

Paper 7
ADVANCING DEVELOPMENT AND ADAPTATION –
THE STATE OF RESOURCES

Sreeja Nair, Sanjay Tomar, and Prabhat Upadhyaya
TERI, India

Executive Summary

The impact of change in climatic variables is progressively being felt on many physical and biological systems. Climate change also undermines the efforts towards achieving the MDGs (Millennium Development Goals) and sustainable development objectives. While development is often said to be the best form of adaptation, measures that enable adaptation are necessary to protect developmental investments from climatic risks. However, integration of adaptation into developmental efforts often throws up some pertinent questions like what really constitutes adaptation to climate change and how it is different from 'good developmental practices'. A major proportion of the population vulnerable to climate change in the developing countries, such as India, comprises the poor who lack the capacities to cope effectively with the adversities of climate change. India has many schemes targeted at social and economic development, which address risks from climate variability and change either directly or indirectly by enhancing the responding capacities of vulnerable communities. An analysis of sector-specific sensitivities to climatic risks underscores the need for specific adaptation measures to minimize the risks associated. Though the GEF (Global Environment Facility) has designed four funds for adaptation, the resources still remain largely inadequate, necessitating increasing need for investment in adaptation. Though India is already utilizing over 2% of its GDP (gross domestic product) for programmes that also address adaptation, there is a need for new and additional resources to further the adaptation efforts. Considering the multi-level governance structure of India, this paper brings out the difference in adaptation priorities and resource allocations in moving from the national to the state and to the local level. At the global level, an issue under much debate is the diversion of resources from the ODA (official development assistance) to adaptation assistance. This paper also discusses different modes of adaptation funding that taps resources from the carbon markets.

Introduction

Short- and long-term changes in the climatic patterns can have serious economic and social manifestations, which can destabilize the social, economic, and environmental pillars of sustainable development. While climate change can impede developmental aspirations, the degree of development itself will be a decisive factor for ensuring adaptive capacities and enhancing resilience in the light of the changing climate and associated risks.¹ In order to safeguard these developmental investments, there is a need for planned strategies to adapt to the changing climatic conditions. Being a developing economy, India has several critical areas of concern such as poverty alleviation, health care development, infrastructure development, access to clean drinking water, sanitation, and so on, which compete for financial resources. With millions of livelihoods dependent on climate-sensitive sectors, severe demographic pressures on land and water resources, a large population below poverty line with low resilience to withstand climatic uncertainties, and a long coastline, India is particularly vulnerable to the adverse impacts of climate variability and change. Furthermore, with an economy intricately tied to the natural resource base, regions in India that face the dual challenge of high climate vulnerability and low adaptive capacities are at high risk to climatic vagaries. Home to 16.2% of

the world's population, India needs to be prepared to the projected scenarios of change in order to minimize the risks associated with climate change.

Climate change and the Millennium Development Goals

In September 2000, at the United Nations Millennium Summit, the international community agreed to strive for alleviating poverty and for improving the welfare of the world's poorest through the achievement of eight measurable development goals, also referred to as the MDGs, by 2015.² Progress towards achieving MDGs in India has been listed in Table 1. Climate change would exacerbate the existing disparities in terms of differential socio-economic, cultural, and demographic parameters that in turn would have implications on development objectives envisaged under the MDGs framework (Box 1).³ Irregular rainfall and humidity patterns, rising temperatures, extreme events (such as droughts, floods, and cyclones), and associated changes in agricultural productivity are likely to create food insecurity, hunger, and malnutrition in several regions, thus impacting MDG 1. Furthermore, occurrence of extreme events results in loss of man-days and increased school dropouts who then engage in labour activities and contribute to overall household incomes.⁴ This manifests as an opportunity cost of lost days of school attendance, thereby impeding the objective of universal education under MDG 2. Reduced availability of surface and groundwater resources translate into more drudgery for women not only in terms of longer hours in search of water but also in terms of increased exposure to climatic extremes, and lost time for decision-making, education, health care, and skill development for income-generation activities, thereby impacting realization of the MDG 3. Changes in climatic variables can also impact human health either directly by causing mortality or indirectly by creating favourable conditions for propagation of disease-causing agents. In areas with low socio-economic profile, these conditions would be further aggravated due to lack of capacities or awareness about health-seeking behaviour, impacting achievement of MDGs 4, 5, 6, and 7. Degradation of environmental ecosystems and natural resource base will hinder attainment of the MDG 7. Though a global issue, the impacts of climate change will be differentially felt across the globe, calling for concerted action at the global, national, and local levels by fostering partnerships and synergies, enabling achievement of MDG 8.

Box 1: The Millennium Development Goals

MDG 1: Eradicate extreme poverty and hunger

MDG 2: Achieve universal primary education

MDG 3: Promote gender equality and empower women

MDG 4: Reduce child mortality

MDG 5: Improve maternal health

MDG 6: Combat HIV/ AIDS, malaria, and other diseases

MDG 7: Ensure environmental sustainability

MDG 8: Develop a global partnership for development

Table 1: Progress towards achieving MDGs in India⁵

S. no.	Indicator	Year	Value	Year	Value	MDG target value
1	Proportion of population below poverty line (%)	1990	37.5	1999/2000	26.1	18.75
2	Undernourished people as % of total population	1990	62.2	1999/2000	53	31.1
3	Proportion of under-nourished children	1990	54.8	1998	47	27.4
4	Literacy rate of 15–24 year olds	1990	64.3	2001	73.3	100
5	Ratio of girls to boys in primary education	1990/91	0.71	2000/01	0.78	1
6	Ratio of girls to boys in secondary education	1990/91	0.49	2000/01	0.63	1
7	Under five mortality rate (per 1000 live births)	1988–92	125	1998–2002	98	41
8	Infant mortality rate (per 1000 live births)	1990	80	2003	60	27
9	Maternal mortality rate (per 100 000 live births)	1991	437	1998	407	109
10	Population with sustainable access to an improved water source, rural (%)	1991	55.54	2005	90	80.5
11	Population with sustainable access to an improved water source, urban (%)	1991	81.38	2001	82.22	94
12	Population with access to sanitation, urban (%)	1991	47	2001	63	72
13	Population with access to sanitation, rural (%)	1991	9.48	2005	32.36	72
14	Deaths due to malaria per 100 000	1994	0.13	2004	0.09	–
15	Deaths due to TB per 100 000	1999	56	2003	33	–
16	Deaths due to HIV/AIDS	2000	471	2004	1114	–

Adaptation and development nexus

The IPCC states, 'While sustainable development can reduce vulnerability to climate change, climate change could hinder sustainable development aspirations'. Attempts to integrate adaptation into developmental efforts are constantly plagued by the questions about what really constitutes adaptation to climate change and its similarities and differences compared to 'good' developmental practices. Apart from the reactive response given by unmanaged natural systems in response to the changing conditions (*autonomous*), planned adaptations can be undertaken by individuals/communities following deliberate policy decision based on the understanding of the changing conditions and the need for action in response. These adaptations can be taken up either after the initial impacts of climate change have occurred (*reactive*) or before impacts are manifested (*anticipatory*). Furthermore, these actions may be motivated by *private* interest (individual households, companies) or *public* interest (government).⁶

While some developmental activities have an inherent component of adaptation within them and constitute *serendipitous adaptation*, some others have additional activities appended onto an ongoing project to ensure its success under a changing climate (*climate-proofing of development*). Climate risk screening goes beyond the traditional 'reactive' approach of relief and rehabilitation after an extreme event, to a 'proactive' approach before the event. Apart from these, there are cases of *discrete adaptation* wherein adaptation forms the primary objective of the project.⁷ Integration of climate change concerns into critical sectors such as water, energy, health, agriculture, and biodiversity was envisaged in the Delhi Declaration adopted at CoP-8 (Conference of Parties) of the UNFCCC (United Nations Framework Convention on Climate Change). Integration of measures for vulnerability reduction to climatic risks into design and implementation of policies and plans pertaining to sustainable development (also referred to as mainstreaming)⁸ can occur at the global level (MDGs, donor assistance strategies), national level (planning and budgetary processes), and the local level (municipal and community-based strategies).⁹

Need for adaptation to climate variability and change: sectoral vulnerabilities

India has many schemes targeted at social and economic development, which address risks from climate variability and change either directly or indirectly by enhancing the responding capacities of vulnerable communities (Box 2 (a) and (b)).

Box 2: (a) Major programmes in the social sector

- National Rural Employment Guarantee Scheme or NREGS: launched on 2 February 2006 in 200 most backward districts in the first phase, expanding to 330 districts in the second phase, and covering the remaining 266 districts from 1 April 2008.
- Bharat Nirman: launched in 2005/06 for creating infrastructure, including housing, irrigation potential, drinking water, roads, electrification, and telephone connections in rural areas.
- Mid-day Meal Scheme: launched in August 1995, with the objective of universalization of primary education, increasing enrollment and attendance, and reducing dropouts with focus on nutrition of students in primary classes.
- National Drinking Water Mission (also called Rajiv Gandhi Drinking Water Mission): introduced as one of the five Societal Missions in 1986.
- The National Rural Health Mission: launched on 12 April 2005, to provide accessible, affordable, and accountable public health services to the poorest households in the remotest rural regions.
- The Jawaharlal Nehru National Urban Renewal Mission or JNNURM: spread over a seven-year span, starting from 2005/06, encompasses BSUP (Basic Services to the Urban Poor) Programme and IHSDP (Integrated Housing and Slum Development Programme).

(b) Major anti-poverty, employment generation, and basic services programmes

- Pradhan Mantri Gram Sadak Yojana or PMGSY: launched on 25 December 2000 as a completely centrally sponsored scheme (to provide all-weather connectivity to the eligible unconnected habitations in the rural areas).
- The Indira Awaas Yojana or IAY: with a 75:25 cost sharing between the centre and the states, it aims at providing free dwelling units to poor families belonging to scheduled castes and tribes, freed bonded labourers, and BPL (below poverty level) persons in rural areas.
- The Swarnjayanti Gram Swarozgar Yojana or SGSY: launched in April 1999 with a 75:25 cost sharing between the centre and the states to bring the beneficiaries above the poverty line through access to bank credit and government subsidy.

Climate change: implications to developmental priorities

With over 600 million people dependent¹⁰ on the agricultural sector in India, impacts of climate variability and change on this sector can have grave implications, not only from the purview of food security concerns but also because of the fact that the sector contributes nearly 18.5% to the country's GDP.¹¹ Furthermore, as about 68% of the net sown area in India is rain-fed,¹² climatic vagaries form a palpable threat to agricultural productivity, crop yields, and farm-level agricultural revenues. India is also vulnerable to extreme events such as droughts and floods—

nearly two-thirds of the total cultivated area is drought prone and nearly 40 million hectares of land area is flood prone.¹³ Furthermore, a mean sea level rise of 46–59 cm has been projected along India’s coast by the end of the century and a 15% increase in intensity of tropical cyclones is projected, thereby putting the 7500-km-long coastline of India, coastal settlements, and livelihoods at high risk.¹⁴ Impacts associated with rising sea levels include population displacement, saltwater intrusion into freshwater reservoirs, and impacts on fisheries and coastal agriculture along with direct and indirect impacts on health and tourism.¹⁵ Changes in climate can also alter the structure and productivity of the forest ecosystems including changes in species composition and secondary impacts on forest-based livelihoods. Extreme events can also affect human health by causing direct mortality or indirectly through water-borne and vector-borne diseases, and/ or changes in ecological and socio-economic systems.¹⁴

Resource allocation for adaptation

International scenario

Few adaptation funding mechanisms have been established under the international climate change negotiations (Box 3). Several articles under the UNFCCC process address the issue of adaptation and adaptation finance. Article 4 refers to ‘...all parties taking into account their common but differentiated responsibilities and their specific national and regional development priorities, objectives and circumstances...’ shall formulate, implement, and publish national measures to facilitate adequate adaptation and cooperate in preparing for adaptation to impacts. Article 4.3 allows for agreed new and additional financial resources for preparing National Communications and the agreed incremental¹ cost of implementation of adaptation measures

Box 3: International Adaptation funding mechanisms^{21, 23}

1. GEF (Global Environment Facility) Trust Fund is a multilateral mechanism funded through developed country contributions that are replenished every four years. Total amount available in the GEF Trust Fund is \$50 million.
2. SCCF (Special Climate Change Fund) is managed by the GEF and funded through pledges from developed countries, to complement activities funded by the GEF Trust Fund. Currently the SCCF is ~\$60 million.
3. LDC (Least-Developed Countries) Fund is managed through voluntary pledges from developed countries to support preparation and implementation of NAPA (National Adaptation Plans of Action) and components of the LDC work programme. The total amount available is \$115 million.
4. Adaptation Fund established in 2007 receives 2% proceeds from CDM (Clean Development Mechanism) to support adaptation projects in developing countries. World Bank estimates that by 2012, the funds would be \$100–500 million.

and actions (Article 4.1), to be funded by developed countries. Article 11 mentions about provision of financial resources (includes technology transfer) as a grant. While discussing adaptation, however, these instruments are plagued by certain drawbacks such as more focus being on mitigation, unclear terms of funds, and contributions being voluntary in nature and often falling short of the requirement.¹⁶

¹ Incremental costs here refer to the cost difference between a baseline action to address a national priority and the additional cost of undertaking an alternative action, relative to the baseline, which generates global benefits.

Figure 1: The adaptation–development nexus: sources of funding



Funding inflows for adaptation in developing countries operate through dedicated multilateral funds and ODA, with the current value of the total estimated resources being about \$200 million, which is quite low compared to the resource demand. Lately, the focus of adaptation funding is increasingly being diverted to the role of ODA (Figure 1). However, the mechanism of allocation of such developmental assistance is still evolving. To enable country governments to seek financial support for developmental activities, the World Bank and the IMF (International Monetary Fund) effected the integration of poverty-reduction strategies into national PRSPs (Poverty-Reduction Strategy Papers). India's strategy for poverty reduction and development was envisaged in the Tenth Five-year Plan (2002–07).¹⁷

Adaptation activities can either have a vulnerability-based approach, wherein one focuses on reducing vulnerability to climate change through building capacities or by focusing on creating response mechanisms specific to each impact. As shown in Figure 1, within the development–adaptation framework, there is a need to fund activities that seek to reduce vulnerability (1 in Figure 1) by enhancing the levels of human development (through poverty alleviation efforts, promoting livelihoods and literacy, addressing gender concerns, and so on). Also, there are efforts to build the capacity to respond to climatic shocks and stresses (2 in Figure 1) (such as natural resource management, bolstering of communication systems, weather monitoring, and so on). Development investment receives a major contribution in the form of ODA from developed countries, with large-scale investments in infrastructure (roads, bridges, dams, and so on). Therefore, to safeguard investments made in these sectors, it often becomes essential to conduct climate risk screening (in addition to the traditional environmental screening) (3 in Figure 1). The success of these screening exercises would, however, depend on the availability of projections of climatic variables that have a high degree of certainty. The fourth category includes activities that exclusively target direct impacts associated with climate change (such as drought-proofing) (4 in Figure 1). However, the distinction between all these four spheres of activities often becomes nebulous. There have been suggestions in terms of financing adaptation—that industrialized countries should fulfill the multilaterally agreed target of ODA of 0.7% GDP and re-orient all ODA and poverty alleviation programmes to accomplish climate change adaptation as a co-benefit. The diversion of ODA from existing developmental priorities, however, faces resistance from many recipient countries.⁷ Routing of resources from the ODA resources for adaptation in developing countries would not be the best solution as development itself is considered the best form of adaptation.¹⁸

The development of NAPA (National Adaptation Programmes of Action) by the UNFCCC also attempts to assist developing countries to cope with the impacts of climate change by understanding the current coping strategies at the community level. The new global aid landscape is marked by the emergence of global funds and non-traditional bilateral donors such as private foundations, NGOs (non-governmental organizations), several corporations, and more public–private partnerships.¹⁹

Under the UNFCCC only a few proposals address the issue of adaptation. These are listed below:

- a) The UNFCCC Impact Response Instrument that proposes formation of a Disaster Relief Fund financed by contributions from industrialized countries.
- b) The Insurance for Adaptation proposal that seeks to establish an insurance pool to pay for adaptation costs in developing countries, financed by a levy on emissions trading.
- c) The South–North Dialogue proposal that addresses the adaptation issue through research and development; capacity building; provision of adequate and predictable revenue streams based on the polluter pays principle and insurance schemes via public–private partnerships.
- d) The Brazilian Proposal is based on a burden-sharing approach and calls on Annex I countries to reduce their GHG (greenhouse gas) emissions by 30% below 1990 levels by 2020, and develop a methodology for allocating emission reduction targets based on their historical emissions. The proposal also included a new CDF (Clean Development Fund) (now referred to as Clean Development Mechanism or CDM), into which developed countries would be required to contribute if they did not meet their emission target (at a rate of \$10/tonne), and which would be used primarily to fund clean development projects in the developing countries (with a small share for adaptation projects). The original pre-Kyoto proposal provided that up to 10% of the CDF could be used to finance adaptation projects in the developing countries. The original proposal involved financial penalty of \$10 for each tonne of CO₂ (carbon dioxide) emissions exceeding the target, to be paid into the CDF.
- e) The Technology-centred Approach is a multifaceted approach aimed at promoting a technology transition in the electricity generation and transportation sectors. It comprises five main components: (1) an R&D (research and development) protocol to ‘push’ the development of new technologies; (2) protocols establishing technology standards to provide a ‘pull’ incentive to commercialize new, low-emitting technologies; (3) a multilateral fund to help spread new technologies to developing countries; (4) a short-term system of pledge and review; and (5) a protocol for adaptation assistance. This proposal is intended to promote a long-term technology transition, but also includes short-term measures such as pledge and review. This fund is financed by contributions from industrialized countries.²⁰

The developing countries were a part of the global efforts to combat climate change through CDM. It was envisaged that CDM will combat climate change, promote sustainable development, and result in effective technology transfer. CDM promotes actions that can mitigate climate change in developing countries. However, the participation of developed countries in providing a technical breakthrough to developing countries has not been satisfactory. Only close to one-third of all CDM projects have claimed to involve technology transfer. Most of the projects those have benefited from technology transfer are larger projects in private institutions. In fact, CDM has been limited to industries only, and only a few projects have any influence on addressing the adaptation concerns. The only way adaptation gets benefited is through 2% levy leading to formation of adaptation fund that reached a consensus

on its operation in CoP-13 in 2007. The present model of reducing emissions shall not be able to provide adequate support to adaptation efforts. The primary reason for the same is that such efforts inadvertently take place in some industrial unit. As of now, out of more than 1000 registered CDM project activities, only one forestry project has been registered. Further, there is no directive on how the money generated through these credits needs to be utilized. It becomes important to understand that the CDM will not be able to provide incentives to adaptation measures. It is, however, important to learn lessons from CDM and its success, and apply them to develop a different mechanism to address adaptation concerns. To ensure that adaptation requirements of a nation are also addressed, following options can be considered.

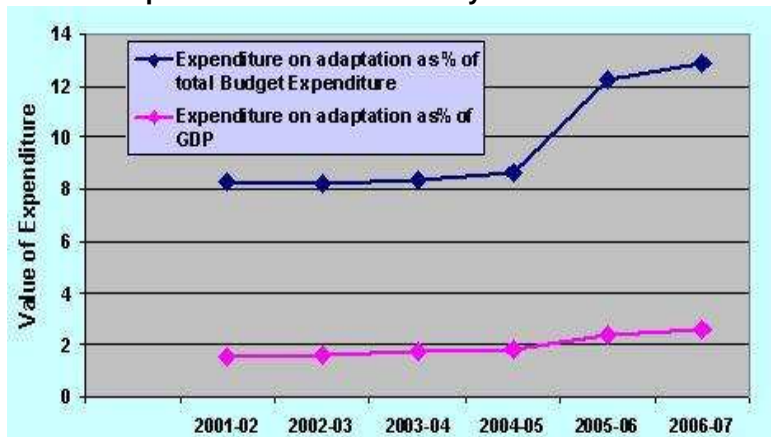
- a) To put a similar levy, which results in creation of adaptation fund from CDM on JI (joint Implementation) projects as well. As credit flowing towards developing countries is levied, it can be argued that the same could be followed within developed countries. This would provide further credibility to the overall UNFCCC process.
- b) A carbon tax to be levied on the products/services being offered. The money collected hence should be used to create a national adaptation fund. The quantum of carbon tax should be decided based on the financial condition of each country. A carbon fund financed from the carbon tax can be created, which shall provide funding to various adaptation-related projects, especially in countries and regions that are most likely to get affected by climate change.
- c) Further, an effort to provide carbon footprint of each product/service to final customer should be made so that the responsible buyers can take an informed decision. This would also promote green consumerism and help the purchasers take better decision.
- d) Mandating the usage of a chunk of carbon credits for undertaking adaptation activities by the beneficiary industry is also a possibility and needs to be explored. Such commitments need to be reported under CSR (corporate social responsibility) of the industrial sector.

To mobilize institutional, human, financial, and technological resources to undertake appropriate actions for adaptation, there is a need to tap other resources as well apart from those envisaged under the UNFCCC. These include aid from international bilateral and multi-lateral financial institutions. The private sector can also be considered as it especially supports the development and implementation of risk-transfer instruments such as insurance schemes, catastrophe bonds, and weather-based derivatives in developing countries²¹.

National scenario

Regarding overall resource requirement, to realize the objectives laid for the Eleventh Five-year Plan period, an increase in domestic investment rates to 35.1% as compared to 27.8% in the Tenth Plan will be required. Nearly half of this investment is expected from the private sector and small and medium enterprises, with the remainder being achieved through public investment. The Government of India is encouraging the development of small and medium enterprises and new modes of finance such as micro-finance, venture capital, and private equity funds.²⁹ This picture of the overall resource allocation structure of the government indicates that these might be the key players to tap for development as well as adaptation efforts. Being a developing economy, India has several critical sectors, such as poverty alleviation, health care, infrastructure development, providing access to clean drinking water, and sanitation, competing for financial resources. Though India is already spending over 2% of GDP on various programmes that also address adaptation, there is a need to initiate and finance adaptation efforts and enabling new and additional resources (Figure 2).

Figure 2: Expenditure on adaptation-related activities by the Government of India (2001–07)²²



This section puts forth some initiatives in priority areas of concern, which require concerted action in order to reduce risks owing to climate variability and change. In terms of adaptation, the major focus of the Government of India has been on the following.

- a) Crop improvement in arid and semi-arid lands, pest management, and capacity building of extension workers and NGOs to foster vulnerability-reducing practices at the farm level.
- b) Drought proofing to minimize the impacts of drought on crop, livestock, and land productivity, on the availability and use of water resources, and on the socio-economic conditions in the drought-prone areas.
- c) Health programmes targeting surveillance and monitoring of vector-borne diseases (malaria, kala-azar, Japanese encephalitis, filaria, dengue, and so on), providing medical assistance during natural calamities, capacity building, and training of human resources.
- d) Risk financing activities mainly in the agricultural sector, including the Crop Insurance Scheme and the Credit Support Mechanism that extends credit to farmers, especially during crop failure due to climatic extremes.
- e) The National Disaster Management Programme provides grants-in-aid to victims of disasters, apart from disaster relief and rehabilitation activities. Other activities include promotion of disaster risk reduction strategies, capacity building of human resources (including communities) for disaster response, and information dissemination.
- f) Livelihood preservation programmes to bolster household incomes through income diversification, especially in climate-sensitive sectors.²³

Given that the main risks that the agricultural sector faces is due to droughts, floods, sea level rise and high or low precipitation, one of the priority action in this sector includes development of climate-hardy crops on a region-specific basis (under high/low temperatures, high salinity, high CO₂ fertilization, and so on). Apart from watershed-based programmes for agriculture, forests and rural development for soil and water conservation and productivity enhancement, technologies facilitating cultivation in arid and semi-arid conditions need to be developed (including resource conserving irrigation technologies like drip irrigation, sprinkler irrigation, in situ soil moisture conservation, zero-tillage, and so on).²⁴ Additionally, there is a need for advanced models to enable better prediction of climatic conditions for advanced decision-making at the farm level and investment in crop diversification and income diversification as a risk spreading measure, apart from access to markets, technology, credit/loan facilities, and so on.²⁵ On the scientific front, there needs to be investments in river basin modelling, groundwater flow and quality monitoring, Integrated Water Resources Management, and so on. Coastal

areas would require adaptation strategies that include cyclone and flood warning systems, dissemination of information to reduce loss to life and infrastructure, and promotion of desalinization, integrated coastal zone management, and land-use controls. Specifically, for drought-proofing, the technological measures being deployed currently include managing seasonal to long-term weather forecasts, rainwater harvesting, rejuvenation of traditional community-based measures for water conservation, and promotion of groundwater recharge. For flood protection, structural measures involve proper construction of dams, levies, and dikes, and strengthening of embankments and non-structural measures include floodplain zoning, flood forecasting systems, planting of mangroves, and so on. In the Eleventh Plan Period, there has been a shift in the approach towards disaster management from being relief-centric to being one that focuses on better preparedness. The Eleventh Five-year Plan also seeks to conceptualize the composition of Disaster Mitigation Fund at national, state, and district levels, as provided in the Disaster Management Act. Extreme events can also lead to mortality and morbidity, and the critical role of public health services in maintaining the health status of a population/ community is undisputable. A holistic assessment of health services in order to prevent direct and indirect health risks due to changes in climatic patterns would include availability and access to health care services and infrastructure, skilled health care workforce, potable drinking water, sanitation, and hygiene inter alia. Research in the health sector would entail establishing baseline relationships between weather and health through retrospective and prospective studies, and developing predictive models to estimate the future burden of infectious disease under projected climate change scenarios. Other areas of research and implementation include developing tools for early warning, preparing vector-specific maps in order to identify vulnerable areas and protect epidemic outbreaks, strengthening surveillance and monitoring systems, and enhancing public education and awareness.²⁶

In terms of natural ecosystems, there is a need to enhance resilience of forest ecosystems and conserve the genetic diversity of forests through in situ and ex situ conservation methods, efficient fire protection, capacity building, and training of the forest personnel. The Eleventh Five-year Plan of India has set an annual target of 3.3 mha (million hectares) of afforestation, to achieve which an annual investment between Rs 49.50–72.60 billion would be required.²⁷ There is also a need for capacity building and training of human resources for skilled personnel to undertake adaptation research and implementation in different sectors that can benefit from sharing of knowledge through international collaboration.

Box 4: Monitorable socio-economic targets of the Eleventh Five-year Plan²⁹

- Accelerate growth rate of GDP (gross domestic product) from 8% to 10% and then maintain at 10% in the Twelfth Plan in order to double per capita income by 2016/17.
- Increase agricultural GDP growth rate to 4% per year to ensure widespread benefits.
- Reduce dropout rates of children from elementary school from 52.2% in 2003/04 to 20% by 2011/12.
- Reduce IMR (infant mortality rate) to 28 and MMR (maternal mortality ratio) to 1 per 1000 live births.
- Provide clean drinking water to all by 2009.
- Reduce malnutrition among children of age group 0–3 to half its present level.
- Ensure all-weather road connection to all habitation with population 1000 and above (500 in hilly and tribal areas) by 2009, and ensure coverage of all significant habitation by 2015.
- Connect every village by telephone by November 2007 and provide broadband connectivity to all villages by 2012.
- Increase forest and tree cover by 5%.

Viewing the sectoral impacts, the resources required for adaptation and development can be viewed as a public good, private good or something in between that has the characteristics of both, in order to create the right regulatory milieu and markets to drive the supply–demand scenario. Roads are important medium of communication in terms of accessibility to information, markets, opportunities, timely relief measures, and so on. There is a need to link all towns at state level and connect villages with all-weather district roads in every

state. In this context, it is essential to mention that the monitorable socio-economic targets (Box 4) for the Eleventh Five-year Plan for India (2007–12) include enhancement of all-weather road connections by 2009.²⁸ It is also essential to invest sufficiently in new and efficient urban infrastructure and retrofit old structures in order to meet the demand. The share of central government expenditure on social services, including rural development in total expenditure, has risen from 11% in 2001/02 to 16.4% in 2007/08.

The country's Initial National Communication¹⁴ identifies that there is a need to provide policy orientation to the scientific assessments and robust scientific foundation to policy-making, which would require development of assessment tools by interdisciplinary teams with international collaboration. Though much adaptation to climate change is a private good, government actions to strengthen private adaptation include providing inputs on public goods such as climate change impacts, early warning systems, construction of coastal defensive infrastructure, and so on, considering climate change impacts during design of public infrastructure (such as roads, bridges, dams, railways, and so on) that may be impacted by changes in the climate, to promote efficient market responses to climate risks to facilitate adaptation (include insurance, providing access to credits and loans) with focus on the poor and marginalized.²⁹ Considering India's institutional arrangement for climate change, on 6 June 2007, the prime minister of India constituted a high-level advisory panel to formulate the country's strategy on climate change. Furthermore, a nine-member expert committee has been formed by the MoEF (Ministry of Environment and Forests), Government of India,³⁰ which will study the impacts of climate change on India and initiate required actions.

State scenario

Central support for social programmes has continued to expand in various forms, although most social sector areas fall within the purview of the states.⁵ There is a need to invest in identifying best practices and success stories in India and adapting them on a region-specific basis. Many states in India now have relatively more autonomous paths of development through foreign and private investments.

Local level

At the grassroots level, there is a crucial role that sharing of knowledge by various stakeholders plays in order to benefit from the diversities existing across the vast expanse of the country, in terms of language, religion, caste, and tribe. Hence, there is a need to build on success stories through sharing of experiences and to custom-tailor successful adaptation models and replicate them to diverse regions. India having a multi-level governance structure (national, state, and local level) needs to ensure synergies between the allocation of responsibilities and resources between different institutional entities. For example, often the local governments or panchayats are provided with 'tied' funds that are attached to centrally planned programmes and are thus unavailable for specific plans that need to be developed at the local level, reflective of the region-specific priorities.

Conclusions

In the coming years, India faces immense opportunities in terms of economic growth and socio-economic development and challenges to development due to the potential impacts of climate variability and change. Development priorities in India can be separated into three closely linked categories—growth, equity, and sustainability. While growth is clearly the central objective for poverty reduction, equity and sustainability are important considerations to ensure the fair distribution of accruable benefits of growth and development. Climate change and variability have been recognized as a potential threat to sustainable development, thereby enhancing the

adaptive capacity of the communities. The major constraints for integrating climate change adaptation issues into development planning process emerge due to uncertainties associated with climate change impact as well as future socio-economic scenarios. The policy-makers are faced with the challenge and practical difficulties of allocating resources for climate change adaptation measures. Developed countries can play a key role in helping developing countries to address their developmental needs while adapting to climate change. There have been suggestions in terms of financing adaptation—that industrialized countries should fulfil the multilaterally agreed target of ODA of 0.7% GDP and re-orient all ODA and poverty alleviation programmes to accomplish climate change adaptation as a co-benefit.²⁸ Routing of resources from the ODA resources for adaptation in developing countries would not be the best solution as development itself often forms the best form of adaptation.²⁴ India being a land of immense diversity and inter-regional variations, adaptation options may obtain varying degree of success depending on the local capacities and climatic conditions. The allocation of limited resources for different sectors crucially depends on the perception of policy planners and decision-makers, and involves prioritizing and balancing development priorities managing uncertainty, change, and surprise because of climate change. Site-specific reliable climate change scenarios are required to enable policy-makers to adopt climate-change-focused adaptation strategies to deal with anticipated and unanticipated conditions.

Endnotes

-
- ¹ United Nations Department of Economic and Social Affairs Division for Sustainable Development Climate Change and Sustainable Development: *A Workshop to Strengthen Research and Understanding*, New Delhi, 7-8 April. *Climate Change Mitigation and Sustainable Development*. Accessible at www.un.org/esa/sustdev/sdissues/energy/op/new_dehli_workshop/mitigation_paper.pdf
- ² <http://www.imf.org/external/np/exr/facts/mdg.html>
- ³ <http://www.undp.org/climatechange/adap01.htm>. Poverty Eradication, MDGs and Climate Change
- ⁴ UNDP (United Nations development Programme). 2007. *Human Development Report*. New York: UNDP.
- ⁵ Gol (Government of India), 2005. *Millennium Development Goals: India Country Report*. Ministry of Statistics and Programme Implementation, Central Statistical Organization, New Delhi
- ⁶ IPCC, 2001, *Climate Change 2001: Impacts, Adaptation and Vulnerability, Summary for Policy Makers*, World Meteorological Organisation, Geneva
- ⁷ McGray, H, Hammill, A., Bradley, R., Schipper, E. L., Parry, J., 2007. *Weathering the storm: options for framing adaptation and development*. World Resources Institute. Washington DC
- ⁸ Huq., S., Rahman, A., Konate, M., Sokona, Y., and Reid, H., 2003, *Mainstreaming Adaptation to Climate Change in Least Developed Countries (LDC)*, IIED, London.
- ⁹ United Nations Department of Economic and Social Affairs Division for Sustainable Development Climate Change and Sustainable Development: *A Workshop to Strengthen Research and Understanding*, New Delhi, 7-8 April. *Climate Change Adaptation and Sustainable Development*. Accessible at www.un.org/esa/sustdev/sdissues/energy/op/new_dehli_workshop/adaptation_paper.pdf
- ¹⁰ www.ficci.com/media-room/speeches-presentations/2007/sep/agri/SessionV/MukundAnnigeri.pdf
- ¹¹ <http://www.indiainbusiness.nic.in/economy/agriculture.htm> as accessed on 18 October 2007
- ¹² <http://www.dhan.org/rainfed/index.htm>
- ¹³ NCDM (National Centre for Disaster Management) and NDMD (National Disaster Management Division). 1999. *Culture of prevention – natural disaster management: India*. New Delhi: National Centre for Disaster Management, Indian Institute of Public Administration and National Disaster Management Division, Department of Agriculture and Cooperation, Ministry of Agriculture.
- ¹⁴ Gol-Government of India, (2004). *India's Initial National Communication to the United Nations Framework Convention on Climate Change*. Ministry of Environment and Forests
- ¹⁵ Gokhale, Y. and Nair, S. 2007. *Global Environment Issues*. In TEDDY 2005-06 (TERI Energy Data Directory and Yearbook). New Delhi: TERI. pp.467 - 512

-
- ¹⁶ Anantram, K. and Noronha, L., 2005. *Background paper prepared by TERI for the side event Adapting to a changing climate: who bears the burden?* For the 11th Conference of Parties to the United Nations Framework Convention on Climate Change, Canada. Published by TERI, New Delhi.
- ¹⁷ Kramer, A.M., 2007. *Adaptation to Climate Change in Poverty Reduction Strategies*. Occasional Paper In UNDP (United Nations Development Programme) Human Development Report 2007/2008. *Fighting climate change: Human solidarity in a divided world*. Accessible at http://hdr.undp.org/en/reports/global/hdr2007-2008/papers/matus%20kramer_arnoldo.pdf
- ¹⁸ *India: Adaptation Approaches and Strategies*, Rajasree Ray, Deputy Secretary, Ministry of Environment & Forests Government of India. http://unfccc.int/files/meetings/dialogue/application/pdf/india_-_adaptation.pdf
- ¹⁹ *Global Monitoring report, 2008*. World Bank- IMF, Washington DC
- ²⁰ Bodansky, D., 2004. *International Climate Efforts Beyond 2012: A Survey Of Approaches*. Pew Center on Global Climate Change. USA
- ²¹ Cosby, A., Bell, W., Murphy, D., Parry, J., Drexhage, J., Hammill, A., and Ham, J. V, 2005. *Which way forward? Issues in developing an effective climate regime after 2012*. International Institute of Sustainable Development (IISD), Canada.
- ²² Gol (Government of India), 2007. *India: Addressing Energy Security And Climate Change*. Ministry of Environment & Forests, Ministry of Power and Bureau of Energy Efficiency
- ²³ Gol (Government of India), 2007. *India: Addressing Energy Security And Climate Change*. Ministry of Environment and Forests, Ministry of Power and Bureau of Energy Efficiency
- ²⁴ http://www.ap-net.org/docs/15th_seminar/india_050912_aps3.pdf. *Climate Change and India: Adaptation issues and concerns: Brief Overview*, Rajasree Ray, Deputy Secretary, Ministry of Environment and Forests, Govt. of India.
- ²⁵ *Report of the Working Group on Risk Management In Agriculture for the Eleventh Five Year Plan (2007-2012)*
- ²⁶ *Report of the Working Group on Public Health Services (including Water and Sanitation) for the Eleventh Five-Year Plan (2007-2012)*, Ministry of Health and Family Welfare.
- ²⁷ *The Working Group on Forests for the XI Five Year Plan*. Ministry of Environment and Forests, Government of India
- ²⁸ Government of India, Planning Commission. *Report of the Working Group on Disaster Management for the Eleventh Five Year Plan (2007-2012)*. December, 2006
- ²⁹ *Global Monitoring report, 2008*. World Bank- IMF, Washington DC
- ²⁹ http://planningcommission.nic.in/plans/planrel/app11_16jan.pdf
- ³⁰ FICCI (Federation of Indian Chambers of Commerce and Industry), 2007. *Climate Change Task Force Report*, New Delhi