on the basis of actuarial calculations could extend such cover. European experience and collaboration with European insurance companies can be explored.

4.2 Mitigation

- *Improving efficiency of coal-based power plants*

Coal is likely to remain the predominant resource for power generation in India. It currently accounts for some 57 per cent of the total installed capacity and the figure is projected to increase to 58.5 per cent by 2030. Hence there is a need to implement cost-effective improvements in the efficiency of coal-based power plants and to introduce economically viable cleaner technologies in order to reduce the environmental impact.

The current generation of power plants in India is based on sub-critical steam cycle technology. More efficient super-critical steam cycle plants are under construction and these will become operational from 2008 onwards. Since this is a cost-effective option for plants in the 500-800 MW range (if they are not situated near the coal mines), it is expected that this will set a pattern for the future for plants of this type. Active consideration is also being given to the question of implementing even more efficient power projects of 800 MW and above, with ultra-supercritical steam parameters. EU-India collaboration should explore possibilities of lowering costs of ultra-supercritical plants through indigenisation of technology and increased foreign direct investment in this sector.

Further improvement in efficiency involves shifting to Integrated Gasification Combined Cycle (IGCC) technology. Currently available IGCC technology is not suitable for Indian coals with their high ash content. Further research on this is another area for potential collaboration.

The ultimate solution for carbon emissions is the Zero Emission Power Plant with Carbon Capture and Storage (CCS). This technology is still at an experimental stage and present capital costs rule it out as an economically viable option for a low income country. Moreover, questions relating accidental leakage and geological requirements still remain to be resolved. However, because of its potential, India has initiated R&D work to identify geologically suitable storage sites. Collaboration with the EU may be an option.

- ***Promotion of renewable energy***

While India will remain heavily dependent on fossil fuels (in particular, coal) for the foreseeable future, renewable energy has the potential to reduce India's dependence on carbon-emitting fuels. Hydropower (comprising large, medium and small projects) offers substantial immediate benefits in this respect. New and renewable energy (solar, wind power, bio-mass, etc.) have promising long-term prospects and could contribute to energy security by lowering India's dependence on fuel imports.

- ***Transportation***

The inevitable rise in emissions from the transportation sector can be moderated in three ways: (a) a shift from road to rail transport; (b) greater reliance on public transport compared to private motor vehicles; and (c) improvements in efficiency standards. The EU experience in this sector could of tremendous value to India.

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