Paper 7

Lessons Learnt for Vulnerability and Adaptation Assessment from India's First National Communication

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The BASIC Project is a capacity strengthening project – funded by the European Commission – that supports the institutional capacity of Brazil, India, China and South Africa to undertake analytical work to determine what kind of climate change actions best fit within their current and future national circumstances, interests and priorities. Additional funding for BASIC has also been kindly provided by the UK, Department for Environment, Food and Rural Affairs and Australian Greenhouse Office. For further information about BASIC go to *http://www.basic-project.net/*

About BASIC

The BASIC Project supports the institutional capacity of Brazil, India, China and South Africa to undertake analytical work to determine what kind of national and international climate change actions best fit within their current and future circumstances, interests and priorities. BASIC has created a multi-national project team linking over 40 individuals from 25 research and policy institutions, the majority based in BASIC countries. Project activities comprise a mix of policy analysis, briefings, workshops, conferences, mentoring and training clustered around five tasks lead by teams as follows:

- Task 1 – Mitigation and sustainable development (China Team);
- Task 2 – Adaptation, vulnerability and finance (India Team);
- Task 3 – Carbon markets, policy coherence and institutional coordination (South Africa Team);
- Task 4 – Designing international climate change policy and enhancing negotiations skills (Brazil Team); and
- Task 5 – Creation of developing country expert group/mechanism on a long term basis (All Teams).

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About this Paper

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Other papers produced by BASIC Task Team 2 include:

- Handbook of Current and Next Generation Vulnerability and Adaptation Assessment Tools, Amit Garg, Ashish Rana and P.R. Shukla, Energy Environment Analytics Limited India, Manmohan Kapshe, Maulana Azad National Institute of Technology, India, K. Narayanan, D. Parthasarathy, and Unmesh Patnaik, Indian Institute of Technology, Bombay, India.
- Vulnerability to Drought, Cyclone and Floods in India, Sumana Bhattacharya and Aditi Das, Winrock International, India
- Disaster Prevention, Preparedness and Management, and Linkages with Climate Change Adaptation, Anand Patwardhan and Meeta Ajit, Technology and Information Forecasting Assessment Council, India
- Proceedings of the BASIC India Workshop, Vulnerability and Adaptation to Climate Change, From Practice to Policy, May 2006, Winrock International, India

Abstract

This Paper sets out the process and substantive conclusions emerging from submission by India of its First National Communication (NATCOM), including lessons for future vulnerability and adaptation (VA) assessment processes. India was chosen for as a basis for lesson learning by other developing countries as the process of putting together the NATCOM was extensive and innovative and a wide range of VA tools were used in the assessment. The paper explains the process and sets out the substantive conclusions emerging from India's NATCOM. It summarizes climate change impacts on India focusing on water resources, agriculture, forests, coastal zones and human health. It then describes the technical limitations of impact assessments, including uncertainties surrounding models, the low resolution of available models and the lack of integrated assessments due to the sector specific and stand alone nature of studies done for NATCOM. It argues that taking socio-economic parameters such as land use, population dynamics and livelihood changes will enable a more useful product and better link scientific assessments with human dimensions, including institutional arrangements for governance and implementation. The paper concludes that one of the most important lessons learnt for India and other countries was the need to further develop institutional and human capacity which is still too scarce – even in a country as large as India. Another lesson is how the NATCOM process sensitized a wide range of policy makers at the national level and resulted in a nascent policy network around adaptation. The paper concludes more work needs to be done to bring in policymakers/stakeholders from village, district and state level as well as the private sector as each of these will play a crucial role in future VA assessment and implementation.

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1 Introduction

This Paper was written as part of Task 2 of the BASIC Project which focuses on contributing to policy discussions and capacity development around vulnerability, adaptation and finance issues (for details on Task 2 see BASIC Project Final Report). The Paper sets out the process and substantive conclusions emerging from submission by India of its First National Communication (NATCOM), including lessons for future vulnerability and adaptation (VA) assessment processes not only for India but also for other developing countries as they begin undertaking more detailed VA in coming years. India was chosen for as a basis for lesson learning as the process of putting together the NATCOM was extensive and innovative and a wide range of VA tools were used in the assessment.

India submitted its Initial National Communication (INC) in 2004 as per the commitments articulated in Article 4.1 of the United Nations Framework Convention on Climate Change (UNFCCC) and the 10/CP.2 guidelines for non-Annex 1 Parties to the UNFCCC. A broad-based approach was undertaken to implement the INC, involving policy makers, researchers and the industry. About 16 ministries and departments and 117 institutions covering universities, research institutions, NGOs, industry associations participated in this process. A website[1] was designed for generating awareness and various publications were made available in the form of brochures, workshop proceedings and books on climate change issues for dissemination amongst concerned stakeholders[2]. The information generated through the various activities undertaken during the preparation of Initial National Communication (INC) was reported as per the guidelines of the COP (10/CP.2) for non-Annex 1 Parties which cover the following elements:

- National circumstances
- National Greenhouse gas emission inventory by sources and removals by sinks
- An assessment of vulnerability due to climate change and adaptation
- Other steps taken to achieve the requirements of the Convention
- Constraints and gaps, and related financial, technical and capacity needs

The INC was one of the first projects in India, wherein creation of awareness in a number of sectors about the potential developmental relationship between climate and sectoral planning was generated. It also created the institutional systems for the periodic consolidation of climate change related data. Additionally, the INC project helped bring together teams from various sectors to work together. The INC process also brought in a large number of new and young researchers into the climate change research enabling them to continue to addresses

1 www.natcomindia.org
2 See list in www.natcomindia.org

climate change concerns in the future. At the policy level, climate change is also now more important than it was prior to this project. The involvement of senior policymakers in the National Project Steering Committee helped sensitise them to the importance of the incorporation of the climate concerns in sectoral policymaking, including research priorities. This closer relationship built between senior policymakers and sectoral research institutions now drives climate change research in India ensuring high levels of user engagement for the future.

In spite of these efforts, however, further work is required to make climate change data more relevant in order to enhance India's capacity to address climate change concerns in the national framework, especially in the context of adapting to climate change. This paper presents in brief the limitations of the various studies carried out during the INC vis a vis the vulnerability to climate change, highlights the achievements, the gaps, the lessons learnt and outlines the path ahead for addressing adaptation concerns in the national context.

2 Climate change and its impacts on India

Observations over India show that the mean annual surface air temperature has increased by 0.4-0.6°C in the last 100 years (Hingane et al., 1985. Rupa Kumar et al., 2002). Climate change projections for India using a high resolution Regional Climate Model (RCM) such as PRECIS[3], indicates that the annual mean surface temperature rise may range between 3 to 5 C under A2 scenario and 2 to 4 C under B2 scenario, by the end of century (Rupa Kumar et al., 2006). The warming may be more pronounced in the northern parts of India. Extremes in maximum and minimum temperatures are also expected to increase. Further, it is projected that on an average there will be a 20 per cent rise in all India summer monsoon rainfall over all states except Punjab and Rajasthan in the North west and Tamil Nadu in the South, which show a slight decrease. As regards the extreme rainfall events, an overall increase in the rainy day intensity by 1-4 mm/day may occur in most areas in India, except for small areas in northwest India where the rainfall intensities may decrease by 1 mm/day. Using the climate model, it is projected that there will be an overall decrease in the number of rainy days over major parts of India. This decrease may be more pronounced in the western and central parts of India (by more than 15 days) while near foothills of Himalayas (Uttaranchal) and in northeast India the number of rainy days may increase by 5-10 days.

3 Developed by Hadley Center, UK.

2.1 Water Resources

It is projected that by 2050s the quantity of surface run off due to climate change would decrease (Gosain et al., 2004). Though an increase in precipitation in the northern, central Indian and the Southern river basins is projected under the climate change scenario, however, the corresponding total runoff for all these basins is not likely to increase. This may be due to increase in evapo-transpiration on account of increased temperatures or variation in the distribution of the rainfall. In the remaining basins, a decrease in precipitation is projected. The rivers in the western regions, namely, Sabarmati and Luni are likely to face 2/3rd decrease in total runoff with respect to current runoff conditions in these basins. These conditions may lead to severe droughts in future. Flooding conditions may deteriorate in two river systems namely in Mahanadi and Brahmani.

2.2 Agriculture

Simulations using dynamic crop models indicate a decrease in yield of crops as temperature increases in different parts of India. For example a study carried out by Sinha and Swaminathan (1991) and Aggarwal and Kalra (1994), shows that on a 2°C increase in mean air temperature, rice yields could decrease by about 0.75 ton/hectare in the high yield areas and by about 0.06 ton/hectare in the low yield coastal regions. This is offset by an increase in CO_2 at moderate rise in temperature and at higher warming; negative impacts on crop productivity is projected due to reduced crop durations (Kalra et al., 2004). For a 425-ppm CO_2 ambient concentration and 2°C rise in temperature, a shift of iso-yield lines of wheat is projected northwards, which also seem to reduce in area (Aggarwal and Kalra, 1994). However, in the agriculture sector the major impacts of climate change will be on rain fed or un-irrigated crops, which is cultivated in nearly 60% of cropland area. In India it is the poorest , most vulnerable farmers who practice rain fed agriculture. A temperature rise by 0.5oC in winter temperature is projected to reduce rain fed wheat yield by 0.45 tons per hectare in India (Lal et al., 1998).

2.3 Forests and their productivity

Enhanced levels of CO_2 are expected to lead to an increase in the net primary productivity (NPP) of forest ecosystems with more than 75% of the grids showing an increase in NPP (Ravindranath et al., 2006). Even in a relatively short span of about 50 years, most of the forest biomes in India seem to be highly vulnerable to the projected change in climate. Further, it is projected that by 2085, 77% and 68% of the forested grids in India are likely to experience shift in forest types under A2 and B2 scenario[4], respectively. Indications are a shift towards

4 Special Report on Socio Economic Scenarios, IPCC, 2001.

wetter forest types in the north-eastern region and drier forest types in the north-western region in the absence of human influence. Increasing atmospheric CO_2 concentration and climate warming could also result in a doubling of net primary productivity under the A2 scenario and nearly 70% increase under the B2 scenario.

2.4 Coastal zones

Long-term cyclonic data analysis indicates that West Bengal and Gujarat have experiences significant increase in cyclonic hits along their coasts, while Orissa showed a significant decreasing trend. Simulation models show an increase in frequencies of tropical cyclones in the Bay of Bengal; particularly intense events are projected to be occurring during the post-monsoon period (NATCOM, 2004). Currently the districts of Jagatsinghpur and Kendrapara in Orrissa; Nellore and Nagapattinam in Tamilnadu; and Junagadh and Porabandar districts in Gujarat are the most vulnerable to impacts of increased intensity and frequency of cyclones in India (Narayanan et al., 2004).

The past observations on the mean sea level along the Indian coast show a long-term (100 year) rising trend of about 1.0 mm/year. However, the recent data suggests a rising trend of 2.5 mm/year in sea level along Indian coastline. Model simulation studies based on an ensemble of four AOGCM outputs indicate that the sea surface temperature adjoining India is likely to warm up by about 1.5–2.0^{o}C by the middle of this century and by about 2.5–3.5^{o}C by the end of the century. The corresponding thermal-expansion related sea-level rise is expected to be about 15 to 38 cm by the middle of the century and about 46 to 59 cm by the end of the century. A one-meter sea-level rise is projected to displace approximately 7.1 million people in India and about 5764 sq km of land area will be lost, along with 4200 km of roads (NATCOM, 2004).

2.5 Human Health

Health impacts of climate change have not been studied much in detail so far in India, however, it is a known fact that the disease burden of climate dependent diseases such as malaria, diaorrhea, and heat stress are very high. Preliminary assessments carried out, indicate that under the climate change scenario, in the 2050s malaria is likely to persist in many states and new regions may become malaria-prone and the duration of the malaria transmission windows is likely to widen in northern and western states and shorten in southern states (Bhattacharya et al., 2006). Simulations made for the current climate indicate that the most endemic malarious regions are the central and eastern Indian regions of India covering Madhya Pradesh, Jharkhand, Chhatisgarh, Orissa, West Bengal and Assam. This is in consonance with the observations made so far. Under the future climate change conditions (results of HadRM2 using 1S92a scenario) in 2050s, it is projected that malaria is likely to

persist still in Orissa, West Bengal and southern parts of Assam, bordering north of West Bengal. However, it may shift from the central Indian region to the southwestern coastal states. Also the northern states at higher altitudes above 1800m, in the North in the northeast may become malaria prone.

3 Limitations of NATCOM-1 Assessments

3.1 Technical limitations of the impact assessments

Most of the studies carried in INC are sector specific and are stand alone in nature with inherent uncertainties associated due to limited understanding of many critical processes in the climate systems, existence of multiple climatic and non-climatic stresses including the human dimensions, regional-scale variations, and nonlinearity. Studies using single scenario projections of the climate system have limited the degree of investigative work ascertaining the range of likely scenarios that one can have of future impacts. Further, uncertainties are compounded by the boundary conditions governing the Regional Climate Model (RCM) that are derived from the comparatively low resolution outputs of coupled AOGCMS (Coupled Atmosphere and Ocean Global Climate Models).

Additionally, some of the sectoral models do not have weather generators or cannot directly take as inputs the climate projections generated by the climate change models (either GCMs or RCMs). Some of the studies were also limited in their scope and use of model-based analytical tools. For instance, the ecosystem study did not use any models. The river run off model did not account for the man made interventions on the river flow, the vegetation cover etc. The infrastructure study focused only on a couple of case studies, the health impacts were limited to the study of malaria transmission.

Most of the sectoral models are sourced from developed countries and may not capture developing country realities like representation of informal sectors; inefficient markets; small and medium enterprises etc. These models have to be indigenised for more robust projections. The current sectoral assessments in India do not consider inter-sectoral linkages adequately. For instance, in order to quantify water resources of a particular basin, direct and indirect effects of structural interventions, agricultural run off, landuse practices, and climate change induced increases in heavy precipitation events etc. would need to be considered along with may other factors. This has been only partially done in the present assessment (Gosain and Rao, 2003, chapter 5 of this book). Therefore, it is essential to adopt an integrated approach to climate change impact assessment modelling. Initially a soft linkage of already employed sectoral models can be adopted with consistent climate change, GHG emission and regional impact assessment scenarios, and shared databases.

3.2 Limitations vis à vis an integrated approach

India is a vast country with wide regional, socio-economic and sectoral variability, and would require sustained and structured efforts for a comprehensive assessment. These studies prepared for the NATCOM provide promising initiatives. The impact assessment models used in the INC, typically look at a certain system in a certain place in isolation from other systems.

Therefore whilst unlinked parallel studies generate important insights on the impacts of climate change, such studies may lead to inconsistencies. For example an assessment of impacts of climate change on water resources is linked closely with its usage in agriculture, industry and households, and the indirect association with livelihoods, therefore synthesis of all these linkages is necessary. Similarly, in the energy sector modelling, GHG emission scenarios are generated by only using energy models driven by perceived demands in food production, change in industry, changes in the technology, land use changes and changes in energy requirements. In the case of water, agriculture and forestry sectors, only climate change scenarios are linked to the sector under consideration. The socio-economic parameters such as land use, population dynamics, livelihood changes and changes in other parameters likely to occur in the future, including the consequent greenhouse gas emissions projections, have not been integrated in these models. The next step would be to integrate all these parameters and establish the inter linkages between the different sectors.

The integration will provide an opportunity for linking wide scientific knowledge and interests to distinctly differing, socio economic and political interests and opinions. These assessments are very much needed not only to provide a platform for the scientists to link their own area of research with other scientific disciplines but also to appraise policy makers about the likely impacts of climate change and the ranges of adaptation strategies available. Therefore in the final analysis, Integrated Assessments (IAs) are essential for facilitating the optimal development of institutional and research linkages, projects and policy recommendations as they synthesize the best available synthesis of current scientific, technical, economic, and sociopolitical knowledge (IPCC, 2001a, b and c). However, in most of the sectoral studies an integrated approach could not be followed because the extensive data required for the integrated assessments are not accessible.

3.3 Adaptation Concerns

Climate change is likely to impact all the natural ecosystems as well as socio-economic systems as indicated above. Further, India being a large developing country with nearly 700 million rural population directly depending on climate-sensitive sectors (agriculture, forests and fisheries) and natural resources (such as water, biodiversity, mangroves, coastal zones, grasslands) for their subsistence and livelihoods, climate change is a looming threat unless preparations are made to adapt to the likely adversities. The enormous task ahead is compounded by the fact that still, the adaptive capacity of dry land farmers, forest dwellers, fisher folk, and nomadic shepherds dependent on the climate sensitive sectors for their livelihoods is very low (Ravindranath and Sathaye, 2002).

Therefore, beyond the sectoral and disciplinary climate change impact assessments, there is a need to integrate the scientific impact assessments and link them the human dimensions of climate change at a regional and sub-regional scale for formulating adaptation frameworks incorporating development as well. The framework will integrate climate change impact assessment and adaptation research with the concerned technology, institutional arrangements for governance and implementation, economic and risk sharing instruments (such as insurance, and financial mechanisms through regional and global cooperation), and other policy options for sustainable development. This would need commitment of sustained resources and institutionalization of multidisciplinary and networked efforts within the scientific and policy-making establishments.

4 Lessons Learnt

The preparation and implementation of India's Initial National Communications project provided a number of lessons and best practices that could enhance the design and implementation of projects related to enhancing adaptation in India and elsewhere. These lessons are:

Appropriate institutional and human capacity is scarce, and its development is essential

The greatest long-term impact of the INC has been the creation of high level awareness about the potential developmental relationship between climate and sectoral planning. Several teams, especially those in the health and the coastal zones management sectors, reported that their sectoral research agenda now incorporates climate change as well. It has also created the institutional systems for the periodic consolidation of climate change related data. For example, land use data and coastal zone data are now compiled and consolidated with climate change concerns in perspective.

Additionally, the project helped bring together research teams from various sectors to work together. This has created opportunities for new research collaborations to be created. At the policy level, climate change is also now more important than it was prior to this project. It is essential to make the policy maker a party to the development of adaptation frameworks, as it will link development with the adaptation planning.

Further, the research networks in INC also included institutions, which are hub of technology development and dissemination, which are the essential tenet of adaptation to climate change. Institutions such as the Indian Remote Sensing Agency, the Agriculture Research Institute, Ministry of Water Resources, the India Meteorological Department and the Institute of Tropical Meteorology and others were part of the INC and will continue to be a part in the SNC.

However, for developing an integrated adaptation mechanism, there is a need to enhance technical and institutional capacity to understand, analyse, and address climate change. India has a large science and technology institutional base in many areas relevant to climate change research. However these have to develop a shared vision, integrated approach and networking for synergistic research in climate change relevant to policy making.

High-level ownership of the project by the policy makers is essential

The national communication process ensured that the communication was acceptable to all the major sectoral ministries of the Government of India. The involvement of senior policy makers in the Project Steering Committee helped sensitize them to the importance of the incorporation of the climate concerns in sectoral policymaking, including research priorities.

This closer relationship (user engagement) between senior policy makers and sectoral research institutions would help sustain climate change research in India. It also helped in securing the participation of the research organisations associated with sectoral ministries in the process. Consequently, the quality and coverage of the assessment was the final national communication document had broad acceptance across all the sectoral ministries. This has created a conducive environment for integrating climate concerns in sectoral planning, and in sustained support for the climate change process, including for subsequent national communications.

Though the INC had a broad based participation including the participation of researchers, the industry and the policy makers at the national level, however, it was felt that for future effective formulation of adaptation frameworks it is essential to have stakeholders/policy makers from the village, district, state level and the private sector participating in the project development and its implementation stages.

5 Path ahead

Based on the successful experience of the INC project implementation and the lessons learnt therein it is envisaged that future projects that will implement adaptation will engage the vibrant INC network for technical coordination, participation of stakeholders including the researchers, industry, NGOs and the private sector and create platforms for policy interface with the stakeholders in key climate change sectors. This will enhance reliability of vulnerability assessment of key sectors like agriculture, water, health and energy and the inter-linkages that exist within them. Future NATCOM projects can now better address some of the gaps identified in the INC, particularly on capacity building needs, sector-specific data acquisitions and developing integrated vulnerability and adaptation frameworks for identified climatically

vulnerable hotspots, thereby making climate change data more relevant and enhancing India's capacity to incorporate climate change in its development processes.

The key tasks to address vulnerability and adaptation may be viewed in the matrix of strategies and geographic hierarchy (Table 1). For India, and for many other developing countries, climate change is a long-term issue, i.e. the change in climatic parameters and their impacts would continue to exacerbate over time. Therefore, the type and intensity of interventions is likely to enhance with time.

Table 1: Key tasks for addressing vulnerability and adaptation needs

Geographic Hierarchy **Strategies**	**Local**	**National**	**Regional/ Global**
Capacity Building	Monitoring, observation Awareness/assessment at state/ district/ community levels	Scientific assessment, measurement, models, national research agenda	Participation in global/ regional modeling and assessments,
Generation of Knowledge/ Information	Locale specific databases, scenarios and assessment, local monitoring networks	Research networks, National databases (e.g. NATCOM), scientific and policy models, national scenarios, technology inventory	Interface with IPCC assessments, interfacing with regional/global databases, scenarios and assessments, technology inventory database
Institutions/ Partnerships	Community initiatives, Early warning networks	Stakeholders networks, public/ private programs	FCCC processes, trans-boundary impacts assessment
Policy/ Instruments	Local specific adaptation plans, community based adaptation programs	Science-policy linkage, economic instruments (e.g. insurance, R&D funds), integration with national development/ planning process	Adaptation funds, trans-boundary regulations
Technology	Locale specific technology adaptation	Targeted R&D, Technology transfer protocols, demonstration/ pilot projects	Scientific exchange, technology transfer

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