

Strengthening adaptive capacity



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Even if all GHG emissions were to cease immediately, the earth would still experience a certain degree of climate change, due to the long lifetime of GHGs in the atmosphere and the inertia of the climate system. Consequently, it is imperative that we strengthen the capacity to cope with changes in the climate, including increases in climatic variability. This chapter describes examples of ongoing efforts in India, which help enhance adaptive capacity, while addressing concerns of food security, water scarcity, biodiversity loss, and environmental degradation.

Adaptation strategies in agriculture

Agriculture is of vital importance to the Indian economy as it contribute about a quarter of the GDP and provides livelihood to two-thirds of the population. The challenge for Indian agriculture is to adapt to potential changes in temperature and precipitation and to extreme events without compromising productivity and food security. The government's emphasis is on mainstreaming climate change adaptation issues in development strategies and programmes. The Ministry of Agriculture has established a Climate Change Cell.

Some of the government's ongoing programmes for sustainable agriculture are as follows.

- Drought-proofing measures through water storage and rainwater harvesting
- Promotion of integrated pest management
- Promotion of zero-tillage practices
- Development of drought-resistant varieties
- On-farm water management and promotion of water conserving technologies like drip and sprinkler irrigation
- National Agriculture Insurance Scheme.

Integrated watershed development has emerged as an effective approach in augmenting water supply through conservation of rainwater in rain-fed farming systems. Practised in the arid, semi-arid, and drought-prone regions of India, rain-fed farming accounts for nearly two-thirds of the India's cultivated area.

Resource-conserving technologies in the Indo-Gangetic Plains

New resource conservation techniques such as zero tillage, reduced tillage, surface seeding, and bed planting, are being promoted for rice and wheat cultivation. The adoption of such techniques can produce multiple benefits in the form of timely farming operations, increased productivity, reduced input requirements, lower cost of cultivation, scope for crop diversification, and improved soil health.

Reducing or elimination of tillage and timely planting of the wheat crop can result in savings on water, fuel, herbicide, and equipment while increasing yields, and consequently, farmer profits. Bed planting of rice improves the efficiency of water and fertilizer use, and can be used in situations of receding water tables, particularly in the trans- and upper Gangetic transects of the Indo-Gangetic plains. Efforts are on for development of a permanent bed planting system for establishment of rice and wheat crops—a significant improvement over the older practice of puddling, which deteriorates the soil structure.

Zero-tillage practices take advantage of residual moisture from the previous rice crop. Use of zero till drill on one hectare of land is estimated to save 60–70 litres of diesel and approximately 1 million litres of irrigation water per hectare. Adoption of zero-till practices over an area of 0.5 million hectares could increase wheat production by 2 million tonnes, and also save 5 billion cubic metres of water and 0.5 billion litres of diesel each year.

Other simple resource conservation options are land levelling to save water and deep placement of urea to reduce ammonia volatilization losses and leaching losses of nitrogen.

These resource-conserving techniques are being tested through trials conducted in Haryana, Punjab, Uttar Pradesh, Uttaranchal, and Bihar. The techniques were introduced to farmers through a participatory approach, which is more cost-effective and reduces the time lag in technology generation and transfer.

Source Gupta (2002)

Watershed development is implemented through an integrated approach, which takes into account the various types of land use in the watershed (silviculture, agroforestry, horticulture, fodder, fuelwood, etc.) and how local inhabitants depend on these for their livelihoods. Its central principle is water conservation. Conserving and utilizing scarce moisture in rain-fed areas enhances the effectiveness of improved seeds and fertilizers. The observed benefits of watershed development consequently include rising water tables, reduced soil erosion, increased cropping intensity, and enhanced crop productivity.

Watershed development is given high priority in India, as evinced by the fact that the country implements one of the largest watershed development programmes in the world. This extends over 20 000 micro-watersheds, covering 28 million hectares of degraded rain-fed land. Integrated watershed development is emphasized in the National Agriculture Policy, 2000, and the government target is to cover 88 million hectares of rain-fed agriculture area and degraded forestland by 2022 (Sharma 2002).



Biodiversity conservation

India is one of the 12 mega biodiversity countries of the world. From about 70% of the total geographical area surveyed so far, about 46 000 plant species and 81 000 animal species have been described. India has 13 biosphere reserves for conservation of biological resources representing various ecosystems of the country. Management Action Plans for conservation research and monitoring of these biosphere reserves are being formulated and implemented. Three Indian biosphere reserves are included in the World Network of

Rainwater harvesting in the Chhota Nagpur region

The Chhota Nagpur plateau covers the southern parts of Bihar, Orissa, and West Bengal. Its arable land has been classified into three parts.

- 1 **Uplands with red lateritic shallow soils, low humus and nutrient content, and mostly barren land** The land is highly degraded and supports low-intensity cropping with low productivity.
- 2 **Midlands with sandy shallow soils and poor moisture retention** The land supports terraced rice fields, but mid-season droughts* occur every two or three years resulting in crop failure.
- 3 **Lowlands with sandy loam soils** Paddy is grown on these.

In consultation with local people and NGOs, a range of rainwater harvesting techniques was introduced to enhance the soil and moisture regime in the area.

- **Staggered trenching** Trenches were excavated on sloping land to prevent run-off and erosion. These were interspaced with the pile of excavated soil, on which trees and grasses were planted.
- **Upland treatment** The land was 'bunded' into rectangular plots, and pits were dug at the lowest corners. The excavated soil was used to prepare *bunds* that were planted with trees and grasses. This helped in arresting run-off and soil erosion, conserving rainwater *in situ*, and recharging the soil profile.
- **Midland treatment** Five per cent of the area of each agricultural plot was excavated at its lowest point to a depth of about one metre. These pits harvested rainwater and also collected sub-surface seepage, reducing the moisture stress on the rice crop.

The adoption of these techniques had the following benefits.

- Growth of trees, shrubs, and grasses on barren and eroded uplands
- Provision of subsistence needs for fuel, fodder, fibre, and timber
- Income generation from sale of excess produce
- Prevention of outright loss of rice crop
- Improvement of rice yield due to soil moisture conservation
- Use of pits in treated midlands for pisciculture for subsistence.

Each of the adopted techniques was able to pay for itself within a few years, indicating the economic sustainability of this approach. Over the period 1992–96, 63 villages were covered, benefiting 1040 households.

*Particularly in September, during the period of flowering and grain formation

Source Myrada and IIRR (1997)

Biosphere Reserves—(1) Sunderbans (West Bengal), (2) Gulf of Mannar (Tamil Nadu), and (3) Nilgiri (Kerala, Karnataka, and Tamil Nadu).

Conservation of wildlife and its habitat has been accorded highest priority for the long-term ecological and environmental security of the country. India has constituted about 4.6% of its geographical areas into protected areas and a chain of 89 national parks and 489 wildlife sanctuaries have been established over 15 million hectares of dense forestland. It has launched an ambitious wildlife action plan (2002–2016) to achieve excellence in protected areas conservation. The MoEF provides financial assistance to the state governments for conservation and management of Biosphere Reserves, and also supports R&D projects. The Participatory Forest Management Strategy of the Government of India secures rehabilitation of degraded areas, conservation of biodiversity, along with sharing of benefits with local people.

Adopting a consultative process with the stakeholders, a National Policy and Action Strategy on Biological Diversity has been drawn up as a macro-level statement of strategies, gaps, and further actions needed for conservation, sustainable use and strategies, and realization of actual and potential value of biological diversity. The ministry has accessed funding from GEF for preparing detailed micro-level action plans at local, state, and regional levels through a participatory planning approach under the NBSAP (National Biodiversity Strategy and Action Plan). Action plans are being prepared at the following levels.

- 17 sub-state local sites
- 10 inter-state eco-regions
- All states and union territories
- 14 biodiversity themes at the national level.

The expected outcome of the NBSAP is an implementable and realistic action plan, which can be easily translated into a number of projects at the ground level in priority areas.



Coastal zone management

Coastal zones have traditionally been centres of intense human activity in India. Sea-level rise caused by climate change will present an added problem, making the inhabitants of coastal areas more vulnerable.

In order to find a judicious balance between economic development and environmental protection, the Coastal Regulation Zone Notification, 1991, declares the limits of the coastal zone, and classifies it into four categories of CRZs (Coastal Regulation Zones).

- 1 CRZ I includes areas that are ecologically sensitive, areas of outstanding natural beauty, historical heritage, or rich genetic diversity.
- 2 CRZ II includes areas that have been already developed up to or close to the shoreline.
- 3 CRZ III includes areas that are relatively undisturbed.
- 4 CRZ IV includes the coastal stretches of the Andaman and Nicobar Islands, the Lakshadweep Islands, and other small islands (except those specified in the above categories).

To protect fragile ecosystems in these areas, restrictions have been imposed on various activities in the area between 200–500 m of the high tide line, while the area up to 200 m from the high tide line is designated a ‘no development zone’ (MoEF 2002).

Coastal zone management plans have been prepared and coastal zone management authorities have been constituted in all 13 coastal states and union territories.

The Department of Ocean Development, established in 1981, has introduced the Integrated Coastal and Marine Area Management project, which aims at management and monitoring of critical habitats such as mangroves, coral reefs, and other areas rich in biodiversity.

The Government of India has also set up Standing Committees for monitoring development in such fragile ecosystems as islands. In 1986/87, the Indian government initiated a programme on the conservation and management

<http://www.envfor.nic.in/cc/index.htm>

The screenshot displays the homepage of the Climate Change website. At the top left, there is a logo for the Government of India, Ministry of Environment & Forests, with the text "Climate Change" in large letters. Below this, a navigation menu lists various topics: "What is climate change?", "Vulnerability & adaptation", "International negotiations", "India and UNFCCC", "India's initiatives", "Projects", "CDM", "Directory", "Useful links", and "Youth page".

On the right side, there is a section for "COP 8" (20th Conference of the Parties to the UNFCCC) held from 23 October to 1 November 2002 in Vigyan Bhawan, New Delhi, India. It states that the Government of India is hosting the conference and provides links to the "UNFCCC COP 8 official site" and "Event Manager - ITDC".

In the center, there is a photograph of a cracked, dry landscape with the text "Extreme Events" below it. To the right of this, there is a section titled "India accedes to the Kyoto Protocol" and "Events" (NGO events during COP 8, Events leading up to COP 8). Below that, there is a section for "NATCOM" (Towards India's Initial National Communication) with a small image of a person.

At the bottom, there is a "Did you know..." section with a small image of a glacier and text stating: "The Gangotri glacier is retreating at a speed of about 30 metres a year and warming is likely to increase the rate of melting. Source: IPCC Reports".

of mangroves and coral reefs and a national committee was constituted to advise the government on policy and management aspects of mangrove ecosystems. Thirty mangroves and four coral reefs have been identified for conservation and management, and state-level steering committees were formed to coordinate the implementation of Management Action Plans for these areas. The major reef formations in India are found in the Gulf of Mannar, Palk Bay, Gulf of Kutch, Andaman and Nicobar Islands, and Lakshadweep Islands. The Indian Coral Reef Monitoring Network was set up to cover activities relating to coral reefs, including research and monitoring, training and capacity building, and the establishment of a database (MoEF 2002).

Outreach and awareness creation

The most important way to reduce vulnerability and to strengthen adaptive capacity is through outreach and awareness creation. The MoEF supports various training programmes, workshops, and projects related to climate change with an aim to strengthen indigenous capabilities of institutions for suitable long-term planning and assessment. Just before COP-8, the MoEF launched a web site on climate change (<http://www.envfor.nic.in/cc/index.htm>) to enable widespread dissemination of information related to climate change. Outreach and awareness creation is a continuing effort, which is being carried forward actively by a range of governmental and non-governmental agencies working on climate change issues.