

Proceedings of the International Workshop on

**Vulnerability and Adaptation to Climate Change:
From Practice to Policy**

May 11-12, 2006
Hotel Metropolitan Nikko
Bangla Sahib Road
New Delhi 110001, India

Organized by



WINROCK
INTERNATIONAL
INDIA

In Association with

Institute of Development Studies, UK
Technology Information Forecasting and Assessment Council, New Delhi
Indian Institute of Technology, Mumbai
Energy Environment Analytics, Ahmedabad
Maulana Azad National Institute of Technology, Bhopal

Under the Aegis of



The BASIC Project is a 2-year capacity building project – funded by the European Commission – that will build and strengthen 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. For further information go to

<http://www.basic-project.net/>

CONTENTS

ACKNOWLEDGEMENT	4
EXECUTIVE SUMMARY	5
DAY – 1: INAUGURAL SESSION	
Welcome and Introduction to the Workshop , Dr. Kinsuk Mitra, <i>Winrock International India</i>	8
About BASIC , Dr. Farhana Yamin, <i>University of Sussex, UK</i>	9
Welcome Address by the European Commission , Ms. Abigail Howells, <i>European Commission, Belgium</i>	11
Concepts and Insights on Vulnerability Assessment and Adaptation , Dr. Jyoti Parikh, <i>Integrated Research and Action for Development, New Delhi</i>	12
Keynote Address: India’s Perspective on Adaptation , Shri Naresh Dayal, <i>Additional Secretary, Ministry of Environment and Forests, Government of India</i>	14
Vote of Thanks , Prof. K Narayanan, <i>Indian Institute of Technology, Mumbai</i>	16
DAY – 1: SESSION I	
An Overview of the Recent Emergent Findings on Climate Impacts, Adaptation , Dr. Anand Patwardhan, <i>Technology Information, Forecasting and Assessment Council (TIFAC), New Delhi</i>	18
Adaptation in the UNFCCC Process , Ms. Olga Pilifosova, <i>UNFCCC Secretariat, Germany</i>	22
Adaptation costs and finances , Dr. Habiba Gitay, <i>World Resource Institute, Washington DC</i>	25
Key Points Raised in the Discussions	26
DAY – 1: SESSION II	
Tools for Assessing Vulnerability and Adaptation , Prof. K. Narayanan, <i>Indian Institute of Technology, Mumbai</i>	31
Risk Sharing Through Insurance , Prof. K C Mishra, <i>National Insurance Academy, Pune</i>	38
Environmental Strategies for Increasing Human Resilience to Climate Change in Sudan – A Tool , Dr. Balgis Osman Elasha, <i>HCENR, Sudan</i>	
ADAPT – A Screening Tool on Adaptation , Ms. Fareeha Iqbal, <i>World Bank, Washington DC</i>	40
Key Points Raised in the Discussions	46
DAY – 2: SESSION III	
Approach to V&A studies in the National Communication Process , Dr. Subodh Sharma, <i>Ministry of Environment and Forests, Government of India</i>	49

<i>Agriculture and Adaptation Concerns in India</i> , Dr. Pramod Aggarwal, <i>Indian Agriculture Research Institute, New Delhi</i>	54
Biodiversity, Ecosystem Services and Adaptation , Prof. Pushpam Kumar <i>Institute of Economic Growth, New Delhi</i>	57
Key Points Raised in the Discussions	61
DAY – 2: SESSION IV	
Coping with extreme climate events: Policy implications , Prof. Joyashree Roy, <i>Jadavpur University, Calcutta</i>	65
Enhancing Adaptive Capacity to Climate Change in Semi Arid Regions of India , Dr. Sai Bhaskar Reddy, <i>AFPRO, Hyderabad</i>	70
Building upon the Adaptive Capacity to Livelihood Resilience in arid, semi arid and flood prone regions , Ms. Aditi Das, <i>Winrock International India, New Delhi</i>	73
Addressing vulnerability to climate variability and change: Strategies to enhance adaptive capacities in agriculture and water resources management , Ms. Suruchi Bhadwal, <i>The Energy Resources Institute, New Delhi</i>	77
A Development Perspective of Impacts and Adaptation for Human Settlements, Energy and Industry , Dr. Manmohan Kapshe, <i>Maulana Azad Institute of Technology, Bhopal</i>	80
Key Points Raised in the Discussions	83
DAY – 2: SESSION V	
Brazil , Dr. Gylvan Meira Filho, <i>IAS, Brazil</i>	86
China , Dr. Xiong Wei, <i>Chinese Academy of Agriculture Sciences, China</i>	88
South Africa , Dr. Lwandle Mqadi, <i>The SouthSouthNorth Group, South Africa</i>	92
Adaptation: Perspectives and Experience from the EU , Ms. Abigail Howells, <i>European Commission, Belgium</i>	95
From Practice to Policy: Learning from V& A Studies and Adaptation Projects to Build Future Climate Policy , Dr. Habiba Gitay, <i>World Resource Institute, Washington DC</i>	97
Emerging Issues	100
Key Points Raised in the Discussions	107
Annex I: List of Speakers, Chairpersons and Panelists	109
Annex II: List of Participants	113
Annex III: Presentations	119

ACKNOWLEDGEMENT

This project was supported by the European Commission and facilitated by the Institute of Development Studies (IDS), University of Sussex, UK.

Winrock international India (WII) would like to express sincere appreciation to the Institute of Development Studies (IDS), University of Sussex, UK and all the partner organization, namely, Technology Information Forecasting and Assessment Council, New Delhi, Indian Institute of Technology, Mumbai, Energy Environment Analytics, Ahmedabad and Maulana Azad National Institute of Technology, Bhopal for their valuable support in organizing the workshop.

We are also grateful to keynote speakers Ms. Abigail Howells (DG-Environment, European Commission, Belgium) Dr. Jyoti Parikh (Executive-Director, Integrated Research and Action for Development, New Delhi) and Shri Naresh Dayal (Additional Secretary, Ministry of Environment and Forests, Government of India) for sharing their valuable perspectives.

WII would also like to thank all chairpersons, eminent speakers and panelists for making valuable contributions, and would like to place on record the extremely enthusiastic response of the participants. Last, but not the least, WII wishes to acknowledge the efforts of its staff members, who worked towards making the workshop a success.

EXECUTIVE SUMMARY

Background

Climate change and variability is posing to be the greatest challenge to mankind at global as well as local levels. Development of strategies for supporting adaptation and responding to the consequences of climate change will require collaboration at local, regional and global level, across disciplinary boundaries and between different sectors of the economy. In order to understand the scale of preparedness required to combat the likely adverse effects of climate change, it is necessary to study the present scientific developments in this direction and assess the technological, policy and risk sharing interventions that will be required.

A workshop was organized on “Vulnerability and Adaptation to Climate Change: From Practice to Policy” under the aegis of the BASIC project (Building and Strengthening Institutional Capacity on Climate Change), funded by the European Commission, Directorate-General Environment. The project aimed to bring together the national and international scientists and policy makers in Brazil, South Africa, India and China to undertake analytical work to determine the kind of climate change actions best fit within their national circumstances, interests and priorities through a multi-level network. The project aimed to draw lessons from the implementation experiences, both in terms of insights gained from institutional processes as well as implementation of specific climate policies for providing opportunities for mutual learning amongst a wider group of developing countries. The project provides an important starting point for shaping future climate policy, domestically and internationally.

The India workshop aimed to provide a timely opportunity to understand the scientific and social issues governing the adaptation process both at the global and national level by bringing together national and international experts, policy makers and concerned stakeholders.

Structure and Flow of the Workshop

The workshop was organized to address five major thematic strands in the emerging global debate over adaptation:

1. Adaptation: Emerging Science, Financing and Policy Issues
2. Vulnerability & Adaptation: Methods, Technologies & Tools
3. Sectoral and Thematic Perspective on Vulnerability & Adaptation
4. Indian and Global Adaptation Experiences: Practices to Policy
5. Panel Discussion on Mainstreaming Adaptation in Planning

1. Adaptation: Emerging Science, Financing and Policy Issues

This session aimed to bring to the fore the emerging understanding of the science of climate change, impacts, vulnerability and the adaptation concerns. This had formed the starting point of the discussions on adaptation and as the entire debate of climate change is driven by the United Nations Framework Convention on Climate Change, the workshop will give an overview of the meaning of adaptation in the context of this Convention. This session also looked into the financing opportunities for adaptation projects through the various mechanisms available.

2. Vulnerability & Adaptation: Methods, Technologies & Tools

Methods and tools to assess impacts of, and vulnerability and adaptation to, climate change are the key to enhance our knowledge on adaptation needs and requirements to address the adverse impacts of climate change. This session also reviewed some of the best practices; methods, technologies and financial tools developed globally and in India to evaluate the adaptation needs and address the climate related disasters to improve the resilience of the communities to such disasters.

3. Sectoral and Thematic Perspective on Vulnerability & Adaptation

Water resources, agriculture and ecosystem services are highly dependent on the climate and any threat in the form of climate change to these systems is a threat to the sustainable development of mankind. India being a developing country is resource constrained, and therefore needs to enhance its capacities to address the adverse impacts of climate change in the future and needs to prioritize the impacts, so that careful planning can go into addressing such impacts using the full capacity at its disposal. Through this workshop, some of the adaptation concerns of the key sectors like agriculture, biodiversity and ecosystem services was explored to understand the management needs to adapt to the likely changes in climate in the future.

4. Indian and Global Adaptation Experiences: Practices to Policy

The challenge facing nations now is to mainstream adaptation concerns into policy making, for facilitating the process of adaptation to climate change at local and national levels. Managing risks is a multilevel process that requires mechanism for spreading and pooling the impacts of smaller scale disruptions on the system as a whole so that growth and conservation phases don't increase rigidity and ultimately vulnerability. The Indian and global adaptation experiences presented in this session identified the practices for managing and sharing some of the adverse impacts of current climate variability. Further the session also focused on as to how such learning experiences can lead to building of future climate policy.

5. Panel Discussion on Mainstreaming Adaptation into Planning

Finally a panel discussion was being organized with policy makers, researchers and stakeholders which consolidated the key points raised in the course of the workshop with the emphasis to understand the current impacts faced by some of the sectors which are highly vulnerable due to climate variability, the approaches being taken to combat such impacts and the steps taken to address such impacts at the policy levels and how the current adaptation project experiences can be integrated into policy planning in the future.

INUAGRAL SESSION

Welcome Address

Dr. Kinsuk Mitra, Winrock International India

Winrock International India (WII) is a not-for-profit organization and works in three focus areas – natural resources management, climate change and energy related issues such as renewable energy and energy efficiency. Since many of its programs span the three areas, WII is a multi-disciplinary focused institution, which aims to develop innovative concepts and solutions and apply them to development challenges. WII seeks to integrate environmental priorities into development planning, management and implementation at the local level, in the states and at the national level through policy related research studies. In addition to sustainable Development and poverty issues, response is required for the new threat of global anthropogenic climate change. The formulation and implementation of an appropriate response is hampered by a lack of precise understanding, awareness about the rate and pattern of climate change and the magnitude of the impacts. To devise future responses, it is necessary to consider the effectiveness of present adaptation policies and measures that exist for coping with climate change and variability and extremes. Adaptation to climate change begins with the current climate variability such as impacts of recurring droughts and floods in India. While the issues of droughts and floods have received a lot of attention from the government and the outside, climate change itself is not a high priority issue as the link between incremental and long term climate change and the worsening of climate related disasters has not been established in the minds of people or policy makers. The response, therefore, cannot be based on the existing evidence so far. More studies, research and other detailed work need to be done as new and incremental risks associated with climate change show the need for greater urgency in coping with climate change variability as a step towards better adaptation. Since it is problem, both in the short-term and long-term, climate risks - climate dependant or climate related need to be mainstreamed into national economic and physical planning across all sectors. This must not be considered as an isolated exercise and capacity needs to be created to keep the situation under review, as climate change science is advancing and experience with adverse impacts is accumulating.

This workshop focuses on many such issues and also addresses them by bringing together national and international scientists and policy makers from around the world, to enable the project gain insights from institutional processes as well as in implementation of specific climate policies. It is hoped that the workshop will provide participants an opportunity for mutual learning among a wider group of developing countries.

Building and Strengthening Institutional Capacity on Climate Change (BASIC)

Dr. Farhana Yamin, Institute of Development Studies, Sussex, UK

Building and Strengthening Institutional Capacity on Climate Change (BASIC), a two year project which was began in February 2005, focuses on four major developing countries – Brazil, China, India and South Africa. The project involves providing support for the implementation of the UNFCCC and the Kyoto Protocol commitments, and assistance to developing countries with negotiations on future climate policy. BASIC aims to gather in-depth knowledge of how major countries are dealing with existing commitments, their circumstances, and to work with them in strengthening capabilities, to take forward existing commitments. The way ahead, both nationally and internationally, will evolve from a bottom up approach.

Workshops conducted under the BASIC project

- National Climate Change Conference October, Oct. 2005
- Beijing: Workshop on Economic Modelling and Sustainable Development Policies, Feb 2006
- Delhi: Workshop on Adaptation Practices and Policy, May 2006
- Brazil: Future Climate Policy, August 2006
- Outreach workshops with OECD, Paris 2005 and COP 11, COP12 etc.

BASIC consists of over 20 research and policy institutions and 40 experts, mainly from member countries, working with other international experts, on a wide range of climate issues. BASIC is in the process of learning how implementation of policies takes place and seeks to fit their experiences into the future regime. BASIC will learn about vulnerability and adaptation from experts and support dialogue and networking among the growing “adaptation community”, to advance national and international work in this area.

The project involves a range of activities, which include analytical papers on policy, development of new methodological tools, workshops supporting national climate policy processes and global networking of experts. Five workshops will be conducted and 16 papers will be completed during the project, most of which result from joint policy analysis of work across countries or multi-disciplinary themes.

Sharing work of the India team

- Disaster risk reduction (DRR) and climate change linkages
- Handbook on current vulnerability and adaptation tools and methodologies
- New conceptual framework, indicators, tools and methodologies for vulnerability and adaptation.
- Future international adaptation policy and finances

The BASIC network is engaged in research and policy or practice, and is mainly based in the four BASIC countries. There is also an international team, which includes IDS, WII and ECFYS, who collaborate with BASIC on a number of issues. The issues are extensive and include topics, of most critical concern to developing countries, which have not being covered in detail earlier. The Indian team is dealing with vulnerability and adaptation while the Chinese have completed a number of papers on sustainable development

policies in China, with an emphasis on mitigation challenges. The South African team is working on issues relating to carbon markets, CDM and national processes, while the team from Brazil is reflecting on the future climate regime and focusing on negotiations and methods of developing positions for developing countries. Together, the four country teams will establish a large network of experts, on developing countries, who will deal with economic modeling, adaptation and carbon markets. BASIC will also attempt to develop a new generation of experts, since climate change is a long-term issue and requires continuity

to ensure that capacity created, is strengthened over time. The final task of BASIC is to set up a permanent mechanism that will help developing country experts to strategize across national boundaries, even though it is difficult to monitor situations in other countries. The project functions under the aegis of the Environment Directorate of the European Commission, with co-financing by the Government of China. DEFRA–United Kingdom, IDS and WRI are other members involved.

Welcome Address

Ms. Abigail Howells, European Commission, Belgium

There is a growing consensus that even though greenhouse gas emissions are completely cut off immediately, global warming and sea level rise will continue for centuries and therefore, scientists need to explore other options for adaptation. The First Assessment Report of the IPCC states that persons in developing countries, rather than developed countries, will be more affected by climate change. A 100 million people are at direct risk due to sea level rise and several billion, will experience indirect risks such as water scarcity. The poor are also more dependent on climate sensitive economic activities like subsistence agriculture and have lesser access to financial or institutional support. The possibility of conflict between scarce resources like water, will add further to global economic uncertainty. It is crucial for developing countries to integrate climate change into policy making at the national and local levels. The European Union has recognized the challenge of climate change and is firmly committed to the implementation of the UNFCCC and the Kyoto Protocol and will continue to play a leading role in the discussions for further action up to 2012. Both adaptation and mitigation play an important part in these negotiations.

The European Commission has established the European Climate Change Programme to identify the most cost effective and environmentally effective policies and measures that can be taken at the European level, to cut GHG emissions. The immediate goal is to meet targets in accordance with the Kyoto Protocol. This requires the 15 states who were member before 2004, to cut GHG emissions by about 8 per cent, before 2012.

The European Union is committed to collaboration with developing countries in the area of climate change. Apart from the commitment to the UNFCCC and the Kyoto Protocol, the European Union is strengthening bilateral efforts on climate change. These include partnerships with India and China. The European Union support to the BASIC project demonstrates its commitment to collaborations with developing countries and increasing its input in climate negotiations. In India, the Commission has begun cooperation through the EU-India Initiative on Clean Development for Climate Change.

Concepts and Insights on Vulnerability Assessment and Adaptation

Dr. Jyoti Parikh, Integrated Research and Action for Development

Climate change and variability is posing to be the greatest challenge to mankind at global as well as local levels. Development of strategies for supporting adaptation and responding to the consequences of climate change will require collaboration at local, regional and global level, across disciplinary boundaries and between different sectors of the economy. In order to understand the scale of preparedness required to combat the likely adverse effects of climate change, it is necessary to study the present scientific developments in this direction and assess the technological, policy and risk sharing interventions that will be required.

Climate change is getting more and more complex and further research areas are emerging. At COP 8, in New Delhi, adaptation in climate change was explicitly included. More recently, at COP11, in Montreal, while adaptation was a theme in the side events, there is the need to bring it into the main arena and perhaps establish a protocol for adaptation.

In the 4th IPCC Assessment Report, adaptation is an important component and these consist of two types of actions, those that have occurred and those that are still emerging since mitigation responsibilities are not adhered to. There are also equity issues involved which have several manifestations. Those who are emitting are not necessarily the one who are most affected. This also applies to the poor, regardless of whether they are from developed or developing countries. The ecosystem also needs to adapt to climate change and there is the need for a very detailed analysis on how the ecosystem is adapting. This subject is increasingly receiving more importance, though it needs to be pursued further.

There is, not yet, any consensus between developed and developing countries on sharing of the mitigation burden and the methodology for it. Developing countries should also examine sharing of the adaptation burden. One possible avenue is insurance – crop insurance, livelihood insurance, insurance against extreme events.

The frequency and intensity of extreme events is increasing. Cities have got flooded recently. In a study of vulnerability of agriculture to climate change in India, and possible adaptation, it was found that in a low adaptive mode, agricultural production could reduce by 25%. This reduction is estimated to be only 7 % if farmers used adaptation measures. Adaptation does have a cost, apart from which it requires an enormous amount of capacity building.

At COP 11, when countries made presentations on adaptation, it was noticed that many adaptation programs were based on poverty alleviation. In keeping with this, adaptation may be made an important component of sustainable development programs. Climate change and adaptation to climate change should not be treated as separate elements, both these need be built into various types of development activities such as water management, watershed management, soil fertility and coastal zone development. Capacity building plays a large role in addressing poverty and adaptation. Essentially, knowing how to deal with climate change and adaptation to climate change is the first step which may not be very costly. However a thorough understanding of this issue may require some funds while the transfer of knowledge will involve a large number of activities which will require substantial funds and the European Union is attempting to this.

Not all aspects of adaptation are friendly to mitigation. Large scale measures of adaptation such as the increasing use of air conditioning equipment may actually add to GHG emissions. This is a case of where issues of mitigation and adaptation do not converge. Other large-scale adaptation measures which require large structures to be built like infrastructure required for climate change mitigation, more roads or embankments also work against mitigation.

There is a need to work on a protocol for adaptation, legalize and institutionalize this. Climate change insurance is one such method. In the case of CDMs, there is a levy of 2 % on the CDRs which are exchanged but there is no levy on emission trading or joint implementation.. There is the urgent need to expand understanding of adaptation both in the case of human beings and ecosystems.

Keynote Address

Shri. Naresh Dayal, Ministry of Environment and Forests, Government of India

IPCC assessments project that climate may warm globally in the next 100 years and will cause sea-level rise. This is likely to increase the intensity and frequency of extreme events. In the Indian region, warming is estimated, at between 2.1 0C to 2.6 0C and 3.3 0C to 3.8 0C, in 2050 and 2080, respectively. Rainfall is projected to increase and there will be variations in the spatial pattern. The capacity to adapt varies considerably in different regions and socio-economic groups. Adaptive capacity is a function of wealth, scientific and technical knowledge, information, skills, infrastructure, institutions and equity. It is important to recognize that enhancing adaptive capacity is necessary, to reduce vulnerability. Vulnerable groups are under considerable pressure, due to population growth, resource depletion and inequity. Climate change is an added stress, which increases their risks, due to their low adaptive capacity. Actions required to enhance adaptive capacity are equivalent to those promoting sustainable development.

The Government of India has taken many policy decisions that reduce risks and enhance adaptive capacities of most vulnerable groups by promoting sustainable development. India's development priorities envisage doubling per capita income by 2012, reducing the population below the poverty line by 10%, and ensuring employment, food, energy, health and economic security to all. However, strategies to attain this must focus on maintaining a balance between natural and human resources. So far, a commitment to a clean environment has been maintained during the process of economic development. The planning process emphasizes promotion of people's participatory institutions and social mobilization, particularly through empowerment of women, for ensuring environmental sustainability of the development process.

The Delhi Declaration, at COP 8, stressed that adaptation to adverse effects of climate change is a high priority for all countries. While developing countries are particularly vulnerable, adaptation deserves urgent attention and action by the entire international community. Effective and result based measures should be supported for the development of approaches at all levels, as well as capacity building for the integration of adaptation concerns into sustainable development strategies.

There is concern and a need to orient policies and programmes to address the additional stress, that are likely to be experienced, due to climate change. The challenge is to identify opportunities that facilitate sustainable use of existing resources and make climate-sensitive systems, sectors and communities, more resilient to current climate variability. Faster economic development with more equitable income distribution, improved disaster management, sustainable sectoral policies, careful planning of capital intensive and climate sensitive infrastructure assets, are some measures that will address vulnerability due to climate change.

During the coming century, under plausible global emissions scenarios, the climate over the Indian sub-continent will be significantly, altered with regional variations in temperature and precipitation, as well as in the distribution of extreme events like hurricanes. Development goals that have been set for India envisage a rise in incomes, a stabilized population, integration with global markets and enhanced social infrastructure. While this will mean increased energy consumption and high emissions, it will also enhance mitigation and adaptive capacities. Climate change will affect key sectors and the absence of adaptation strategies could cause significant damage. In the water sector, there is considerable stress in several areas and this is expected to continue in the future. With increased variability in precipitation, modeling and managing water resources needs more attention, along with allocation of resources and policies for water conservation and abstraction. Setting clear-cut priorities among competing water uses, arresting wasteful

use, adopting new techniques such as drip and sprinkler irrigation on a larger scale, are some measures, which may be adopted. Human activities and natural processes along the Indian coastline, along with effects like sea-level rise and increased hurricane activity, make these areas especially vulnerable to changes in climatic parameters. The globalization process adds to environmental stress, as trade tends to concentrate economic activities and population in coastal zones. The degree of impact and vulnerability will be determined by the extent of climate change and the pace and quality of development. While a successful global climate regime may keep concentrations of greenhouse gases, in the atmosphere within safer limits, the quality of development will be the main factor to deal with adverse impacts of climate change. India, as a responsible party to UNFCCC, is taking steps to fulfill its commitments and has furnished its Initial National Communication in time. The Ministry of Environment and Forests, as a nodal ministry in the Government of India, is currently formulating the Second National Communication, which will detail approaches for addressing vulnerability and adaptation.

Vote of thanks

Dr. K. Narayanan, Indian Institute of Technology, Mumbai

Research has revealed that vulnerability and adaptation need to be integrated into the development planning process and this has resulted in an International Workshop 'Vulnerability and Adaptation to Climate Change: from Practice to Policy', where researchers, policy makers and other actors will deliberate on this. This workshop is expected to provide a platform for sharing experiences across countries and regions.

SESSION I

Emerging ideas on adaptation to climate change

Dr. Anand Patwardhan, Technology Information, Forecasting and Assessment Council, Ministry of Science and Technology, Government of India

“Adaptation is the adjustment in natural or human systems to actual or expected climatic stimuli and includes anticipatory and reactive adaptation, private and public adaptation, and autonomous and planned adaptation. Climate risks are increasing and managing climate risk is important for sustainable development and therefore, adaptation should be part of a policy response to climate change. Vulnerability and adaptive capacity are central to adaptation and has to be mainstreamed into sustainable development. The IPCC’s Fourth Assessment Report suggests that adaptation practices need to be looked at from various perspectives: spatial scale; sectors; climate stress/hazards; and baseline economic development level of the systems they are implemented in. Adaptive capacity is influenced by factors that promote or constrain the adoption of technologies and management practices, and also economic, social, political, environmental, institutional, and cultural factors that create both external and internal incentives as well as barriers to adaptation. Adaptation interventions are now viewed in integration with each other and development programmes. An approach needs to identify interventions that can be taken up across sectors and which are relevant to sustainable development. While funding may not always be sufficient, other instruments like insurance need to be considered. Research should focus on methodologies for mainstreaming adaptation, development and diffusion of technologies, fostering public-private partnerships in these areas and exploring innovative funding mechanisms that provide resource generation.”

The presentation examines three aspects of adaptation: the state of science, knowledge and the evolution of understanding; the state of policy dialogue which parallels and is linked to the science process since concepts of adaptation are evolving and an organic link is needed so that policy, understanding and actions taken make communities more resilient; and the way forward.

Adaptation is the response in natural or human systems to actual or expected climatic stimuli and their effects, which moderates harm or exploits beneficial opportunities. Types of adaptation include anticipatory and reactive adaptation, private and public adaptation, and autonomous and planned adaptation. Adaptive Capacity is the ability of communities, household and individuals at all levels of the spectrum to comprehend internalize and respond to climate stress. It is the ability of a system to adjust to climate change (including climate variability and extremes) to moderate potential damages, to take advantage of opportunities, or to cope with the consequences. Sensitivity is the degree to which a system is affected, either adversely or beneficially and vulnerability is the degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and extremes. Vulnerability is a function of the character, magnitude, and rate of climate variation to which a system is exposed, its sensitivity, and its adaptive capacity.

In the broad climate regime, regardless of mitigation or stabilization targets there is a finite and significant degree of anthropogenic climate change and so policy dialogue has to have a bearing on adaptation. Managing climate risk is critical for many development activities, especially sustainable development. An example of this, are the floods in Mumbai, where the combination of excessive rainfall, inadequate drainage, illegal and unauthorized construction led to disaster. For both these reasons, adaptation should be an important part of policy response to climate change.

Scientific literature and adaptation science reveals that adaptation is evolving and should not viewed purely as a response mechanism to impacts but also the changes in impacts over the next 50 or 100 years

in the socio-economic context. This is now understood at the policy level and adaptive capacity is a central theme in adaptation, which has to be mainstreamed for sustainable development.

Adaptation was initially viewed as a function of response. This is seen in the seven step methodology for impact assessment, in the IPCC Second Assessment Report, which defined the problem, selected the method of assessment, tested methods/conducted sensitivity analysis, selected and applied climate change scenarios, assessed biophysical and socio-economic impacts, assessed autonomous adjustments and evaluated adaptation strategies. In the Third Assessment Report of IPCC, vulnerability and adaptation were given more importance and shifted from an emphasis on mechanistic impact assessment. The importance of extreme events, cross-sectoral analysis and multiple stresses and uncertain regional predictions were noted and it focused on adaptation, its links with development and equity issues and adaptive capacity. It was also recognized that those with least resources have the least ability to adapt. This is reflected in the creation of LDC Funds with priority for LDCs and the Small Island Developing States (SIDS).

Preliminary suggestions from the IPCC's Fourth Assessment Report are that adaptation needs to be defined as adjustments made to enhance resilience or reduce vulnerability and practices need to be looked at from various perspectives: spatial scale; sectors; climate stress/hazards; and baseline economic development level of the systems they are implemented in, especially in countries which are changing quickly. In Indian agriculture there are frequent changes in the cropping mix and what farmers decide to grow. This has implications for deciding who is vulnerable, in what way and what are the factors responsible. There are also research issues which include indicators and measuring adaptation; adaptive capacity, structuring and formulating adaptation interventions; proximate, non-proximate; marginal, non-marginal, stocks vs. flows impacts; interactions across scales (spatial, temporal, institutional) and aggregation; and extremes and climate variability

Many discussions on adaptation focus on the type of adaptation intervention. In COP 1, there is recognition that there are different stages of activity. Adaptive capacity could mean assessment, capacity building or programmes and projects and each of these requires financing for supporting adaptation.

There is a wide range of adaptation responses, some of which can be found in the table below.

Classification	Examples
Bear the costs	Accept the costs because it is the most effective choice or because there is no other choice
Share the losses	Use insurance or government relief, or community or family sharing
Prevent or modify the events or the impacts	Change the actual physical events themselves (e.g. flood control; irrigation projects) or change human use activities (e.g. regulate flood plain land use; use drought-tolerant crops)
Change the use of natural resources and relocate socio-economic systems	Use flood plains for recreation, parking areas or wildlife instead of agriculture or housing; avoid expanding agriculture into unsustainable moisture-deficit regions
Research and/or restore	Study adaptation alternatives, identify new alternatives, remedy past mistakes

Classification of adaptation

		Anticipatory	Reactive
Human Systems	Private	<ul style="list-style-type: none"> • Purchase of insurance • Construction of house on stilts • Redesign of oil-rigs 	<ul style="list-style-type: none"> • Changes in farm practices • Changes in insurance premiums • Purchase of air-conditioning
	Public	<ul style="list-style-type: none"> • Early-warning systems • New building codes, design standards • Incentives for relocation 	<ul style="list-style-type: none"> • Compensatory payments, subsidies • Enforcement of building codes • Beach nourishment
Natural Systems			<ul style="list-style-type: none"> • Changes in length of growing season • Changes in ecosystem composition • Wetland migration

There is considerable debate in the scientific and policy communities as responses on the ground are seen in the context of current climate variability. The time scale is important. However, climate change will happen over a period of time and so response has to address long-term change. The very different time scales are very important when dealing with adaptation and the structure of the response. Responses across the three levels are closely intertwined, and indeed might form a continuum.

Initial thinking on action adaptation had to be dealt with according to the financial mechanism of the Convention. It needed identification of need for programming adaptation interventions within the climate change response framework and viewed it as an independent process rather than an action, which could be integrated into ongoing programmes. This staged approach to adaptation surfaced in the UNFCCC (decision 11/CP.1) and viewed adaptation in three stages of interventions. The first was planning through studies to identify vulnerabilities, policy options and appropriate capacity building. The second stage involved identifying measures to prepare for adaptation and further capacity building and the third promoted measures to facilitate adaptation, including insurance and other adaptation interventions

This dialogue further led to the guiding principles for funding adaptation and this could mean the LDC Fund, SCCF Fund or the new Adaptation Fund. The identification of 'concrete adaptation deciding on concrete adaptation measures and there is the urgent need to see action on the ground. However defining concrete measures is required to access funds. After funds for adaptation are received, the method of mainstreaming has to be decided on. There is need for new mechanisms, innovations and tools since the magnitude of funding is more than what exists.

It also has to be decided whether: pilot projects or full programmes are to be funded; these address climate variability or anthropogenic climate change; and there are climate and/or non-climate benefits. It is difficult to differentiate between climate change and variability. Most often adaptation projects have local benefits and not global benefits.

The earlier process of voluntary funding required identifying projects, generating documents and approaching donors. The Adaptation Fund however has a share of proceeds so there is automaticity, with the CDM as there is the process of generation of CERs and when these are monetised, funds are received. Since mechanisms are sustainable and saleable, this concept will have to be retained. The

adequacy and predictability of resources, as predictable inputs are required to deliver funding to projects on the ground, is particularly important. A move from enabling activities to real projects is needed. The institutional process, governance of the institution and its structure is also important to ensure flexibility in expediting the process and enable wider access.

Concrete interventions mean moving away from the staged approach. New knowledge acquired on the theme of adaptation suggests that adaptation interventions are not sequential. Adaptation interventions are now viewed in integration with each other and the development programmes. There is a need to identify a new approach that identifies major types of interventions that can be taken up across sectors relevant in sustainable development

A portfolio approach of broad interventions must be used for adaptation. Examples are sanitation and drainage projects, which must be made climate proof or civil infrastructure, resource management or water resource management. In the case of extreme events and climate variability, insurance is an important tool for providing cover. Exploring the tool, creation of viable insurance markets requires risk pooling and reinsurance mechanisms, which might require pooling across sectors and even countries. This might require access to a source of funds that is generated through automatic contributions. Possibilities are public-private partnerships and disaster risk insurance.

There is the emerging realization of the links between climate change and sustainable development. It has further been understood that climate change adaptation and equity goals can be achieved through the route taken for achieving development goals such as improving food security, provision of safe drinking water, shelter and health care and access to other resources.

Mainstreaming adaptation into development activities is becoming very important because of the scale of response. The larger flow of resources and funds in countries and between countries is for development and adaptation alone will not be able to leverage concessional developmental funds. Adaptation will have to be a component of development projects and programmes. However there are barriers to adaptation, which are financial, institutional, social and cultural, technological and informational.

There are many new directions in research and sciences. In many cases adaptation is a topic where much theory building and conceptualising has been done. Both science and research needs a base of practice on which the next step of understanding will be built. The dialogues of policy and practice have to come together. There is a need for generating new mechanisms for funding and for utilizing these resources to effectively address adaptation on the ground.

Adaptation in the UNFCCC Process

Ms. Olga Pilifosova, UNFCCC Secretariat

The objective of the UNFCCC and the Kyoto Protocol is to achieve stabilization of greenhouse gas concentrations to levels that will prevent anthropogenic interference with the climate system within a period that is sufficient for ecosystems to adapt naturally and ensure that food production is not threatened as well as to enable economic development through sustainable approaches. In principle, the beginning of the international effort to address climate change, accords priority to adaptation. The Convention and the Protocol stress commitment to national, and where appropriate regional, measures, to facilitate adequate adaptation. They also specify cooperation in preparing for adaptation to the impacts of climate change across all sectors, especially water resources and agriculture, to address food production and restoration of ecosystems. Developed countries should assist developing countries, which are vulnerable to climate change by meeting adaptation costs and ensure that the share of the proceeds from certified project activities are used for the purpose. The Convention focuses on: small islands and low-lying coastal areas; arid and semi-arid areas; forested areas and areas liable to forest decay; areas prone to natural disasters, drought and desertification; areas with high urban atmospheric pollution; and areas with fragile ecosystems. Specific needs of least developed countries should be addressed through funding and transfer of technology.

International efforts till 2003 were mainly focused on mitigation through policies and measures to reduce greenhouse gas emissions. However, adaptation is increasingly, being given importance. This has been reflected in the three Assessment Reports of the IPCC, as well as the international political process. In 2006, IPCC concluded that human induced climate change was taking place and that mitigation alone, could not reduce the impacts of climate change. There were three stages of adaptation and during the first, possible impacts of climate change were studied to identify particularly vulnerable countries or regions, capacity building and policy options for adaptation. The second involved planning and measures including capacity building to prepare for adaptation and implementing these two stages in the long and medium-term, was the third stage.

This assessment was done using climate change scenarios as an output from global climate models, impact models. IPCC's Third Assessment Report confirmed that adaptation is needed for all countries, along with mitigation, to address climate change and that the developing countries are more vulnerable. It also featured adaptation in its studies on the impacts on sectors such as water and agriculture and also examines adaptation in the context of sustainable development and equity. At COP 7, three funds were established - the Special Climate Change Fund – which is partially for adaptation, Adaptation Fund and the Least Developed Country Fund. Eighteen areas were identified and the National Adaptation Program of Actions (NAPAs), were initiated in LDCs, based on an analysis of vulnerability to current climate variability and risks. This marked a paradigm shift from the bottom up approach to the top down approach. A major outcome was the adoption of the Buenos Aires Programme of Work on Adaptation and Response Measures. This included 4 workshops on adaptation and included funding and systems. This required Subsidiary Board for Scientific and Technology Advice (SBSTA) to develop a five-year programme on impacts, vulnerability and adaptation to climate change. COP 11 adopted SBSTA and advancing funding arrangements and technologies for adaptation, were reviewed. From 2006, the programme shifted from a negotiation mode to implementation.

The objectives of the SBSTA 5 year program of work on impacts, vulnerability and adaptation program are to assist in improving understanding, and assessment of impacts, vulnerability and adaptation, and also,

make informed decisions on practical adaptation actions. The expected outcomes are enhanced capacity, cooperation and integration at the international, regional, sectoral and local levels by targeting relevant organizations, business, civil society, and decision makers. It will also provide improved information and advice to the COP. The themes are impacts and vulnerability, and adaptation planning measures and actions. There are ten action-oriented sub-themes, which have crosscutting aspects for integration with sustainable development. The process for implementation according to pre-determined modalities – workshops, papers and bringing people together – begins with initial activities as defined by SBSTA23 and these, will be reviewed at SBSTA28, when the Fourth Assessment Report is ready, to enable revisions if necessary.

At SBSTA 23, an indicative list of 24 specific activities, modalities, timeframes and possible partners was prepared. These were further developed and a list of initial activities was prepared, which maintained a balance between the enhancement of ongoing activities and new ones. They also aimed to maximize involvement of stakeholders and organizations considering the need to target a range of audiences and the practical constraints of time, availability of human and financial resources. The nine initial activities planned at the Vienna meeting included building on systematic observations focusing on target audience and the needs to address impacts, vulnerability and adaptation. Working on methods and tools for both top-down and bottom-up approaches; promoting applications, applicability and availability in climate modeling and down scaling; promoting understanding of risks of climate variability, climate change and extreme events and adaptation to these; availability and applicability of socio-economic information for improving vulnerability assessments; using the work of practitioners and experts to share knowledge and information and bringing together sectoral and climate change communities, including the 400 organisations that were identified, to mainstream experience on the ground into different sectors; increasing economic resilience in vulnerable economic sectors and decreasing reliance on any one sector, alone; and building on and coordinating SBSTA research and the Expert Group on Technology Transfer (EGTT) work on technologies for adaptation which includes exploring new areas, one of which is insurance. This will be followed by the approval of these activities, negotiations and agreements on modalities, timing, target audiences, partners – including the private sector, deliverables and the role of the SBSTA, followed by implementation. The challenges are the high expectations and the strategic choices and initial activities planning to maintain the momentum at COP 10 and 11.

A share of the proceeds from the CDM is to be used to fund concrete adaptation projects and programmes in developing countries, which are parties to the Kyoto Protocol. These will use a country-driven and learning-by-doing approach. It will have sound financial management, transparency and separated from other funding sources. During a one year process, specific policies, programme priorities, eligibility criteria and management of advance funding– GEF or non-GEF, will be identified. A workshop was held to discuss the complexity of fund operation and issues to be considered. A draft decision will be prepared for COP/MOP2, and this will be cross-linked to the review of FM and the MOU with GEF under Kyoto Protocol.

The LDC Fund provides complete funding for incremental costs of adaptation as identified and prioritized in the NAPAs and the GEF has been requested to develop a co-financing scales and flexible modalities during a meeting between LDCs and GEF held in Dhaka, Bangladesh. Funds are currently available through the LDC fund to start implementation of specific projects. Several NAPAs have been developed and projects are ready to be implemented.

Two regional workshops have been held, and these reflect regional priorities and priorities and action have been identified. The EGTT considered a technical paper on applications of environmentally sound

technologies for adaptation to climate change in 2005 and also in Brussels, March 2006 and a special side event of on technologies for adaptation will be held at SBSTA25.

So far, very little international cooperation exists in addressing adaptation and there is a need for international partnerships or other formal mechanisms. Proposals for an international political process that can promote adaptation on the ground include: targeting practitioners such as relevant national and sectoral institutions/organizations, projects, planners rather than negotiators; bringing together sectoral communities such as water, agriculture with disaster reduction communities to discuss additional climate change risks and possible adaptations in specific sectors; encouraging incorporation of climate change adaptation into national planning; promoting bottom-up approaches and technology transfer; and working closely with implementing agencies. A study of how experiences on the ground, can contribute to international policy needs to be done along with mainstreaming adaptation without duplicating work of other development agencies.

Adaptation costs and finances

Dr. Habiba Gitay, World Resources Institute, USA

The three main sources of funding for exposure to risks due to climate change are overseas development assistance and concessional lending, foreign direct investment and gross domestic investment. According to World Bank estimates, the cost of adaptation is between 10 and 20 per cent of the funds lent to developing countries that are exposed risks of climate change. Annually, overseas development assistance and concessional lending is about US \$ 100 billion and forty per cent of these funds are for developing countries. Therefore, the annual cost of adaptation ranges between US \$ 4 and 8 billion. Annual foreign direct investment, which includes long-term infrastructure projects with a time frame ranging between 20 and 25 years, is about US \$ 160 billion and 10 per cent is for exposure to climate variability and future climate change. The cost of adaptation is between US \$ 2 and 3 billion. In larger developing countries like India, China, Brazil and South Africa, which are part of the BASIC project, gross domestic investment is about US \$ 1500 billion and between 2 and 10 per cent of this is for exposure to climate risks. The cost of adaptation varies between US\$ 3 and US\$ 30 billion. Therefore, the total annual funding available to meet the costs of adaptation ranges between US \$ 10 and 40 billion.

This is a large amount for developed countries to give to developing countries. However, ignoring climate change will cost much more. There are various estimates of direct impacts in developing countries and the consequences of inaction will cost between US \$ 10 and US\$ 100 billion per year. In this context, the costs of adaptation are not very high in comparison to the cost of the impacts due to climate change and climate variability. The costs of mitigation include those from voluntary action, international grants and trade. Trade is the largest source of funds for developing countries and is about US\$ 20 - US\$ 120 billion per year. In this context also, the costs of mitigation and adaptation are not very high.

The funds available for adaptation are the Adaptation Fund, which targets adaptation and this is 2% levy from the CDM. The amount, which depends on the number of CDMs and the price of carbon, is estimated to range between US\$ 10 million and US\$ 200 million. Adaptation is a component of the Special Climate Change Fund, while technology transfer and mitigation are others. About US\$ 40 million has been pledged to Least Developed Country (LDC) Funds. There are about 40 least developed countries where National Adaptation Plans of Action (NAPAs) are underway. Three have been formally submitted to the UNFCCC, which has also received several drafts. These list country priorities and while some lists are large, it is expected that they will be shortened. The requests for urgent priorities for adaptation range between C \$ 8 and C \$200 million. After listing priorities, least developed countries have begun formulating projects. As part of the Dacca meeting, in April 2006, least developed countries identified projects and requested funding. Bangladesh's request of US\$ 74 million is about 0.1 per cent of its GDP, for a project that addresses adaptation. Countries feel the need to move beyond the NAPAs and requested US\$ 500,000 each, for the next phase.

The costs of adaptation are substantial and impacts will affect sustainable development goals. In addition to overseas funding, developing countries will have to bear a part of the costs, as the cost of inaction is likely to be much greater. While finances available or pledged are limited to less than a billion and the costs are very much higher, there is a need to think innovatively. Actions need to be aimed at including climate change into projects and learning through doing, to make communities more resilient.

DISCUSSIONS

Dr. Chatterjee, Winrock International India

Economic and social development and the eradication of poverty are the over-riding priorities of developing countries, though this is stated implicitly in Article 2 of the UNFCCC. Capacity development in developing countries for adaptation efforts can work only through demonstration projects. In the area of technologies for adaptation, the CDM is a good method as a good CDM will have a very strong sustainable development component. International cooperation should not be restricted to funding and must promote learning through doing and a number of demonstration projects in each country are necessary. Every small area has different traditional adaptation practices which are not common to the region and this makes mainstreaming difficult. In India, planning starts in the planning commission and much of the funds that are allocated do not reach targeted communities as the monitoring process is not adequate. A bottom-up approach would be more useful, where the resource needs of all these communities are integrated into the planning process.

Markets are driven by factors like economies of scale and monoculture and they discourage diversification. A study in Uttaranchal, which has a very fragile environment where farmers are vulnerable, showed that farmers are diversifying their land use and through traditional crop varieties as adaptation measures. These are not highly productive crops though they ensure risk reduction. The government is promoting monoculture. At a workshop, the Agriculture Officer of the district presented incentives for high-end varieties which are a failure in these areas as water scarcity can lead to a loss of more than 90 per cent. On one hand, farmers are able to recover a considerable amount using traditional practices, while the government is promoting the opposite approach.

Adaptation cost and who bears that cost is a very important issue since adaptation is inevitable in developing countries which are vulnerable. There are development funds for poverty alleviation and education and if these are diverted to adaptation it would dislocate progress. The developing countries have made a commitment in the convention will provide funds for adaptation in developing countries and a mechanism should be established for this. Developing countries will definitely adapt though this will impede development.

David Radcliffe, DFID

The World Bank is working on an investment frame work around the issues of clean energy and climate change. Part of the costing for adaptation comes from the clean technology initiative in the World Bank. This initiative is a response which examines and tries to ensure that mitigation and adaptation are not unlinked. Some of the CDM projects can be undertaken with a sustainable development goal and t include adaptation activities. The Director of DFID, in the United Kingdom has received a presentation from the World Bank which includes the draft proposal but the costing is an important component and the figures used are from the World Bank documents which are part of the G8 response.

Dr. Xion Wei, China

Adaptation funding comes from the implementation of the Kyoto Protocol and without this there would have been no funding for adaptation. There are uncertainties of funding. In the Least Development Countries Fund, US\$ 40 million per country is very little as the investment required for adaptation is large and as this is for capacity building there will a minimal impact on adaptation. The NAPAs are still only on paper if no

investments follow, the impact on adaptation will be negligible. The Small Grants Funds are critical. Research has revealed that there are very small-scale examples where communities themselves can bear the cost in the scale of US\$ 5000 for wells or alternative livelihood structures and there has to be a much greater focus on community based adaptation and how these mechanisms can support them. The front-line vulnerable groups will need similar small-scale funding.

Dr. K. Narayanan, IIT Mumbai

While US\$ 500,000 may not be very large, one of the most successful initiatives are the Small Grants of the GEF, and these are about US\$ 50,000 dollars in many cases. In many developing countries especially the least developed countries US\$ 5,000 can fund initiatives that are community based and which makes them more resilient. It is necessary to be innovative and some of these initiatives generate my micro-credit types of schemes and this may not be part of the projects activity but is sustainable. In a project based approach, there are concerns that at the end of the project period, whatever has being built tends to fade away. The sustainability of community based action, even with smaller amount of moneys, is extremely important and should be supported. This also addresses coping capacity which really comes in terms of social and behavioural changes, and helps improve the resilience of the community. The future of the Special Climate Change Fund after 2012 can be discussed later. The cost of adaptation is a World Bank exercise that was done and is also now, part of the UK Government and is called the Standard View. Estimates are being made for the cost of climate changes as a whole is, the cost of inaction and the cost of the action. Perhaps coping capacity is not included. Considerations of place based activity, response of people and what the dollar can buy are part of the full exercise gone which is now feeding into the process within the UK government.

Dr. A. K. Gossain, IIT Delhi

Action is needed in the present for coping strategies of each country. Both industry and government are working but there is still no mechanism, which can provide coping strategy options. This has to be the starting point for future coping strategies. There is need for a framework. Projects only work in the project mode. Action has to be at the local level and the state does not the capacity for this. They continue to do things the way it was done about forty years ago. Capacity building can be done in the conventional manner by conducting training courses but what is needed more is hand holding. There are institutions which can provide technology and capacity building will enable local governments to take over. Only then will this be sustainable. The speed of interventions is increasing but there must be a mapping mechanism for coping strategies and options available along with community participation who will require to know the next level of action.

Dr. Xion Wei, China

The studies relate to adaptation and not adaptive capacity. Development has to be included in to adaptive capacity. There are interventions like insurance, but in poor areas it is not possible for everybody to pay premiums which makes insurance irrelevant in some cases. Without capacity building and education of communities, it is difficult to do much.

Dr. Farhana Yamin, IDS

The implication that there is no staged approach is very profound. We are in a constant cycle of learning and doing the whole time. There are no external interventions that can be used by a community in a

different place. Action research will determine the predominant mode in which successful adaptation is done. IDRC and DFID are providing funding for community based action. Adaptation is looked at negatively, as something which has to be done and positively as it has to be aligned to sustainable development. Lots of experiences from disasters show that there are many positives outcomes which have helped most vulnerable groups.

Dr. Xion Wei, China

Climate change will bring about quick surprises and environmental changes. Studies focus on policies, programs and projects which help bring about action on the ground and these may not be able to adapt to changes. This could also apply to policies which do not explicitly address vulnerability and adaptation. A four year research project is studying how policies, programs and projects can be made more robust and adaptive to climate change.

Dr. Lwandle Mqadi, SouthSouthNorth

The issue of timescale comes up and it is very difficult to differentiate whether communities at the local level are adapting to climate variability or climate change. This understanding is crucial to access funding for implementation of projects at the community level. At the community level, technology transfer through institutions and the processes seems to be lacking. Communities are supposed to be receptive towards technologies and tools and the institutional processes which go into adaptation strategies, including funding and finance, need to be examined.

Dr. Habiba Gitay, WRI

The need is to be action oriented and one concern is that multiple projects may not provide learning. It is important to involve networks, like BASIC has done, and while there may be differences at the local level, there are commonalities. Learnings from the ground should be mainstreamed into institutions, which are dynamic enough to learn and adapt to the changes. The ICDPs in 1970 and 1980 had a lot action on the ground but nothing really addressed the conservation and development together.

Chairperson's Summary

Adaptation is here and now and in many ways we are maladapted. Infrastructure in cyclone prone areas is often rebuilt in the same areas. Climate change exacerbates current vulnerability and some technologies are more climate proof than others. There is a huge investment at risk. Therefore climate change has to be looked at as a due diligence exercise. We hope that we will get development benefits in spite of climate change. Mainstreaming this concern leads to adaptive capacity. There is the victim-centric approach and the other is to be a part of the agent of change. Individuals, communities and countries will investments in irrigation, agriculture and infrastructure and the impacts of climate change, and these are geographically distribute, have to be examined. Screening tools can help to find out where the impact will occur and what kind of impact will take place. Down-scaled climate models will be useful. It is important to learn how mitigation has been mainstreamed. Rules, guidelines and institutions make a difference. These are created only when adaptation is mainstreamed into sustainable development. In India, the Electricity Act stipulates that a certain amount of energy has to be produced from renewable resources and the Energy Efficiency Act which ensures that certain benchmarks for efficiency exist. There is a culture and for adaptation climate change impacts should be evaluated for each project. These have to be implemented. The answers may not be clear and after starting the desired results may not be there. There is a need to probe

and learn from the many projects which are community driven. And networks can help build communities of knowledge, at the level of decision makers, planners such as those involved in planning the water sector, and the operators. There are examples of how these communities of knowledge have helped capture new technologies. Building a network of communities who share experiences as this can help develop guidelines or tools which can help planners and operators to learn from these experiences and mainstream them.

SESSION II

Tools for Assessing Vulnerability and Adaptation

Dr. K. Narayanan, Dr. D. Parthasarathy and Dr. Unmesh Patnaik, Indian Institute of Technology, Mumbai

This is part of the work done during the BASIC project and the Initial National Communication. A Vulnerability Index is being constructed for the assessment of vulnerability and an Adaptive Efficiency Tool is being developed for adaptation. The development of these involves examining existing tools, adding improvisations and incorporating local factors. This development is being carried out in the context of coastal zones.

Vulnerability Index

Two frameworks were used in the development of the Vulnerability Index. The Livelihood Vulnerability and Adaptation Framework identified livelihoods likely to be affected by climate related uncertainties, which include rainfall, temperature, sea level changes and precipitation. Livelihoods are also, affected by uncertainties exacerbated by social, economic and political inefficiencies. This has been ignored in most literature on the subject. These include policies and institutions, markets, government, physical infrastructure, social infrastructure. Demographic factors include population growth, density and literacy. The same population is unlikely to be similarly, affected in certain circumstances. In the case of the Tsunami, some populations were devastated and others who were doing very well. The age, gender, class, race, ethnicity and region, of those affected by loss or livelihood reduction was examined along with are the factors that enhance or reduce risk. The factors which were more important in influencing or mediating livelihood impacts and the existing and potential mechanisms of adaptation were studied within this framework.

The other framework dealt with physical vulnerability and adaptation, in the same context as the first. An important link to be identified is the perception of threats and risks which influences adaptation behaviour and vulnerability. This varies across countries and regions. The perception of risk is also, dependent on social attitudes, values, social structure, and culture along with livelihood patterns, structures and poverty levels. A farmer's perception of risk will differ from that of an administrator and perception of risk varies across different income levels. There are information and integrity issues which deal with availability and access to information; and its reliability. A lot of effort was required to convince farmers to use a high yielding variety of seed. In Maharashtra, local people have several locally developed tools and mechanisms for coping with risks, but these have not been documented.

Some of the tools for assessing the relation between risk perception and adaptation behaviour will include correlations and regressions (poverty – threat – response) and will be qualitative with field based empirical validation.

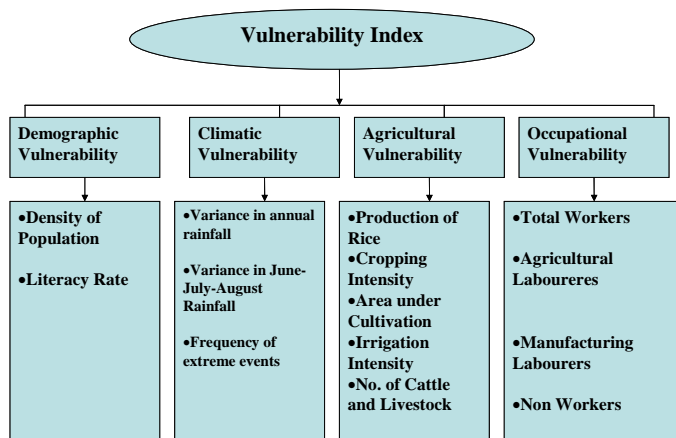
Vulnerability Index.

This index uses factors that are crucial in determining overall vulnerability of people in the area of concern. The sources of vulnerability are derived from demographic, climatic, occupational and agricultural factors. The index aims to map vulnerability in various coastal districts of the eastern coast of India, which is more vulnerable than the western coast, and rank them in terms of vulnerability.

The methods used to measure vulnerability can be categorized as: conceptual approaches; extended vulnerability framework; critical thresholds framework; and indicator lead approaches (bottom-up approaches and top down approaches). Methods for assessing vulnerability include historical narratives; statistical analysis; GIS and mapping techniques; and comparative analysis. The dynamics of vulnerability are captured by relating it to climate change, adaptation to climate change, impacts of climate change, natural hazards and responses and social indicators.

The quantification of vulnerability involved a study of settlements, food, health, ecosystems and water, which provides a sensitivity indicator. Coping and adaptive indicators are derived from the economy, human resources and environment. These may be used with national baseline estimates and projections of sectoral – indicators

Sources and Indicators of Vulnerability



Methodology of Calculation:

The methodology used to calculate the vulnerability index follows the basic approach developed (Anand and Sen, 1994) for the calculation of the human development index (HDI).

Step 1: Calculate a dimension index of the each of the indicators for a district (X I) by using the formula

$$(\text{Actual } X I - \text{Minimum } X I) / (\text{Maximum } X I - \text{Minimum } X I)$$

Step 2: Calculate an average index for each of the four sources of vulnerability – Demographic, Climatic, Agricultural and Occupational vulnerability. This is done by taking a simple average of the indicators in each category.

$$\text{Average Index } i = [\text{Indicator } 1 + \dots + \text{Indicator } J] / J$$

Step 3: Aggregate across all the sources of vulnerability by the following formula.

$$\text{Vulnerability Index} = \left[\sum_{i=1}^n (\text{Average Index } i)^{\alpha} \right]^{1/\alpha} / n$$

Where,

J = Number of indicators in each source of vulnerability

n = Number of sources of vulnerability

(in the present case $n = \alpha = 4$)

This computation was repeated for different time periods 1971, 1981 and 1991 and 2001. It shows how the vulnerability profile has changed over the years for the districts, in terms of the indicators used to measure the vulnerability.

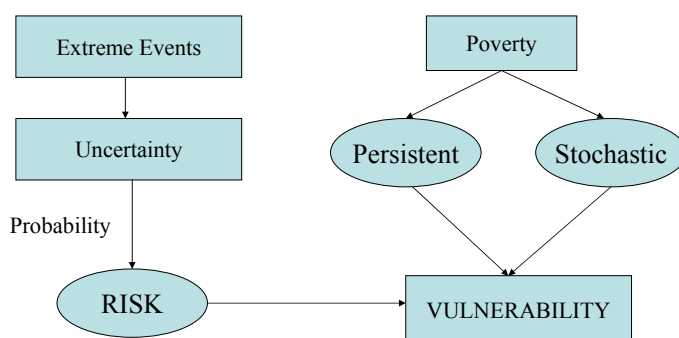
Vulnerability Index: Findings

Districts	Vulnerability Rank in 1971 (Base)		Vulnerability Rank in 1981	Vulnerability Rank in 1991
Dhenkanal	1	<div style="display: flex; flex-direction: column; align-items: center;"> <div style="background-color: #90EE90; padding: 2px;">Most Vulnerable</div> <div style="margin: 10px 0;">↓</div> <div style="background-color: #90EE90; padding: 2px;">Least Vulnerable</div> </div>	1	1
Nellore	2		2	3
Ganjam	3		3	5
Krishna	4		5	6
Visakhapatnam	5		4	7
Puri	6		11	4
West Godavari	7		7	8
Guntur	8		9	9
East Godavari	9		6	10
Srikakulam	10		8	11
Cuttack	11		10	12
Balasore	12		12	2

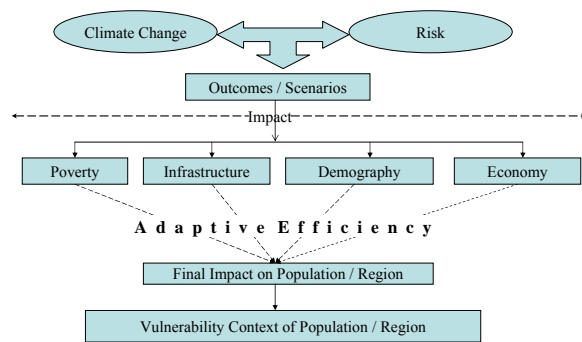
Adaptive Efficiency Tool

The concept defines how economies and societies work effectively in a dynamic time frame and helps in assessing adaptive efficiency, of population or region, to climate change. It predicts probability distribution of outcomes due to climate change under different risk scenarios and enables the vulnerability of population/region to be captured through simple proxy variables (poverty, infrastructure, etc.) or a more comprehensive index and permits mapping of climate change scenarios with vulnerability scenarios over a period of time.

Adaptive Efficiency and the Vulnerability Context



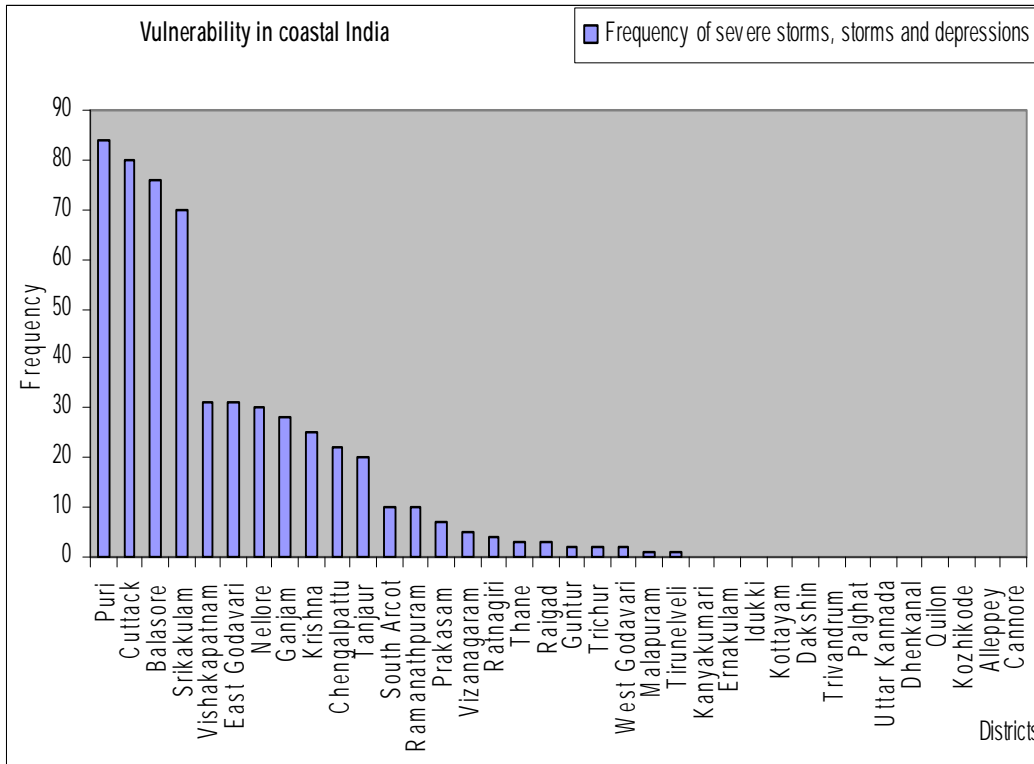
Framework for using adaptive efficiency



Adaptive efficiency = f (income, infrastructure, literacy, poverty, institutions, extremes, occupational distribution, risk)

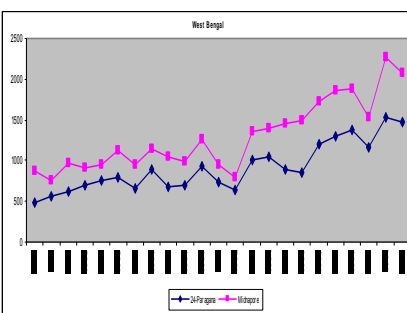
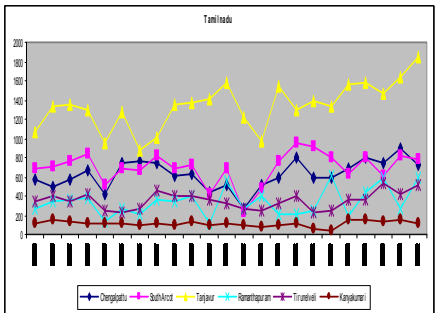
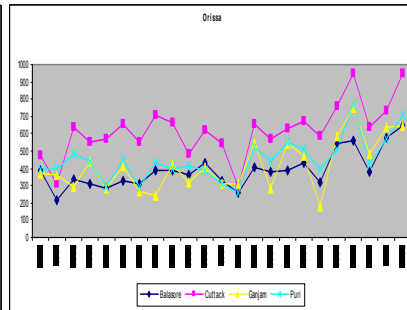
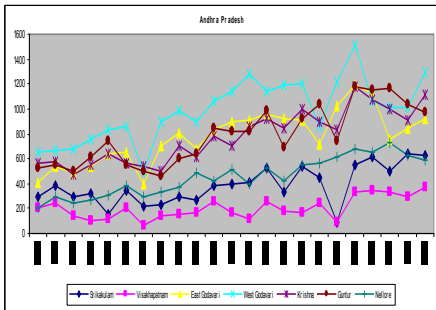
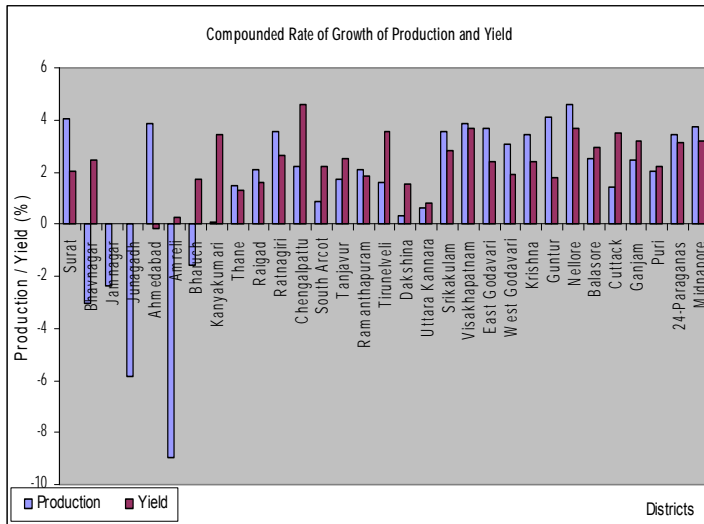
Vulnerability arising from	Description of Variables	Expected Relationship
Income	Income per capita	Inverse Relationship ↑ proxies ↓ Vulnerability
Infrastructure	Performance measured in terms of composite index of infrastructure	
Literacy	Literacy Rate	
Institutions	Institutional support	
Occupational Distribution	Index of occupational distribution of workforce (composite index)	
Risk	risk bearing capacity based on alternate sources of income support	Direct Relationship ↑ proxies ↑ Vulnerability
Poverty	Incidence of poverty	
Extremes	Number and intensities of extreme events	

The preliminary findings, relating to extreme events, show that in developing countries like India, climate change could represent an additional stress on ecological and socioeconomic systems. These are already facing tremendous pressures due to rapid urbanization, industrialization and economic development. The Eastern Coast is more vulnerable than the Western Coast due to the frequency of extreme events, like cyclones and depressions. The districts of Orissa and Andhra Pradesh being the most vulnerable followed by the districts in Tamilnadu.



The preliminary findings, relating to impacts between 1970 and 1990, show that most extreme events occur in Cuttack and 24 – Parganas districts (1970-1990). Tanjaur, Cuttack and Nellore districts have the highest number of death. The coastal zones of Gujarat, Maharashtra and Karnataka report very few extreme events, with many districts reporting none and persons affected are quite low, when compared with states on the eastern coast. Therefore, in terms of impacts also, the districts on the eastern coast of India are more vulnerable.

The preliminary findings, relating to agricultural production, show that coastal zones are the major producers of paddy. It is cultivated in both seasons and districts on the eastern coast account for the majority of paddy production. Districts in Gujarat, Maharashtra and Karnataka have a very low production. Other districts exhibit positive growth rates for production as well as yield except for those in Gujarat. The average rate of growth of production and yield is more than 2% for all districts on the eastern coast. Adverse climate change effects, like increase in frequency of extreme events, may have an impact on production and availability of food grains.



Preliminary Findings

The overall production over the years is sharply increasing in all the districts, though there are fluctuations. The declining trend, in some years, can be attributed to the occurrences of extreme events. This is true for most districts between 1970 and 1980. The occurrence of extreme events is followed by decline in agricultural production. After 1980, the occurrence of a particular event is not always followed by a decline in the production values. For example, in districts of West Bengal, the decline in paddy production, after extreme events, is around 20-25% than the average production till 1982. After that although disasters were reported, paddy production has not declined. This applies to districts in Orissa, Andhra Pradesh and Tamilnadu. In most cases, till early 1980 there was a decline in paddy production after the occurrence of extreme events. This pattern is not reflected later, especially after 1985.

Conclusions

Methodologically, it is very difficult to separate climate effects from other factors such as technological change and economic development, because of the complexities of these systems. There is some

evidence of the adaptation process in the agricultural sector. However, these cannot be generalized and more rigorous analysis needs to be done for other sectors. One of the limitations of the present study is its focus on agriculture. Future research should aim at studying the dynamics of the entire social-economic systems.

Vulnerability and adaptation: methods, technologies and tools

Prof. K C Mishra, National Insurance Academy

In the context of climate change insurance: removal of the cause is not possible; reduction of the severity of the cause is possible to a small extent; mitigation of consequence can be addressed through insurance; reduction of the severity of consequences can be achieved through financial engineering; creating an internal-external-social funding interface through a layering system is possible; and risks sharing is not necessary if the ability to handle it exists. There are three kinds of losses that arise due to climate hazards. Direct losses are physical losses that can be easily quantified. These losses relate to property, infrastructure and assets. Indirect losses are caused due to a disruption in trade and commerce.

After a cyclone in Chennai, the prices of rice and potatoes increased from Rs.20 and Rs.10 to Rs.120 and Rs.70, respectively. In the Andaman Islands, people could not afford this increase and did not have the financial ability to store these commodities for the period of the cyclone. This was a secondary risk. Though the impacts of the cyclone were restricted to Chennai, the effects were felt in other areas.

Secondary losses, being intangible in nature, are difficult to quantify. Such losses are very critical in developing nations, like India. When a climatic disaster of a large magnitude occurs, funds are diverted from development to meet the immediate requirement.

There are many international protocols on insurance and one of these is the Yokohama Message: Management of Hazards (1994). This stated that the most affected are the poor and the socially disadvantaged, in developing countries, as they are least equipped to cope with the situation. Hazard prevention, mitigation and preparedness are better than hazard response. Hazard response offers temporary relief at a very high cost, while prevention contributes to lasting well-being. This protocol was used by Prudential Insurance to develop a range of products. The Indian response to the protocol showed how translation of international measures takes place as a reactive measure. The response included the need to identify vulnerable areas, with reference to natural hazards such as earthquakes, cyclones, floods and climate change. It also, included preparation of a Vulnerability Atlas, showing areas vulnerable to natural hazards and determination of risk levels in households. It also formulated a strategy for disaster resistant construction and planning in natural hazard-prone human settlements, using appropriate technology and enforcing this legally.

The management of natural risks involves assessment of exposure, adequate provisioning and protection in the occurrence of an extreme event. These are the factors which insurance takes into account. The key elements of risk management are: prevention, mitigation, preparedness, response, relief and rehabilitation. The various stake-holders in the process of risk mitigation are: policy makers, decision makers, administrators, professionals, professional institutions, research and development institutions, financial institutions, insurance sector, community, NGOs and the common man. Insurance works on the basis of risks and its pricing on the evaluation of these risks.

In Bangladesh, a cyclone killed 300,000 people and the destruction was equivalent to 10 percent of the GDP. A cyclone of the same magnitude killed, only 18 people in Carolina, USA. Vulnerability depends on many factors. For mitigation, or for insurance to be used more widely, awareness is required. Climate change, which takes place in the long-term, is not considered a hazard and therefore awareness needs to be created by government or civil society.

Underwriting

The insurance industry has at its disposal comprehensive worldwide loss experience which can be used to calculate premiums that are commensurate with the risk and in classifying hazard areas, known as rating zones. This experience can also be used to trace relationships between event frequency and loss intensity, and also estimate loss potential from realistic disaster scenarios. In the area of climate change, insurance needs considerable financial engineering and large-scale networking. For some areas, including the Honduras and Turkey, a fund has been put together to provide insurance. Similar mechanisms must be established and pools need to be created, similar to the terrorism pool in India. This requires institutional networking, governmental assistance and public-private partnerships. Underwriting requires governmental assistance and globalization.

Covariance risk

Covariance risk is based on double jeopardy. In the event of floods there is the risk of property loss and death. This can happen to a large number of people and this becomes mass covariance risk. It is more expensive to insure against and the poor will not be able to afford it. Strong mitigation measures are needed to reduce the costs of risks and any proposal must focus on mitigation along with effective measures to reduce losses. Cross-subsidization of risks should be limited, as these will affect the poor.

Parametric insurance

Losses are often made in relationship to a third party like earthquakes and hurricanes, which cannot be controlled. Crop loss can be controlled, though precipitation cannot. Parametric insurance involves establishing the correlation of the loss with the parameter not under the control of the insurer or the insured. Crop insurance is based on this and has been introduced in 21 districts in India. The methodology has also been adopted by Florida.

Climatic transurance

Climatic transurance makes secondary losses insurable and helps the insured deal with the full impact of loss events. It has been developed by Kentucky University and has been adopted in India. To popularize climatic transurance, institutions like insurance exchanges need to be established.

Assessment & Design for Adaptation (ADAPT): a Prototype Tool

Ms. Fareeha Y. Iqbal, World Bank, USA

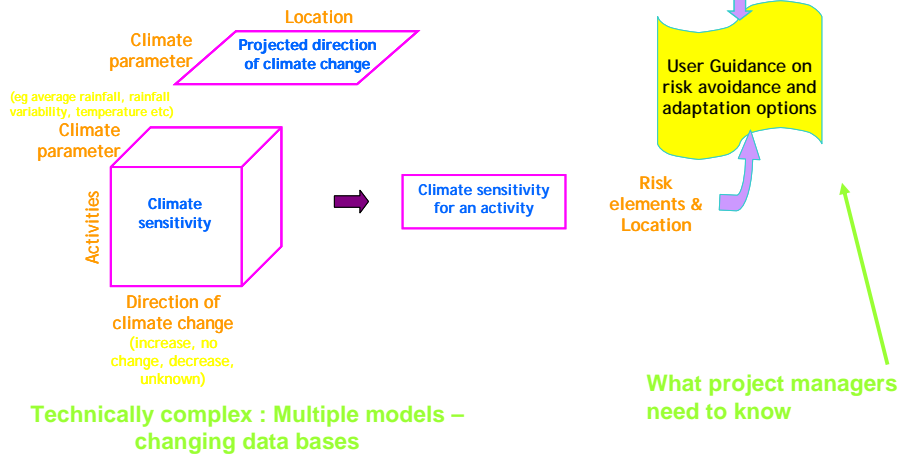
Projects that the World Bank, USAID and the UN undertake are very large, expensive, multi-component and cover irrigation, infrastructure, energy, human health and transport. These sectors are highly sensitive to the impacts of climate change. Impacts are of special importance in infrastructure projects, which are spread over the long-term. While mainstreaming adaptation into development programmes is important, unless project design takes climate change into account, adaptation of poor communities will definitely continue to be hindered. The difficulties that project managers face are information which emphasizes uncertainties. They are often asked to provide highly quantitative data so that models can compute answers for them. Since models are usually under development and they are asked to come back in a year or two when the adaptation pilot project is complete and results have started to be processed.

The World Bank began working on a screening tool which includes climate risks in development projects at the design stage. ADAPT is a screening and design tool intended for project developers, field staff, multilateral organizations and NGOs and is not a community level tool for decision making. It provides a quick, initial check of potential issues that might arise in design or implementation of project that is climate sensitive. It guides project developers to appropriate knowledge and experience. It also, generates a database of local experts, who are familiar with the project activity and raises awareness of risks due to climate change. It offers suggestions to make the project more robust.

ADAPT screens projects using existing knowledge, current trends and modeling results. It is an expert interactive system which identifies key activities that might be sensitive to climate variability and change, uses qualitative climate change data bases which combine models and current trends. It provides a qualitative assessment of risks and opportunities and directs project planners to appropriate literature, tools, projects and experts.

It a warning flag system which provides qualitative advice. The red flag indicates that adaptation issues are important and further follow up is strongly recommended. Yellow is the next level, which identifies some concerns that should be checked. Orange indicates that not enough is known for assessment. This may be due to models conflicting on the ground or unavailability of detailed activities in the project. Green indicates that adaptation issues are not foreseen and blue indicates that the project includes a positive adaptation component.

A framework for a screening & design tool



Project managers need guidance on risk guidance and adaptation options. This is shown in the yellow area. Other complexities are shown in the other areas.

A framework for a screening & design tool



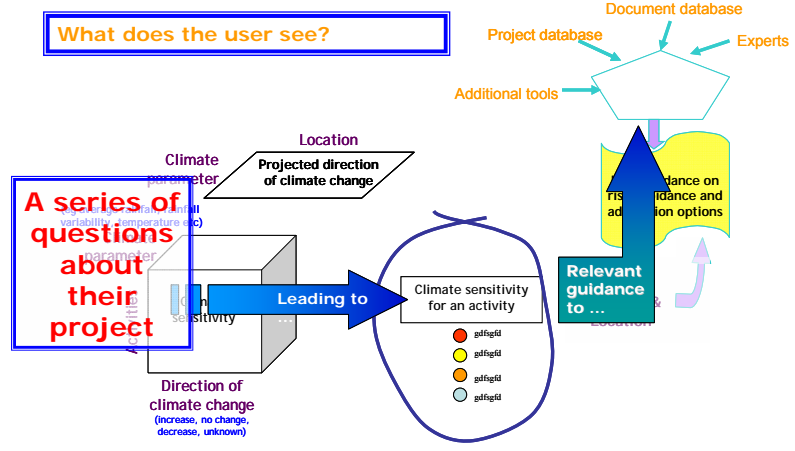
based on expert advice



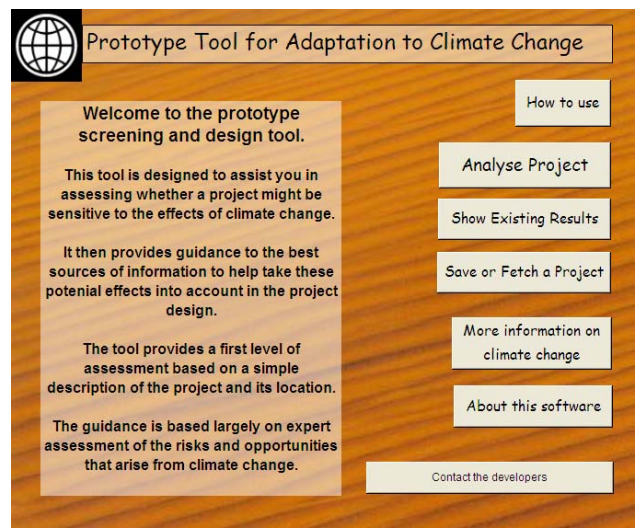
The tool permits movement to selected scenarios and current trends. A list of relevant activities is drawn up and an expert ranks the sensitivity of activities identified using climate scenarios.

The tool points the user to relevant guidance

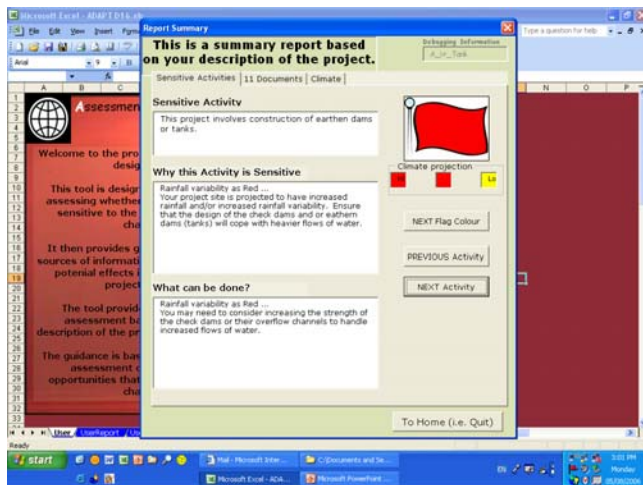
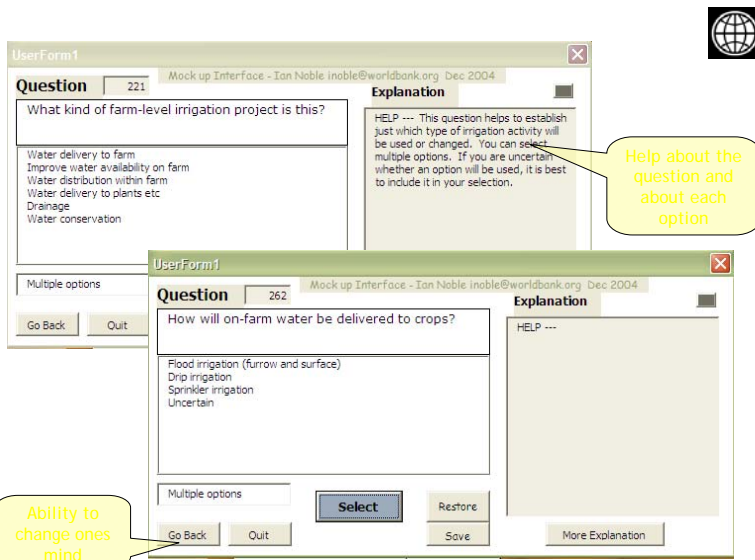
A framework for a screening & design tool



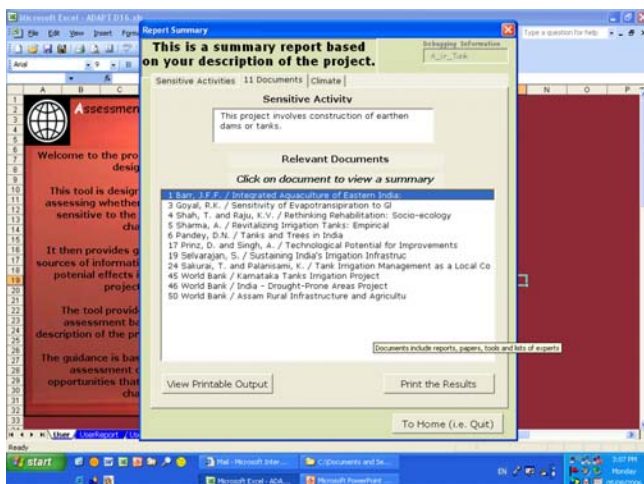
A prototype of the tool for adaptation to climate change is being developed with a focus on Indian agriculture. The user may click on Analyze Projects and a series of questions would be asked about the project.



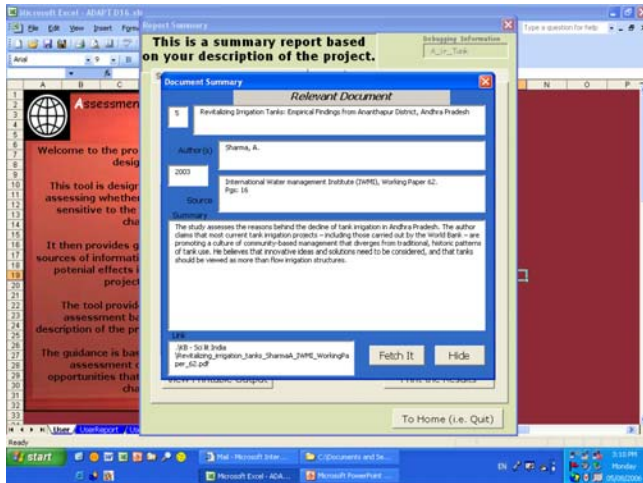
The first screen displays the choice of sector, which in this case is irrigation. The second questions the methods, which is whether water is delivered through flood irrigation, drip irrigation or a sprinkler system.



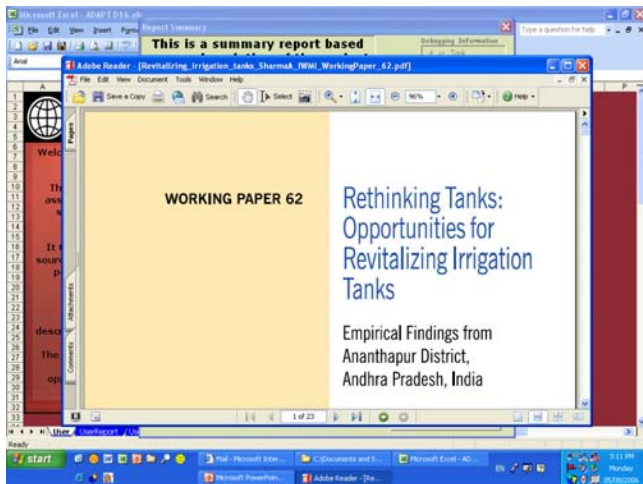
This screen is the summary. The summary sheet gives the sensitivity level along with a brief explanation, and if possible some basic advice on what can be done. On the top of the screen are icons which can help retrieve relevant documents and an expert database.



There is a list of tools, documents and former World Bank projects. An example is prevention of soil erosion. Grass was planted at two sites. This was a failure at one site as the impacts of climate were not considered.



The summary sheet allows relevant documents to be retrieved.



The prototype is user friendly and provides printable outputs. It contains a database of relevant local experts, has a simple structure and can be periodically updated to add more activities. It is has been created in MS Excel and during project implementation will be incorporated into an appropriate software platform.

DISCUSSIONS

Prof. K. C. Mishra, NIA

There is self-insurance and the formal insurance system, however in India, there is also an informal system where the relatives neighbours and the community participates in mitigation. This is called social capital. Social capital is lauded all over the world and has been adopted by an attorney in New York who has commented on lending within a tribal community in India. This needs to be strengthened. It has been institutionalized. There is a Fire Fund in Dharavi, which is used to reconstruct houses and the entire community is involved. In Japan the entire agriculture is through a risk fund and not through insurance. A risk fund can also be commoditized.

After Warrangal, all insurance companies provide terrorism cover. In USA, there is a terrorism pool. A small pool of Rs.200 crores was established with several safeguards. Terrorism was not covered alone. The cover was for fire, engineering or malicious damage along with terrorism. With these covenants, there were few claims and the pool is currently profitable. There were separate plans for industries and individuals. The premium has reduced since there are few claims.

This works well in the organized sector but the poor who are living in marginalized areas like the flood plains are not reached by insurance companies. In India in the case of floods, the government provides assistance and relief. There is a sense of endowment and people feel that they do not need insurance.

Prof. K. Narayana, IIT Mumbai

The poor are more vulnerable than the rich. Krishna district, according to development indicators more vulnerable and Srikakulam is shown to be less vulnerable even though it is one of the poorest districts in the state. In agriculture, demand and supply situations affect the poor. Since the area is mainly paddy dependent, the study was restricted to paddy and other factors do have to be studied.

Several factors including socio-demographic factors are used to construct an index. In terms of political factors, institutions are being considered and there is tremendous scope for improvement in some of these districts in terms of institutional building. Paddy has been given a high weightage compared to other socio-economic factors when you are measuring the index as the area is paddy dependant.

There are the livelihoods frameworks and the physical frameworks. Having integrated both, an index for vulnerability is being constructed a tool will be developed. After which a model which includes vulnerability, adaptation, exposure to risk and other factors will be introduced.

Ms. Fareeha Iqbal, World Bank

Have you tried to validate your interface and what are the validation methods for qualitative information? This tool need not be relevant only to climate change and may work to determine the viability of any project. Is it being used in current World Bank projects? There are two bank projects in one state. One is rejuvenation of tanks and the other is a watershed management program in the same district. Analysis shows that if there is no trade off as constructing check dams will reduce the catchments area of existing tanks which are being rejuvenated in the other project. The perception is that desilting old tanks will benefit the local communities. Conclusions from analysis show desilting will not help. These tools should consider that qualitative findings need to be supported by quantitative element.

We have tried to validate this tool over the past one year and focus groups who consist of technical specialists and project managers in Washington and India. These focus groups included diverse groups including NGOs have made suggestions and an effort has been made to validate the interface.

This tool is in its prototype stage and has not been used so far. Different versions are being developed and features are being added on. The World Bank has certain safeguards for environmental aspects of all projects. This tool is exclusively for climate change issues as there are other mechanical screenings for other projects. There is a need to have quantitative assessments, but this tool is just to provide project managers with a warning of possible climate related threats. The knowledge base is very important and is a part of it along with climate modeling.

The tool can be used for decision making and is not a community level tool but is not only for multilateral agencies alone, even NGOs can use it.

Since the foundation is a climate model output, do you use a set of GCMs outputs or one GCM or a regional climate model? At the moment this has not been done though it will be.

At the focus group sessions it was felt that there could be one standard model for the bank and different versions for different experts at different levels. There would have to be some verification procedures.

Chairperson's Summary

The first presentation explains in detail the risks, risk tools and how they are linked to insurance and the various ways of using insurance tools. One of the primary efforts is to create awareness about both insurance and enhanced risks due to climate change. The presentation also covers risk sharing, institutions, accessibility within systems and local level insurance which has led to the development of tools. We are increasingly seeing agriculture risk insurance practices. The next presentation explored coastal vulnerability and indices for calculating and quantifying it. Issues such as mapping of extreme events in coastal zones and the effect of these on vulnerability were also covered. The last presentation details Adapt, a tool for assessing adaptation in projects.

There are many of tools and methods that have been developed, though mainstreaming adaptation into the decision making process needs accessibility of these tools into a system which policy makers draw upon. Capacities need to be created at the institutional level and while it need not be a large structured capacity, it should have high networking capabilities to access these tools on a dynamic basis. These tools will need upgrading frequently for which trained people are required and this will help to communicate to policy makers for mainstreaming adaptation.

SESSION III

Approach to vulnerability and adaptation studies in the National Communication Process

Dr. Subodh Sharma, Ministry of Environment and Forests, Government of India

The National Communication (NATCOM) is a reporting obligation of Government of India, under Article 12 of the UNFCCC, which relates to implementation of the convention. Vulnerability and adaptation are a component of this. The current understanding indicates that adverse effects of climate change in many sectors, including water resources and agriculture, will impact food security, natural ecosystems such as biodiversity and forests, coastal zones and human health. These will consequently impact economic development in India.

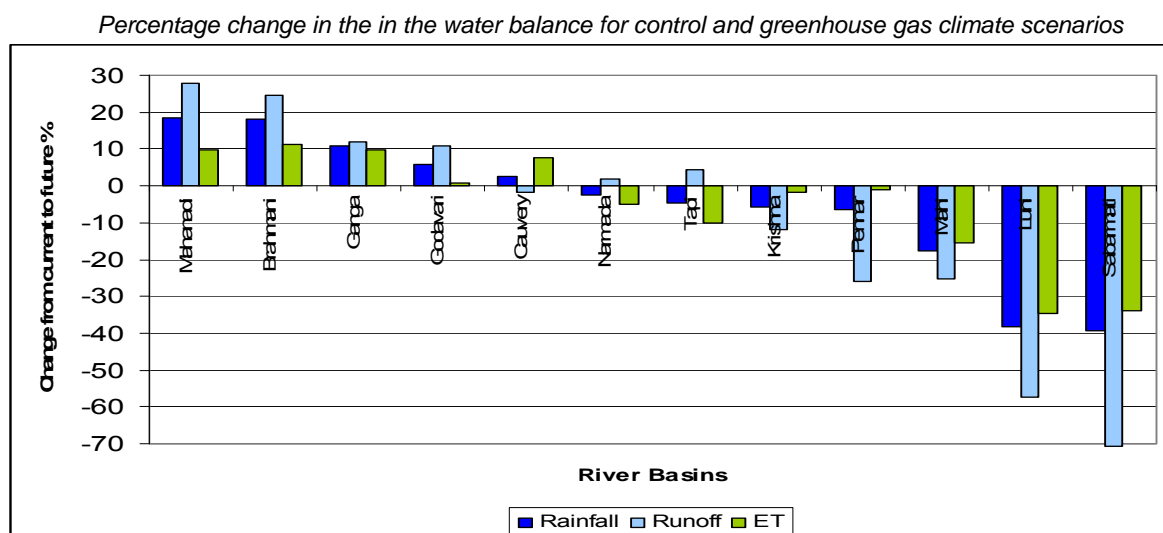
India is a vast country with a population of over 1000 million people and a livestock population of 475 million. It occupies 2.4% of the world's land area and supports 16.2% of the world population. Its physiographic features include the Himalayas, coastal areas, northern plains, a peninsular plateau and islands. It has varied soils, climate, biodiversity and ecological regions. The main feature of climate is the monsoon on which agriculture is dependent. While agriculture is less than 25% of the GDP, it supports 650 million people. Coal is the dominant source of energy. Vulnerability to climate change has to be viewed in the context of the diversity and dependence on the monsoon along with the natural endowments of the country.

In the initial NATCOM, knowledge of vulnerability and adaptation existed. This knowledge was scattered and there was a high degree of uncertainty in all impact projections. This arose due to limited understanding of many critical processes in the climate system, existence of multiple climatic and non-climatic stresses and regional scale variations and non-linearities.

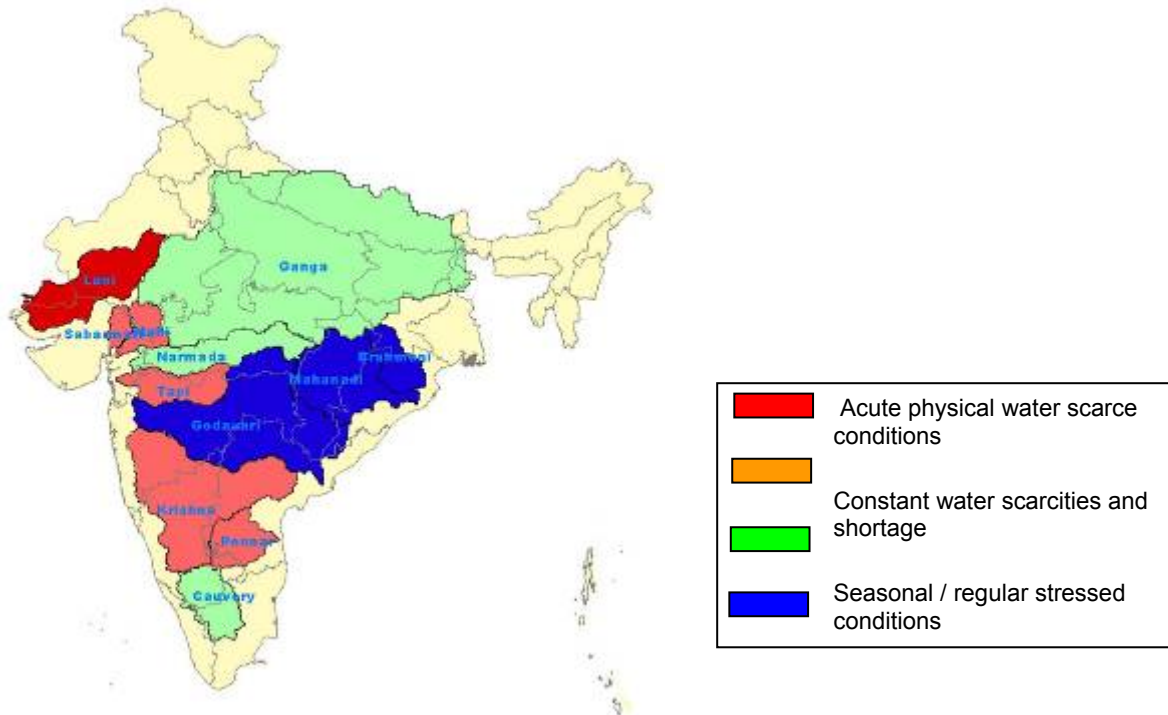
An outline of the results of the Initial National Communication, in relation to the seasonal temperature and precipitation projections, for the year 2050, in the context of vulnerability are shown below. In the northern parts of India there are indications of vulnerabilities that exist due to these variations.

Water resources

Studies were conducted in different river basins.



Some areas in India experience acute water scarcity. Many have constant water scarcities and seasonal or regular stresses. There are a few areas where water scarcity is rare.

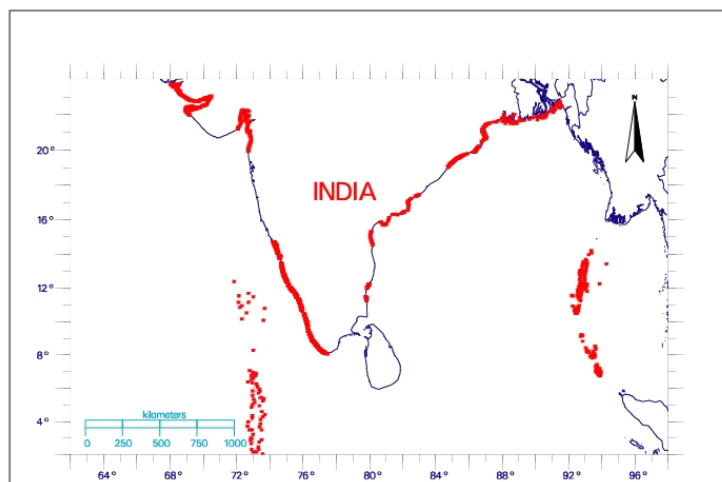


Agriculture

There is a general decrease in crop productivity due to the shifting of the lines of between 2.5 t/ha and 4.5 t/ha northwards, which also reduces the area under agricultural production. The eastern regions are projected to be most impacted by temperature increase and reduced radiation, resulting in lesser grain yield and a shorter grain filling duration. In Northern India, the potential reduction in yields will be offset by higher radiation, lessening the impacts of climate change. Additional CO₂ may benefit crops but will be nullified by the increase in temperature.

Coastal zones

A hazard based analysis of impacts of cyclones in districts show that most coastal zones in peninsular India are vulnerable, especially Jagatsinghpur in Orissa.



Forests

In a study of present biome types and expected biome types under climate projections for 2050, the indications are that forest types are likely to shift and Xeric Shrubland and Xeric woodlands will be the dominant species.

Health

A study of transmission windows of malaria in different states of India and projections in 2080 show that, due to rising temperatures and moisture conditions, malaria may penetrate elevations above 1800 meters and some coastal areas. About 10% more states may offer climatic opportunities for malaria vector breeding throughout the year as compared with year 2000.

During NATCOM 1, vulnerability studies were conducted by developing climate scenarios and socio-economic scenarios across all sectors. A number of institutions were involved in this assessment.

In NATCOM I, impact assessment was made using climate change projections based on single model outputs (RCM Had RM2) and a single scenario was the basis of its development. Uncertainties in projections of climate parameters and limitations of models in assessing sectoral impacts, at the regional level, were noted. Adaptation was not satisfactory and was termed as preliminary assessments made for different sectors, It included assessment of current policies and programmes in relation to vulnerability and indicated that more had to be done. Further analysis was needed to identify adaptation technologies, measures, institutions and financial needs. All this was constrained by limited data, since the entire exercise involved putting teams together within 12 months. Another limitation was the resources.

NATCOM 1 illustrated the need to improve future vulnerability and adaptation studies. This included improved and reliable regional climate models and climate projections for impact assessment. There was the need for sectoral, regional and integrated climate change impact or response models. Appropriate data had to be generated for modeling. The assessment of impacts at the regional level and identification of vulnerable regions and socio-economic systems had to be undertaken. The development of adaptation strategies and a framework for adaptation was required. Networking of institutions, capacity building and sustained research teams were established and resulted in an Indian network. More financial and institutional support was also needed.

The nature of assessments had to be improved and the scope of work proposed the generation of climate change scenarios derived from the recent generation of regional or global climate models. These were HadRM3, PRECIS and other AOGCMs. Mapping of climatically vulnerable regions, in more detail, was contemplated. Development of socio-economic scenarios, at the national level, related to the relevant Special Report Emission Scenarios (SRES) had to be done. Improvement of impact assessments of climate change on water resources, agriculture, forestry, natural ecosystems, coastal zones, human health, energy and infrastructure had to be improved.

Approach

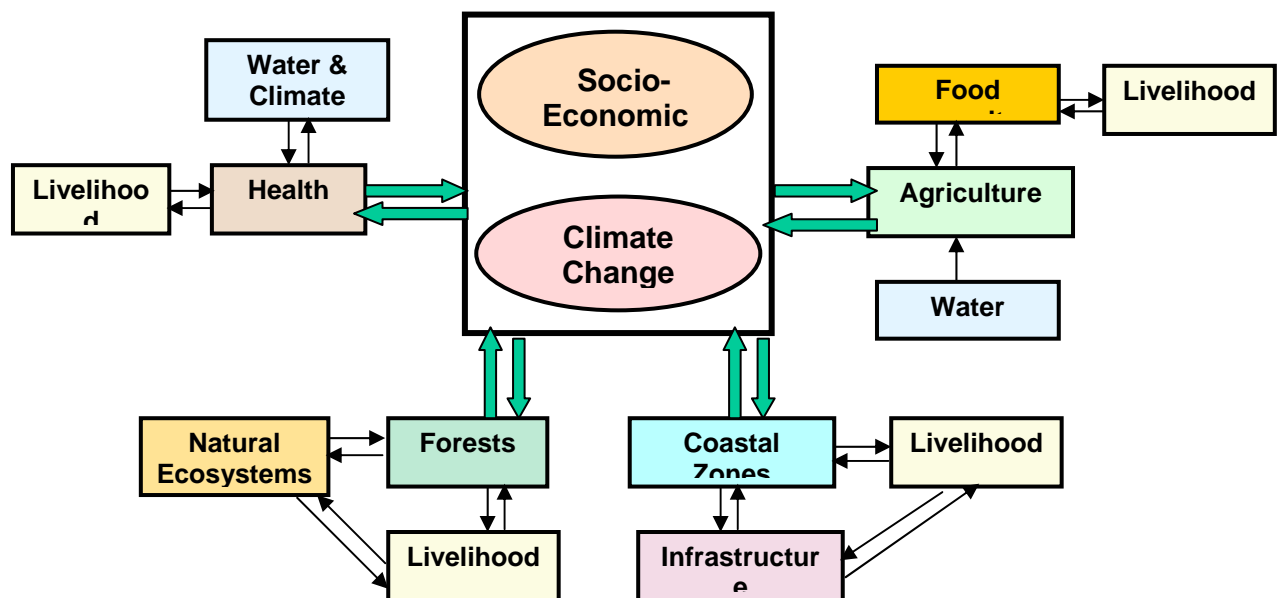
The work envisaged in the second NATCOM, is the improvement of understanding on vulnerability and adaptation and the approach used would integrate vulnerability frameworks and adaptation options. This may evolve into adaptation frameworks. Linkages will be established between socio-economic scenarios and water resources and agriculture productivity and, therefore, food security. Similar linkages would be

established between: human health associated with climate change and the changing profile of extreme events; vulnerabilities due to the impacts on forests and other natural ecosystem products; sea level rise and vulnerabilities of coastal zones; and vulnerabilities of energy systems and infrastructure.

Integration

In order to develop an integrated framework, case studies will be carried out in the identified hotspots to assess associated physical and socio-economic vulnerabilities. An analysis of current coping mechanisms, operational at the local level, which include indigenous strategies, policies and programmes, institutional mechanisms, technological options and risk sharing measures, to combat climate variability. The studies would identify the incremental measures required to cope with the adverse impacts of climate change and help develop adaptation frameworks. These will be the inputs for development of a national framework for adaptation, using the UNDP guidelines, and through linkages to the Adaptation Learning Mechanism

Integrated Vulnerability Assessment – A Conceptual Framework now we will try to integrate in the context of climate change



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
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

Approach to Mainstreaming Vulnerability and Adaptation

A broad based participatory approach is used to involve concerned stakeholders through focused thematic training workshops which will enhance assessment capacities of researchers. Inter-sectoral workshops will facilitate integration. Workshops to sensitize policymakers, media and NGOs, about the outputs of assessments and synergies with other ongoing vulnerability and adaptation projects, will be conducted. The results will be disseminated through web-based and print media.

Climate Change and Indian Agriculture: Current Focus and Future Priorities

Dr. Pramod Aggarwal, Indian Agriculture Research Institute

Indian agriculture continues to remain dependant on changes in weather, in spite of many irrigation interventions. The contribution of agriculture to GDP has decreased to almost 20%, though a large population of almost 65% is still dependent on it for their livelihoods. That makes agriculture an important sector and there is a need to understand the impacts of climate change, increasing climatic risks and possible adaptations.

A variety of approaches have been used and these include experiments and new technologies, including carbon dioxide enrichment and crop modeling. INFOCROP is a user-friendly crop modeling system developed at Indian Agriculture Research Institute (IARI). The model responds to change in environment – radiation, temperature, CO₂, rainfall, wind speed, vapor pressure, flooding and frost; soil variety; agronomic management; and pest population. It has been validated for rice, wheat, maize, sorghum, cotton, potato, groundnut, soybean and mustard in different agro-climatic regions.

Increasing temperature will lead to decreasing yields in wheat, an important crop in North India though this may be compensated by an increase in CO₂ levels. Various scenarios project that a significant impact is unlikely to be felt in wheat production by 2020. However these are mean changes and not increased climate variability. By 2050, there will be a decrease of about 10% and if the situation continues the

Items	Production (million tons)			Demand of food (million tons)		
	2000	2010	2020	2010	2020	2030
Rice	85.4	103.6	122.1			
Wheat	71.0	85.8	102.8			
Coarse grains	29.9	34.9	40.9			
Total cereals	184.7	224.3	265.8			
Pulses	16.1	21.4	27.8			
Foodgrains	200.8	245.7	293.6			
Fruits	41.1	56.3	77.0			
Vegetables	84.5	112.7	149.7			
Milk	75.3	103.7	142.7			
Meat and eggs	3.7	5.4	7.8			
Marine products	5.7	8.2	11.8			

decrease will be more severe. In countries like India where population growth rates are high, the demand for food is increasing and is far more than what is being currently produced. Studies show that demand is greater than supply and the impacts of climate change is projected to further reduce supply. It needs to be studied whether adaptation will ease this pressure and the type of adaptation strategy to follow for convergence in demand and supply.

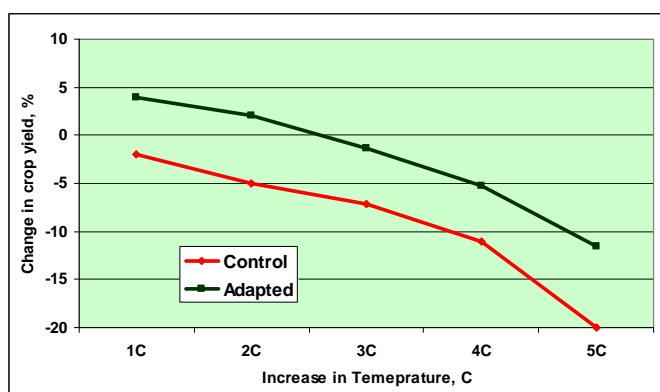
India has been categorized into 95 homogeneous agro-ecological zones by the Planning Commission. This is the primary unit for understanding impacts. INFOCROP has been tested with models at regional scales and has been found satisfactory, even though each state is so different.

Care must be ensured when using regional climate change scenarios as they can be misleading. The total number of frost days and rainy days at Delhi for observed and baseline scenario show that crop will not be able to survive. Using TCMS, with different types of technology scenarios show impacts at different time periods for different crops.

To increase food production there is a need to increase fertilizer and irrigation. As time progresses and as temperature rises, the efficiency of nutrients decreases and more is required. This leads to greater GHG emissions. Analysis has shown that decline in yield is apparently related to decrease in radiation and increase in minimum temperature; and that climate is to some extent responsible. From 5th March to 28th March 2004 there was a heat wave in North and Central India. The temperature increase of between 5 ° C and 8 ° C caused a loss of 4.5 million tons of wheat. The increase in temperature in February this year is likely to cause a similar loss.

Adaptation in agriculture is a continuous process and agriculture diversity is a manifestation of climatic adaptation and also to some extent socio-economic adaptation. Farmers and society have always adapted when allowed by technology availability, their socio-economic capacity and the economics of producing a given commodity. Induced adaptation has been aided by innovation and the Green Revolution of 1960s was one of these. Farmers are increasingly using resource conservation technologies such as zero tillage to address the increase in fuel prices. Other concerns are saving time. GMOs are rare in India. Traditional adaptations and coping strategies practiced by farmers include: low yielding varieties that are less sensitive to climate; resource conservation; single cropping; frost management by irrigation, Heat stress alleviation by frequent irrigation; and shelter belts. There are more that could follow and these are autonomous adaptation options which are: changing varieties/crops; altering fertiliser rates to maintain grain or fruit quality that is more suited to the prevailing climate; altering amounts and timing of irrigation; more effective use of water including harvesting; conserving soil moisture through different ways including crop residue retention; altering the timing or location of cropping activities; and diversifying income including livestock rearing.

Scope of autonomous adaptations in wheat in north India in different scenarios



The redline shows impact without adaptation. As temperature increases there is a decline in production. The green line shows that by using adaptation measures, farmers will be able to cope when temperatures increase by 1 or 2 per cent.

The constraints in autonomous adaptations are its availability and cost. Fields for a desired activity may not be available due to the cropping pattern. Extension services may not be available as the management of the variety used is different. Seed varieties required for adaptation, along with irrigation water, fertilizer and machinery may not be available.

Adaptation options require planned or government interventions. Investments in adaptation research capacity are necessary to develop new technologies. Improved communication of climate changes and adaptation options along with investments in infrastructure for water management, transportation and marketing are needed. Changes in policies, with more incentives for resource conservation and efficient usage, will induce practice among farmers and also, benefit society. A mechanism for credit availability needs to be developed for the transition to adaptation technologies. Relocation to more productive areas will be difficult as infrastructure also has to be moved. Alternate livelihood options are important as agriculture is at risk due to climate change and about 65 percent of the population is dependant on agriculture. Greater insurance coverage for the farm crops is needed.

The complex future agriculture scenario indicates that for India and most developing countries, there will be greater demand for food. Crop yields are either reducing or stagnating due to intensive agriculture and climate change is an additional pressure. As development progresses, there will be greater stress on availability of natural resources for agriculture and a need for increased resources such as land, water, fertilizers and capital. This is likely to increase over time with greater demand for food. There is also a need to preserve environment from the impacts of agriculture.

In an uncertain future, an integrated assessment of the vulnerability of agriculture to global climate change needs to be done. The assessment must take into account demand, markets, technologies and availability of natural resources in a changing global scenario. More research infrastructure for assessment of direct impacts such as FACE and FATE are required and NATCOM is expected to help. Better models are required for integrated assessments. Sectoral research, such as scenarios of climate change, water resources, agriculture and policy and feedbacks, has to be linked. There is also a need to identify research, technology and policy options for the short-term since policy makers focus on the short-term.

Biodiversity, Ecosystem Services and Adaptation

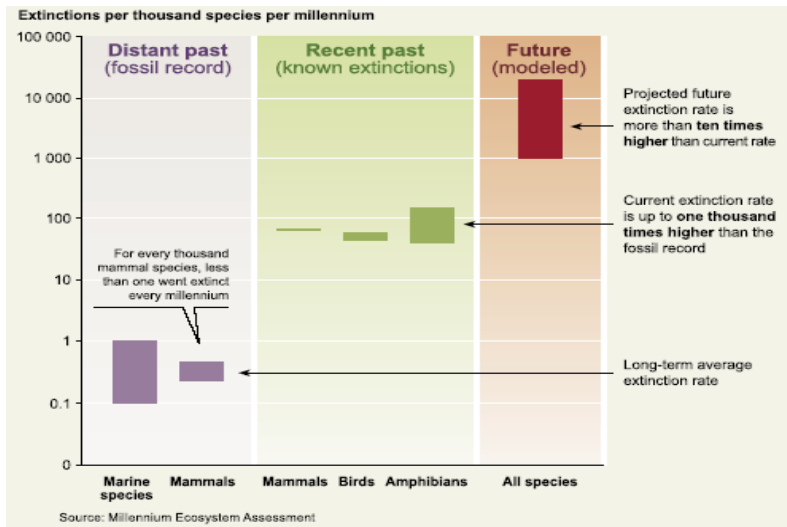
Dr Pushpam Kumar, Institute of Economic Growth, Delhi

Biodiversity and Climate Change

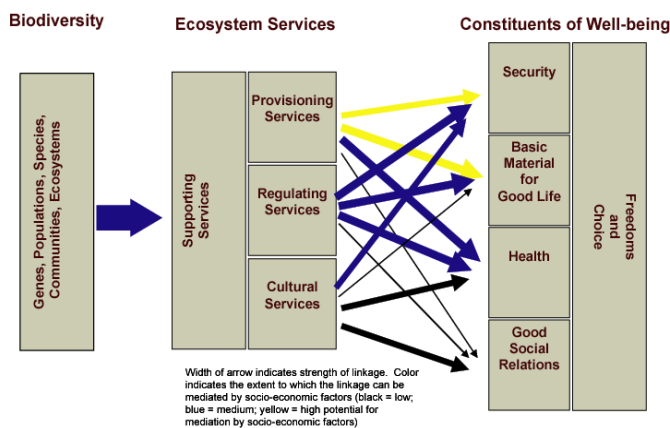
Biodiversity consists of life forms, their variety and variability at all levels. Adaptation comprises of activities that reduce the human and natural systems vulnerability to climate change. Biodiversity is influenced by mean climate and climate variability; productivity of site; original stock of biodiversity; spatial heterogeneity of habitats; and the intensity and interdependency of biotic interactions which include competition, predation, mutualism and symbolism. Various assessments show past changes in global climate have resulted in major shifts in the species range. There has been a marked reorganisation of biological communities, landscapes and biomes. Some findings from the millennium assessments are that 20% of the world's coral reefs have been lost and more than 20% degraded. About 35% of the mangrove area has been lost in the last several decades. Climate change and adaptation responses can enable combinations of biodiversity return to previous levels.

Every year, 3.2 Gt of atmospheric carbon is released after subtracting the assimilation by terrestrial and oceanic ecosystems. The ecosystems approach increases the scope of adaptation to have an impact on biodiversity. Fifteen years ago biodiversity was considered in terms of air, ground and surface water, land, forests, coastal and marine resources. The ecosystem approach treats the dynamic and complex natural habitat as a whole, where biology and biotic resources interact. There are certain criteria and indicators to include them in one of the twelve types of ecosystems, recommended by the millennium assessment. Land use change can significantly influence the reduction of GHGs through avoiding deforestation along with substitution of fossil fuels. Bio-energy and hydropower are also, useful responses for enhancing and strengthening biodiversity and addressing climate change. Resilient ecosystems are more likely to adapt to climate change and climate variability, which is predicted to occur faster during the 21st century than in the past 10,000 years. There will be changes in exotic species and invasive alien species. Some ecosystems are particularly vulnerable to climate change and changes in biodiversity at ecosystem and landscape scale will further change the climate.

Findings show that in the distant past, losses have not been very much. In the recent past extinctions have been significant and the projected rate is alarming. Climate change is one of the critical drivers for this.

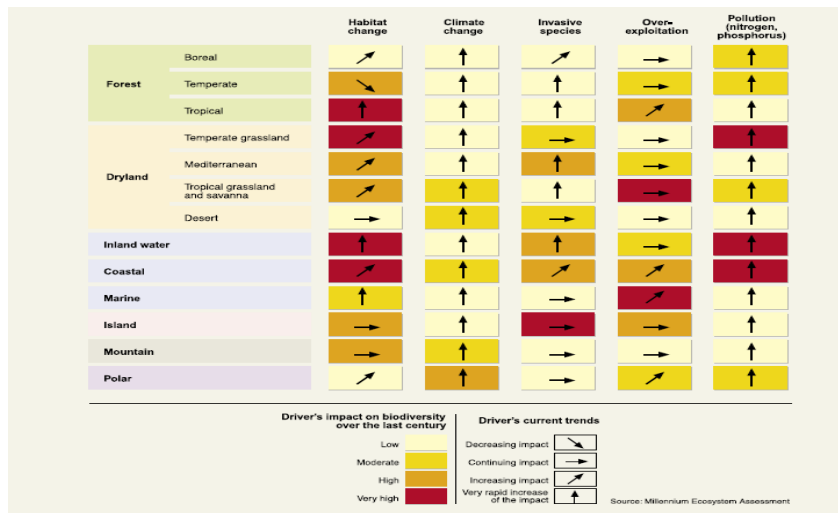


Linkages among Biodiversity, Ecosystem services, and Human Well-Being



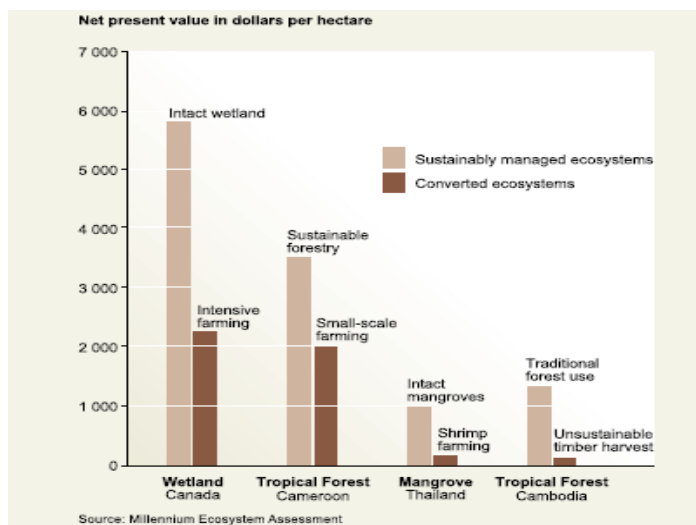
Ecosystem services, which are critically dependent on the richness of biodiversity at all levels, enrich, strengthen and enhance different constituents of well-being. Human well-being consists of physical security, material for a good life, health, good social relations and freedom of choice and action. This is linked to direct and indirect drivers of change. Indirect drivers of change are demographic; economic such as globalization, trade, market and policy frameworks; socio-political which includes governance and institutional frameworks; science and technology; and culture and religion. Direct drivers are changes in land use; introduction or removal of species; technology adaptation and use; external inputs like irrigation; resource consumption; climate change; and natural physical and biological drivers such as volcanoes. These drivers impact biodiversity, which in turn impacts ecosystem services. These linkages exist at the local, national, regional and global levels.

Main causes



This is part of the millennium assessments, which shows that climate change has affected ecosystems.

Approximately 60% or 15 of 24 ecosystem services, evaluated in this assessment, are being degraded or used unsustainably over the past 60 years. These include fisheries, wild foods, wood fuel, genetic resources, bio-chemicals, fresh water, air quality regulation, regional and local climate regulation, erosion regulation, water purification, pest regulation, pollination, natural hazard regulation and spiritual, religious and aesthetic values. The few who have been enhanced are crops, livestock, aquaculture and carbon sequestration.



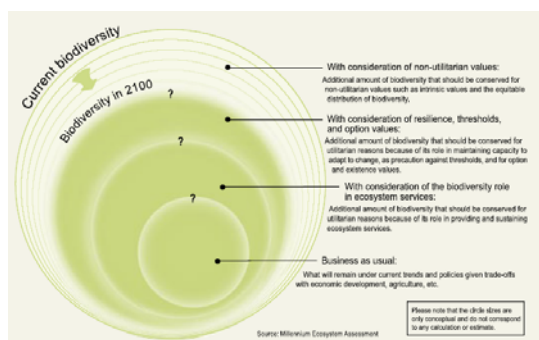
Due to a gap in social and natural phenomena, decision makers do not connect ecosystems services and human well-being. Mangroves and wetlands are being degraded and tropical forests are being destroyed. Lucrative options lead to destruction of ecosystems. The fertile flood plains of the Yamuna River in India have been converted into townships or used for industrial purposes, in the past 50 years. Water recharging is damaged, the capacity for bio-remediation has been degraded and nutrient recycling is no longer possible. The cost benefit analysis of the preservation of flood plains as they are vis-à-vis conversion for development show that the benefit costs are more than 6 times.

Many of the costs of changes in biodiversity have not been factored into decision-making. Costs associated with changes in biodiversity may be slow to become apparent or may be apparent from a distance. These may involve thresholds or changes in stability. All these are difficult to measure. Some

ecosystem services are more difficult to value and many decisions continue to be made in the absence of a detailed analysis of the costs, risks, and benefits. Additional efforts would be required to achieve, by 2010, a significant reduction in the rate of biodiversity loss at all levels. In spite of the targets of the MDG, biodiversity will continue to decline this century, at least in developing countries. However, it is possible to achieve, by 2010, a reduction of the rate of biodiversity loss for certain components or for certain indicators and several of the sub-targets can be met. There are many examples where conservation and sustainable use of biodiversity does work. More progress can be made through better integration into broader development and poverty reduction strategies. There should be greater coherence and synergies among sectoral responses, with a more systematic consideration of trade-offs among ecosystem services along with more equitable and fair access to ecosystem services. Payment for ecosystems has recently, been considered, though the modalities and institutional arrangements may be difficult to arrive at.

Biodiversity loss has dire consequences for many critical constituents of well-being including material wealth, security, health, social relations and the freedom of choice and action. While many have benefited over the last century from conversion of natural ecosystems to human-dominated ecosystems and the exploitation of biodiversity, losses in biodiversity and changes in ecosystem services have caused others

to experience declining well-being, with poverty in some social groups being exacerbated.



This diagram shows the how different considerations can reduce biodiversity loss.

The value of all ecosystem services, not just those bought and sold in the market, must be taken into account when making decisions and integrated into broader development and poverty reduction strategies. There should be a more

systematic consideration of trade-offs among ecosystem services and equitable and fair access to ecosystem services, especially regulating services.

Conservation alone may not be very effective and strengthening responses, with the primary goal of sustainable use, rather than conservation have shown more promise. Therefore, integrated responses that address both conservation and sustainable use need to be strengthened along with those that address direct and indirect drivers and that seek to establish enabling conditions, which are particularly important for biodiversity and ecosystem services. The opportunity exists to harness the synergy among different conventions, such as CBD, UNFCCC, through a transparent and participative decision making process. Ecosystems management and biodiversity conservation have a strong bearing on the success of adaptation strategy and innovative decision making tools and responses that are available should be utilized effectively.

DISCUSSIONS

Dr. Habiba Gitay, WRI

You talked about doing some pilot studies as part of the NATCOM and you can learn from them. Its one of the things I am trying to work on at the global level. Do you have any specific studies in mind and have they started.

Dr. Subodh Sharma, MoEF

We are in the stage of formulating our work. We have indications what is vulnerable. We are going to go further. We have not zeroed down to the state or level but this will evolve. Sometime there will be consultations to define the nature of our work.

Dr. Aggarwal

The insights you showed clearly about the regional model. And one of the things people have done in the past is impact analysis and you have done something similar just to see what would happen if temperature changes by 10 per cent and that was done in Australia and went into the 3rd Assessment Report of IPCC

Prof Pushpam Kumar, IEG

In agriculture there are critical stages and critical timings of those stages that can be affected by climate change and in flowerings and also the seedling establishment and you have the critical issue of heat waves are you doing research that's looking not at just generic crops and what the response would be but what really affects those critical stages what are the climatic pressures, land degradation, fertilizer use and water availability that really affects them and the responses we can develop in terms of adaptation in the short term and medium term.

CBD and UNFCCC have a joint work program and some of the issues are dealing with adaptation and bringing all the agendas and decisions of the different conventions together. During discussions for bringing the IPCC into the CBD process, CBD produced a technical paper adding to what IPCC had done on climate change and biodiversity loss. There is an effort and there are multiple ways which are being explored.

When you start using regional models for time steps there are pitfalls, however regional models are spatially useful and in most studies daily time steps are not required. In forestry, monthly time steps are doing well. Regional models are good though there is a need to continuously improve them. Literature is full of analysis where validation of these types of scenarios has not been carefully thought of. The short time steps of temperature and CO₂ is a traditional method. We have to relate it to climate change scenarios. There are critical stages and in flowering, pollen germination is critical as in this stage it is a single cell. We are screening varieties as part of adaptation strategies. Policy makers are looking only at the short term, however in climate change, sensitivity is not there in the short term and the long term has to be kept in mind.

Dr. Farhana Yamin, IDS

Impacts will be regional in agriculture. Is there research for making adaptation site specific? Is there any training of farmers to train them in adaptation?

Prof Pushpam Kumar, IEG

IARI is a large institution where climate change is one of the priorities and there is a small group working in this area. However, there is a large network in India. Adaptation is site-specific and in agriculture everything is site-specific. There are lots of strategies available for a variety of crops, livestock and fisheries. There is considerable work which is underway and historical evidence which exists.

In the case of future NATCOMs, there is resistance among some developing countries to more detailed work being done. During the process of constructing a large network of institutions and moving towards a more participatory work, do you find the same resistance to detailed guidelines since that has a bearing on the financial assistance available on the completion of the work? The experience from other countries shows that it is a very positive process that has developed a lot of capacity.

We visualize the process of communication is sharing information and developing capacities for which financial resources are required. It is an opportunity to make assessments including adverse impacts. Enhanced guidelines require training, resources and capacity building for more detailed guidelines, to the extent it permits and the convention has agreed to pay the full costs.

Dr. Chatterjee, WII

The destruction of mangroves has resulted in flooding and a huge loss of lives and has your institute done any work which can help farmers who lose their productivity in their land due to salinity and what livelihoods can they diversify to. Mangroves destruction is due to human activity and there is a need for communities to be aware of the benefits of mangroves.

Very little work has been done on mangroves. There is the overall impression that climate change and climate variability is driven by assessments of IPCC and we have to respond to them. We have two NATCOMs. Even if climate parameters are not taken into consideration, India's food security is being questioned. Farmers, in any part of the country, talk only of market and climate. The ground water table is reducing by half a meter every year. Every farmer is using a pump at three times the cost to irrigate their crops. The state is unable to cope and policies and mechanisms are not in place to use the water in a sustainable manner. The farmer feels there are no options. Adaptation science is not being driven by the problems of farmers and this has to be starting point. Capacity building is required to predict the monsoon or modeling, but capacity building is also required for participatory work like scientists working with farmers. Integrated approaches have to be operationalized.

Can incentives for communities help in controlling biodiversity loss?

It can work provided the rights and responsibilities of the local community have to be recognized. It is more of rewarding the local communities for using traditional practices. These communities provide insights into what can work on the ground and rewarding them can work. No policy or mechanism can work if it does not benefit the local communities. In the case of mangroves, one way is to give rights to local communities and the foresters at the state level know the level of protection the mangroves provide and when communities are destroying mangroves, the cost-benefits must be factored out.

Chairperson's Summary

The communications program can be a vehicle to build capacities, networks and databases to improve vulnerability and adaptation assessments. There is significant learning from the initial National communication and assessments will improve in the second and third. There is consensus that to convince policy makers to take proactive measures for strategies and programs, they will need viable assessments of vulnerabilities and impacts in different sectors by projected climate change. After studies in forestry and agriculture, it has been found that a lot of modeling research is required before policy makers can be told that in each part of the region or country what the likely impact on forest regeneration and forest biodiversity will be. There is need for considerable research to convince policy makers to initiate some mitigation and adaptation activities on the ground. It is also important to consider the links between biodiversity, ecosystem services and climate change as degradation of each affects the other. Ultimately degradation of natural resources, biodiversity, soil and water impact human beings. All natural resources are under stress due to increasing population and incorrect policies and climate change will be an added threat to all these resources. Large developing countries need to begin planning as climate change is definitely a problem and planning for it is long process which requires long term research and long term planning. There is a need to promote synergies between addressing current stresses on natural resources, food production and water and adaptation to climate change. There are reports which show how promotion of adaptation has multiple benefits.

SESSION IV

Coping with Extreme Climate Events: Policy Implications

Prof. Joyashree Roy, Jadavpur University, Kolkata

A study, funded by Asia Pacific Network, was conducted in Bangladesh, India, Nepal and Pakistan on integrating climate issues with larger development issues. A framework, adapted from the Millennium Development Goals, was used and it clarified the need to integrate adaptation activity into broader development goals. Well-being was examined, in the context of the multi-dimensional aspects of poverty, which include livelihoods, health, vulnerability to environmental change and participation in decision-making. These were linked to extreme climate events and the effect on environmental sectors such as the natural resource base, access to water and sanitation. The link between access to information about climate variability and extreme events was also examined.

The field survey used a LIFE (Livelihood – employment; Institution – decision making and social capital at the local level; Food – poverty; Empowerment – education, health) approach, which was consistent with sustainable development goals. It used a bottom-up approach and was built up on insights that were based on activities of stakeholders, working on adaptation. It involved field visits, to observe stakeholders and behavioural analysis. Hotspots were identified for the survey, which aimed to understand vulnerability and define coping mechanisms of households and communities. Adaptive actions by households and communities with private motives and those by government and non-government agencies with a social welfare motive, along with infrastructure available, were also examined. A careful analysis led to a portfolio of actions and the means of integrating it into policy, from the climate variability perspective.

The survey related to floods was conducted in Orissa, and the one related to drought was carried out in Gujarat. The selection of hot spots was based on hydrological model results of climate variability and related water availability scenarios, which had been done for India. A district wise map, with representations of population density, intensity of agricultural activity, degree of water stress or abundance and precipitation patterns was used. They were overlaid on each other to identify villages (hotspots) where characteristics intersected. Vulnerable areas and actions taken were examined. A random sample of households in each village was chosen, based on landholding patterns and socio-economic backgrounds.

The flood survey, in the Mahanadi river basin, covered Nandabar, Karabar and Manitiri villages of Nayagarh district, Orissa, The drought survey was carried out in the Sabarmati river basin, covering Sabarkantha and Ahmedabad districts, in Gujarat. Eight villages - two each from the talukas Himmatnagar and Modasa in Sabarkantha and Dholka and Sanand in Ahmedabad were selected. Though the 200 households surveyed was a very small sample, the random selection procedure made it a fairly representative sample and a stakeholder workshop where participants shared their findings validated the study findings.

Vulnerability of the study areas was judged by three component indices representing three sources of vulnerability: threats to livelihood (VIL); food security (VIF); and access to markets (VIM). The assessment showed that flood prone areas are more vulnerable than drought prone areas. Though it may not be possible to generalize, it needs to be determined whether policy level actions will focus more on the flood prone zones as compared to drought prone zones. Similar feedback has been received in the other three countries. This validation could help access to vulnerability funds, across all countries. The results, based on household responses, are a hypothesis for more feed back and more research needs to done.

Using the Life approach and Millennium Development Goals framework, coping capacities were studied, in the context of the diversified occupational pattern, infrastructure, asset base, social capital and indebtedness.

Mahanadi river basin

In the flood-prone Mahanadi river basin, occupations were less diverse and the number of marginal and small farmers was very large. About 80% of the land was used for farming. Education levels were low and education, which is part of social capital, needed infrastructure. Cooking fuel is mainly wood or kerosene. Paddy, sugarcane and vegetables are predominant crops. Short-term coping measures include storing dry food and medicines; working in nearby villages; crop insurance and migration. Long-term strategies include building flood resistant houses and walls around houses; maintaining contingency funds; and purchase of polythene. A flood resistant variety of seeds is provided by the government and is effective for floods, lasting up to 7 days. Since there is no provision of potable water, flood-water is mainly used for drinking. Social capital consists of support from relatives, other villagers and friends in an informal arrangement. They help in providing food, clothing, seeds, building material and loans. Institutional support, from government and non-governmental organizations, works similarly. Insurance is available, though it is not widely used. Crop compensation, loans, supplies of essential items, agricultural input assistance, drinking water, health, compensation and infrastructure, such as transport and healthcare are concerns. Policy needs to address these.

Sabarmati river basin

In the drought-prone Sabarmati river basin, occupations were relatively more diverse. They included agriculture, animal husbandry and agricultural labour. Land holdings were marginal and a large number were landless. Cooking fuel is wood-based and paddy, wheat, maize, cumin seeds, jowar and cotton, are the predominant crops. The villages in the study area are largely, not irrigated. Coping strategies include using savings of cash and fodder; migration; working for the government; selling, mortgaging or leasing property; and selling livestock. About 70 per cent of households receive aid from the state government and about 60 per cent receive aid from other sources. Stakeholder concerns include irrigation, insurance, higher wages, more relief, food, fertilizer and agricultural input assistance. Policy needs to address these.

Policies

Responses show that adaptive capacity building is a complex combination of both, technology and institutional building. Some commonalities were observed in both flood and drought zone, and measures were suggested. These were short term measures to be undertaken at the local level, medium term measures, which are to be undertaken at the community and state level and long term measures which can be undertaken at the national level. The following policy matrix details these.

Policies Specific to Flood Prone Areas

<p>Short –term Local Measures</p>	<ul style="list-style-type: none"> • Safe places • Flood proofing (structural & non-structural) • Water management through appropriate storage and distribution systems to accelerate access to safe water • Food preservation 	<ul style="list-style-type: none"> • Resources to address disease outbreak
<p>Medium –term Community/state level Measures</p>	<ul style="list-style-type: none"> • Phasing out high-risk land use practices • Assessing redistribution of risks from structural measures including dams, diversions and dykes 	<ul style="list-style-type: none"> • Recognising both positive & negative aspects of “floods” • Fostering institutional learning • Investment in public health • Policies to encourage efficient water use
<p>Long –term National Measures</p>	<ul style="list-style-type: none"> • Building for current & future regimes 	<ul style="list-style-type: none"> • Enforcing land-use zoning & building restrictions in flood plains or removing perverse incentives for inappropriate risk-taking or redistributing involuntary risks likely to help for current & future variability • Inter-governmental cooperation on information systems including those related to assessing changes in flood regime due to climate interacting with land-use – residential & agricultural.

Policies Specific to Drought Prone Areas

<p>Short –term Local Measures</p>	<ul style="list-style-type: none"> • Small storage ponds • Low cost irrigation 	<ul style="list-style-type: none"> • Early purchase schemes for livestock at good prices
<p>Medium –term Community/state level Measures</p>	<ul style="list-style-type: none"> • Data dissemination 	<ul style="list-style-type: none"> • Ensuring technological gains are not over-run by increases in intensity of activities (enforced caps on crops/year, land receiving water) • Employing people during drought • Information systems and monitoring to ensure “fair compliance” & allocation at times of scarcity. “Managers” can then do their jobs • Water rights
<p>Long –term National Measures</p>	<ul style="list-style-type: none"> • Improving scientific knowledge, data capability • Investments in R&D in water saving practices and varieties 	<ul style="list-style-type: none"> • Regional water sharing agreements • Water resource development strategies that “take-into-account” variability • Structural changes • Shift towards demand management rather than never-ending strategies of augmenting supply

Time Scale, Coverage & Actor	Technical	Institutional
<i>Policies Common to Flood & Drought Prone Areas</i>		
Short –term Local Measures	<ul style="list-style-type: none"> • Early detection systems of extreme weather events 	<ul style="list-style-type: none"> • Communication of early warning systems • Emergency relief • Public distribution systems. & Food banks • Purchase/mortgage scheme for livestock
Medium –term Community/state level Measures	<ul style="list-style-type: none"> • Diversification of livelihoods through skill formation 	<ul style="list-style-type: none"> • Low interest credit systems • Better education • Yearly joint scientific meetings
Long –term National Measures	<ul style="list-style-type: none"> • Capacity building that transforms livelihood option set • R&D to develop disaster resistant crop strains • R&D to develop alternative cropping patterns • Investments in studying “the diverse” impacts of floods /droughts including impacts on water quality • Investments in rainfall & river monitoring & their modeling 	<ul style="list-style-type: none"> • Media- radio/T.V. programme disseminating information on adaptation measures

Enhancing Adaptive Capacity in Semi-Arid Regions of India

Dr. N. Sai Bhaskar Reddy, AFRO

Vulnerability assessment and enhancing adaptive capacity in semi-arid areas of India is a 4 year programme, conducted in the states of Andhra Pradesh and Rajasthan, in India. It is supported by Swiss Agency for Development and Cooperation (SDC), under the Global Environment Facility (GEF) and is a multi-stakeholder programme with MSSRF as the lead partner and AFPRO and Manage as co-partners. INFRAS and INTERCOOPERATION, Switzerland, provide support services. The programme aims to secure livelihoods of the rural poor and vulnerable communities by promoting adaptive measures that build and enhance their capacity to cope with adverse impacts of climate change. It also promotes disaster preparedness.

The project objectives are to build community level capacities of best practices and technologies in the agriculture, water and energy sector. This is being done by AFPRO. MANAGE will optimize a service delivery system and services at selected sites. The promotion of policy dialogue, and advocacy at different levels, will be undertaken by MSS Research Foundation.

Semi-arid regions have a climate characterized by precipitation that is less than potential evapo-transpiration. It has a relatively low annual rainfall of between 25 to 60 centimeters. The terrain has scrubby vegetation and short, coarse grasses. Climate extremes are a characteristic of semi-arid lands. People living in these areas are particularly vulnerable to droughts, which trigger frequent subsistence crises. These include sharply increasing crop failures, dislocation, famine and poverty, which lead to stratification and social inequities.

Increase in migration in our village is due to lack of rains, the agricultural labor are migrating to urban areas. - Mr. Balaram Reddy, Karimnagar

Adaptive capacity is the ability of institutions, systems, and individuals to adjust to potential damage, to take advantage of opportunities or cope with the consequences. Most populations know, from local history, the frequency and likely consequences of extreme climatic events. They shape their livelihood systems to adapt to potential catastrophes in these zones. Climate extremes are growing in intensity and there is a need to enhance this capacity at all levels.

People are shifting out of agriculture and taking up other means of livelihood activities due to lack of water. In this context food security has become another important issue - Mr. Sheshagiri Rao, Bharat Krishak Samaj Mahabubnagar

UNFCCC addresses mitigation through internal and external measures. The basis of this programme is adaptation through assessment of impacts and vulnerability, capacity building and adaptation measures. The components which are linked are: preparation which includes training and training needs evaluation; vulnerability assessment; and implementation of adaptation measures.

The objectives of policy and advocacy in the programme are to improve communication between all stakeholders and encourage dialogue. The aim is to arrive at a consensus among partners on a common conceptual framework. Linkages will be maintained through policy dialogue at the national and international level. The programme will support processes that influence systems within the government, through a dialogue on an appropriate platform, at the national level. It will support processes that simplify protocols and mechanisms in favor of the poor, internationally. Partners will be provided support for documenting best practices and cases to influence policies.

The process involves national and international partners for selected activities. SDC has a steering committee and a key issue is climate change. At the national level, there is a steering committee constituted with secretaries from the agriculture and environment ministries, NGOs, research institutions, SDC and other donors. At the state level, advisory committees have been formed in both states. The National Forum on Advocacy is networked with other organizations. A vulnerability atlas and a website are underway.

The main feature of the programme is that it is process oriented. This allows a multi-level, learning-action-reflection cycle and has a holistic approach in the context of funds, functionaries and functions towards systemic livelihoods. It will interlink the community level at the state, national, regional and international level, with a focus on optimizing delivery systems at the community level to enhance coping capacity of livelihood systems. Existing delivery systems are very poor and this has been recorded after a situational analysis conducted by MANAGE. Capacities of delivery systems or extension services therefore, have to be built. The three thematic sectors are agriculture with an emphasis on food security; water availability and quality; and rural energy, specifically biomass. Field level interventions will be within a framework, which include capacity building through research, facilitation and actions or any combination of these.

The project is divided into phases and the first is the inception phase from 2005, where the work plan will be finalized. A situational analysis, at the village level, will be done. The implementation phase, between 2006 and 2007, will involve research, action learning and pilot activities at the community level. From 2008, outreach and dissemination will take place. While policy issues have been taken up in 2005, action learning and pilots will result in a policy dialogue.

The scope of activities will include: research on vulnerability profiles, knowledge gaps, appropriate technologies, situational analyses, review of institutional functions and policies and documentation of best practices; and capacity building at the community and institutional level. MANAGE is working at the institutional level to incorporate these issues in to training. Education is aimed at creating awareness. Other activities are partnership building, infrastructure building and demonstration of relevant ideas and technologies.

Mahabubnagar is the second largest district in Andhra Pradesh. It is a drought prone district and is known for migration. It has a geographical area 18.45 lakhs hectares with a male population of 17.81 Lakhs and a female population of 17.28 Lakhs. The literacy level of 38.67%, make it the least literate district in the state. It has a forest area of 16% and normal rainfall of 604 mm. Its cattle population is 19.10 Lakh Cow Units. People are dependent on cattle and other ruminants, as is the case in most drought prone areas. All the blocks are declared as Drought Prone Areas. Analysis has shown that lower rainfall has led to migration rather than coping. The causes of drought situation are: the skewed distribution of rainfall with a 40% deficit from June-August which is the sowing season; depletion of ground water; untimely and heavy rains between September and October which affects crops; and lack of rainfall during November and December which adversely affects rabi, the second crop.

Due to low productivity of lands and small land holdings, disguised unemployment increases vulnerability. The district is traditionally known for its migrant laborers due to non-sustainable traditional occupations and low wage rates with women being paid less. About 1.75 lakhs small farmers and 2.94 lakh marginal farmers are dependent on wage employment, while about 3.20 lakh agricultural laborers, living below the poverty line, are dependent on agricultural wage employment.

The situational analysis, at the village level, in phase – I has been prepared. The situational analysis in phase – 2, involved the community. It used secondary data and recorded best practices and story lines. Participatory situational analysis and bio-physical studies were undertaken. A participatory action plan has been prepared and capacity building is complete.

The framework for situation analysis shows that the factors influencing vulnerability are human and social; natural, environmental and physical; and economic and political.

Intensive awareness campaigns were conducted and villagers are now adopting some practices. Participatory action planning is being carried out. Field visits were made to provide exposure and create awareness among farmers, women and youth. Sustainable agricultural practices, agricultural implements, farm animals, kitchen gardens, food processing, non-farm livelihood options, agro-meteorology information, agri-business, agri-clinics, non-farm based livelihoods have been promoted.

Water Management action plan with community participation is underway.

Earlier villagers were not aware of the quality of the soil. Kits have been developed to enable soil testing to be completed within an hour and village youth have been trained to conduct these tests.

Salinity and other tests are used. Because of continuous drought the soil has become saline and alkaline

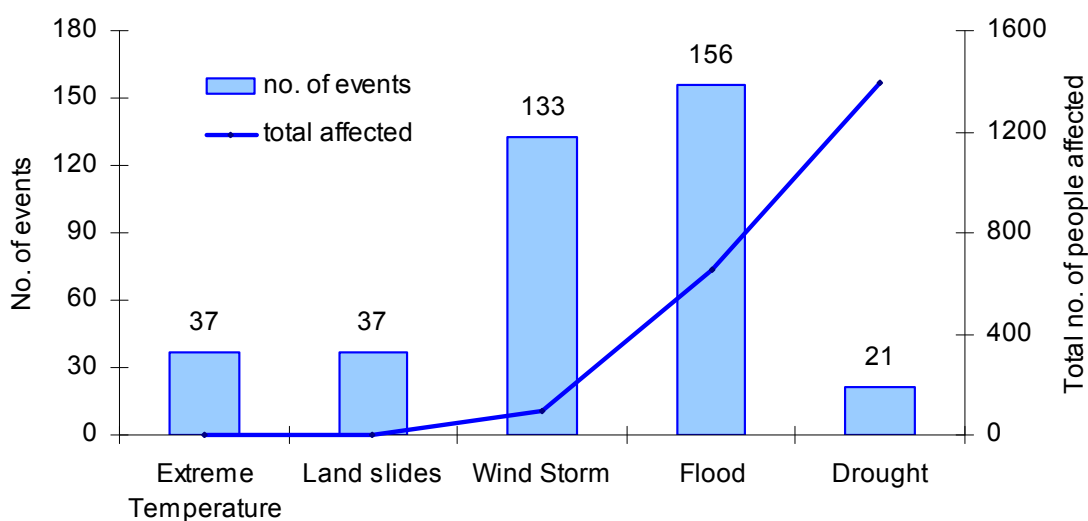
Captions for photos

1. Home gardens provide nutrition and support for the family
2. Very primitive stoves were being used in the study area. The community was involved in developing a new stove. These are called Good Stoves. It has been adopted by the community. This stove has been designed for people cooking with stoves that have two openings. Another stove has been created using local technology and this costs less than Rs.10.00. It converts wood into coal. Cooking is done for 10 people at a time.
3. Low Cost Wood Gas Stoves designed with community participation
4. Village Knowledge Centers Information Knowledge (Locale Specific and Demand Driven)
5. Establishment of Automatic Weather Stations in the Project Villages

Building upon Adaptive capacities for Livelihood Resilience

Ms. Aditi Das, Winrock International India, New Delhi

This work looks at building upon adaptive capacities for livelihood resilience, in arid, semi-arid and flood prone regions, examines risks, vulnerabilities and adaptation strategies in four states. Villages within the most drought prone districts of Rajasthan, Andhra Pradesh and Karnataka were selected along with a flood prone district in Orissa, a state susceptible to cyclones. In India, flood and drought are common events with drought being a perennial feature that affects 19 % of the area and 12 % of the population, annually.



Drought

Droughts occur, on an average, once every 2.5 years in Tamil Nadu, Jammu and Kashmir, Telangana and West Rajasthan; every 3 years in Gujarat, East Rajasthan and Western Uttar Pradesh; and between 4 and 5 years, in other states. In 2002, a severe drought affected 29 % of the area. The major impacts were water availability, agricultural production and hydropower generation. Secondary impacts include a drop in agricultural GDP and increase in commodity prices. In India, 61 % of the area is rain-fed and drought affects livelihoods of people dependent on rain-fed farming, especially marginal farmers and farm workers.

Risks and adaptation

The depletion of water for agriculture, leads to reduction in crop yields and a change in the cropping pattern. The declining income and fodder stock of farmers result in cattle sales at depressed prices, leading to increased incidences of debt. There was a decline in nutrition and health especially, among children and women. An analysis showed that local levels of adaptation were different in all three states. The government institutions and policies to combat droughts are the Central Arid Zone Research Institute (CAZRI); Rural Works Programme; Drought Prone Area Programme (DPAP); CRIDA; Desert Development Programme (DDP), Integrated Watershed Management Programme; and the National Watershed Program for Rainfed Areas (NWSDPRA) covering around 22 million ha. DPAP consists of labor intensive schemes such as medium and minor irrigation, road construction, soil conservation and afforestation. CRIDA disseminates technologies relating to soil management, water harvesting, improved agronomic practices

and drought-resistant crops. The Integrated Watershed Management Programme helps rejuvenate depleted natural resources.

Traditional Coping Strategies

These include: migration (15-30%); sale of land, livestock and other durable assets; reduced intake of food and expenditure; shifting to inferior food grains; and mixed cropping. The government has a food distribution system; employment programmes; and water supply, which includes provision of tankers and facilitates digging wells. At the social level, there is sharing and cooperation; sacrifices by senior members and women of the household; assistance through enhanced community relationships; and exchange programmes. Economic strategies include: borrowing; imports; assistance from family and community; diversification of income; subsidies and grants from NGOs; and relief work.

Modern Coping Strategies

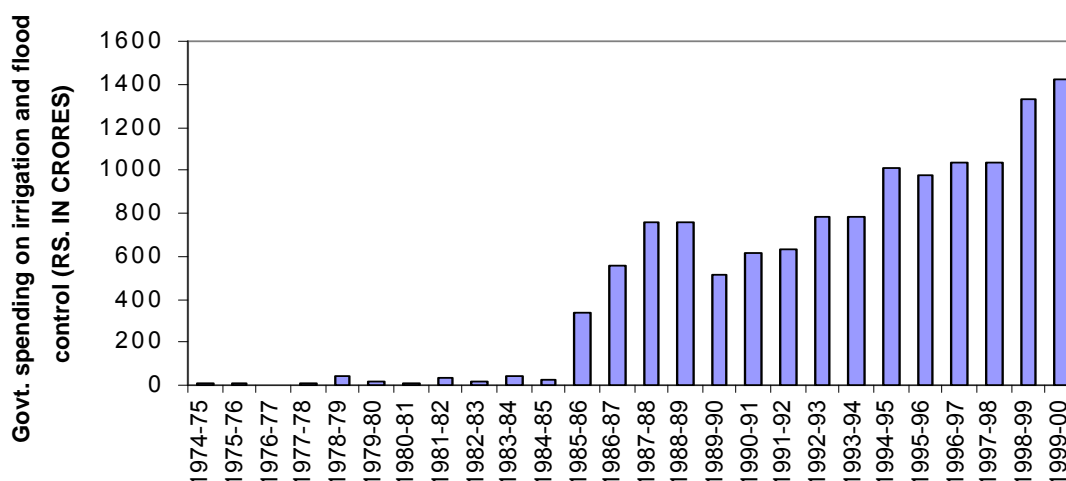
Improved farming techniques include soil and water conservation practices; building farm ponds for storing runoff water; and planting drought resistant varieties of crop provided by State Agriculture Universities. However these measures are not being used widely. Coping strategies for livelihoods include education and skill based diversification of occupations. The livestock ownership pattern has changed from few people owning herds, to almost all households owning a few small animals. The government effort includes area-specific development programs initiated to mitigate poverty.

Conclusion

Marginal, small farmers and the landless are the most vulnerable. Mid-level farmers are also affected by a decline in crop acreage; and fall in the water table and water harvesting structures. These reduce employment opportunities. Both, communities and livestock suffer due to scarcity of food and fodder. The inability to repay loans, from government and the private sector, due to recurrent drought, continuing with existing cropping patterns and the unavailability of drought resistant seeds, also affects medium farmers. Droughts in Rajasthan are managed effectively as it has experienced droughts over a long period. The dominant strategies in drought prone areas are the adoption of mixed farming systems – crop, livestock and agro-forestry, resource conservation and collective sustenance.

Floods

Floods occur frequently and the Gangetic belt is the most affected. West Bengal, Bihar and Orissa are the most flood prone states and the government has significantly increased expenditure to meet the needs of those affected.



Impacts

Marginalised communities are more vulnerable to floods. The impacts are on infrastructure, health, sanitation, water supply, roads, educational institutions and the environment. Individual property, particularly, *kachcha* houses are destroyed, while stored food and other household assets are lost. The poor resort to loans at high rates of interest for survival. There is an increase in water-borne diseases such as cholera, dysentery, typhoid and other gastrointestinal diseases. The healthcare system is ineffective due to its prohibitive cost. Well water and flood water mix. This increases health risks as drinking water is not potable. Women are the most affected, as they lose control over food, fodder, fuel and livestock. In the disaster recovery phase, they are unable to get loans, against lands which are not in their name.

Coping strategies

Since controlling floods is not possible, coping measures are needed. Structural measures undertaken by the government include: construction of storage dams, reservoirs, embankments and drainage structures, as required at suitable locations; raising levels of roads; and constructing houses at higher levels, raising plinth levels and rebuilding mud houses. Non-structural measures are flood forecasting and warning, which are undertaken by the Central Water Commission (CWC). This covers 62 major rivers in 13 States with 157 stations. It permits transmission of flood warnings on a real time basis; post-flood activities for rescue, relief and rehabilitation operations; and encourages people's participation.

Case study in Jagatsinghpur

Measures taken in Jagatsinghpur, Orissa which was the worst affected by floods in 2001.

Heights of embankments raised by 3-4 ft

Repairing of weak points of embankment was taken up by government.

Elevated spots *merdha* were used for immediate shelter for those affected by floods.

Mud houses that were completely washed away were rebuilt on elevated areas.

People stored dry food reserves and essential items before the monsoons.

Different varieties of paddy were sown in flood prone areas which would not be destroyed even if the plant remains under water for 10 days.

Conclusion

The 3 successive disasters that have seriously affected sustainability of livelihoods in Jagatsinghpur, were the Super Cyclone 1999; and floods in 2001 and 2003. Thousands of lives were lost since preparedness was not effective. The areas, most affected by the floods of 2001 and 2003, were the same as those affected by cyclone in 1999. This reflects a gap in disaster preparedness methods. Mechanisms and restoration work undertaken by the government, NGOs and international communities have to extend beyond normal time frames.

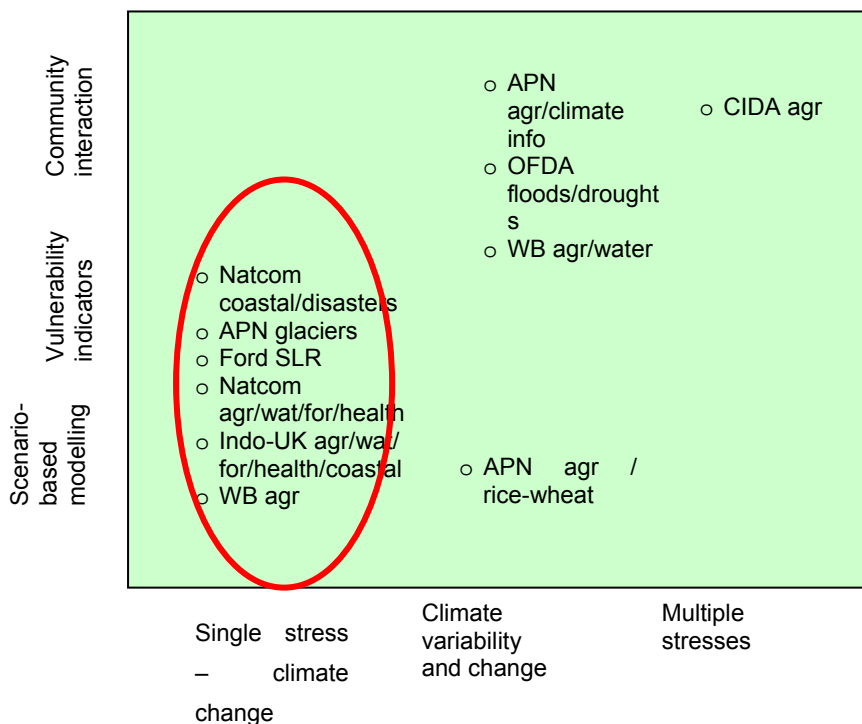
Mainstreaming

Mainstreaming climate change, vulnerability and adaptation need to be done, as climate change over the long term is likely to have impacts that are irreversible. There is a long gestation period required for adaptation, such as developing drought resistant varieties of crops. Since infrastructure is at risk, long-term institutional arrangements are required to manage impacts, at the national and village levels. There is a need to examine different approaches to deal with the expected adverse impacts of climate change.

Addressing vulnerability to climate variability and change: strategies to enhance adaptive capacities

Ms. Suruchi Bhadwal, The Energy and Resources Institute

The Energy and Resources Institute (TERI) reviewed existing studies on coping measures to extreme events, in India. These studies have focused on drought in the states of Rajasthan, Karnataka, Gujarat, Andhra Pradesh and Chattisgarh. Others have focused on floods in Assam, Uttar Pradesh, Bihar and Orissa.



On the X and Y axis, are the various approaches in these studies and stress factors. The studies are mainly based on scenario-based modeling. Some of the studies have carried out vulnerability assessments, to an extent. However there is a dearth of studies that address community based interactive approaches, to assess coping strategies and analyze situations, where adaptive capacities have to be enhanced and what can promote adaptation measures. There has been a tendency to use such studies, instead of using scenario modeling and community based interactive approaches, to address coping

capacities and enhance adaptive capacity, at the local level. In the case of different indicators of stress, the focus was initially on climate change. There has now, been a shift, and climate variability and change are included, as stress factors. There are few studies which look at other multiple stress factors and sectors.

Macro-scale modeling approaches, highlight vulnerable regions across the world, and may help identify vulnerable regions within a country. Micro-scale or case study approaches help understanding of the micro-level dimensions of vulnerability. In one such study, supported by Canadian International Development Agency (CIDA) and Ministry of Foreign Affairs, Government of Norway in coordination with CICERO, IISD, Rutgers University, an attempt was made to consider globalization or economic change as a stress factor along with climate change, and the impacts on agriculture and economic changes, in India. Different elements of vulnerability profiles were considered, at the macro level, and this included developing indices on various aspects including climate sensitivity, trade sensitivity and inherent adaptive capacity, across various regions. An overlay of climate and trade sensitivity with inherent adaptive capacity, showed the extent of vulnerability both, due to climate change vulnerability and globalization vulnerability. And an overlay of these showed regions that are doubly exposed to dual factors, which make regions more vulnerable. This is shown in fig (map slide 6) which shows regions of high and low exposure to globalization.

Different case studies show, that a macro-level exercise can provide an insight, into regions that are more vulnerable and need to be targeted more specifically, for more detailed case studies. These will examine existing coping strategies and determine adaptive capacities that are required to be built, to help communities cope better with climate variability and extremes. There are several measures that can be undertaken at the local level. An example shows that opportunities to diversify actually exist, for those who have good access infrastructure for irrigation rather than for those who do not. Coping capacities in these regions need to be enhanced.

A study for the World Bank aimed to review coping strategies employed by communities in India and assess issues and opportunities for adaptation. The focus of the study was on drought and flood affected regions. It intended to distinguish between temporary, reactive mechanisms and proactive measures for strengthening adaptive capacities, which are linked to development. The study included, assessing effectiveness of coping measures that are being employed and the factors that influencing their effective implementation. This will be followed by identifying measures to enhance adaptive capacities.

Three regions were chosen for the study. The drought prone regions were located in the Pennar Basin, in Andhra Pradesh, and the Godavari Basin, in Maharashtra. A flood prone region in the Mahanadi Basin, in Orissa, was also part of the study, which examined coping strategies adopted by communities. The macro-level component on vulnerability examines two time periods 1991 and 2001 and tries to establish changing vulnerability patterns, and regions which need further studies. Micro-scale or case study approaches highlight, those more vulnerable and the extent of their vulnerability.

Coping options include irrigation, insurance, change in cropping pattern, marketing networks and migration. The awareness of government schemes influence the effectiveness of irrigation, insurance and change in cropping pattern. Education has an effect on irrigation, insurance and marketing networks. Land holding size influences irrigation and change in crop patterns. Community organisations such as SHGs, PRIs and NGOs influence irrigation and marketing networks. Micro-scale studies show that adaptive capacity, at the local level, is influenced by physical factors such as cropping pattern; crop diversification or shift to resistant varieties or tolerant crops. It is also influenced by socio-economic factors such as: asset ownership which includes land, house, cattle, pump sets, tractors, tillers and threshers; access to public goods and facilities such as banking, education and health services; infrastructural support including irrigation, markets and proper communication network; and alternative employment options.

A summary of findings of a case study show, that coping measures may be proactive or reactive. Reactive coping includes change in cropping intensity; credit and loans; and shifting cattle and households. Proactive coping, which is more permanent, includes diversification to non-vulnerable income sources such as aquaculture and using tolerant crop varieties; house adaptation platforms; insurance; and access to government programs.

During the study in Orissa, villagers in the area suggested the priority of interventions and these are shown in Fig No. They have policy linkages at the local level.

Rank	Respondents Priorities
1	Construction of embankment
2	Desiltation of drainage channels
3	Repairment of breaches along embankments
4	Safe drinking water/ food availability/ health
5	Flood shelter on upland
6	Construction of multipurpose dams
7	Easy access to boats and nets
8	Reconstruction of rehabilitation units

During the case study in Maharashtra, developments in the last 15 years show that watershed activities include soil conservation initiatives that were introduced uphill, by the village head and undertaken by the community, with no government assistance. This is drought prone zone with no irrigation. Most villagers were not

supportive of this activity, initially. The activities include digging trenches to control soil erosion and increase fertility. Construction and restoration of tanks began and the process for building large and small tanks for, simultaneous, storage and recharge began 15 years ago. The tanks were located downhill, one after the other, in series. The results which accrue are: reduced run-off, increased recharge rates, increase in water tables and recharge of open wells; community investments and other bilateral investments for soil conservation efforts and development of tanks were started; the water table, available for irrigation, has risen from 250 feet to between 40 and 50 feet; checking of outward migration; and generation of other income generating opportunities, such as rearing poultry and livestock.

The change in village structure has enabled proper planning and execution of plans and programmes in the village. They have set up an NGO, in the village, and villagers are members. Development activities have increased and these include education and health centres, among others. Villagers have introduced restrictions in water usage according to crop plans. They have shifted from sugarcane to less water intensive crops, such as onions, groundnuts and maize. These are economically viable and two crops are sown in a year. Crops are chosen based on an annual review of rainfall. The village has a very clear outline of its response. Strong and purposive leadership in the village has brought about a transformation. It has enhanced the resilience of communities and they are able to cope, even during drought years. Similar successful initiatives are those of Tarun Bhagat Sangh and initiatives by Ana Hazare in Raley Gaon Sidhi. There is a need to understand the processes and factors, which influence these measures at the local level.

There are varying degrees of vulnerability at the national, state, district, village and household level. Policy formulation must recognise the differentials. Learning's from community initiatives and successful government initiatives in Maharashtra need to be adopted. Participatory irrigation management, where the farmers decide the cropping pattern, has been successful. Conditions for replication at different levels need to be critically analysed, as socio-political issues vary across the country. There is a need to synergise with different government policies, for different purposes for to enhance capacities. SGSY is a program for income diversification. Bharat Nirmaan is for rural development. IWDP and DPAP address drought.

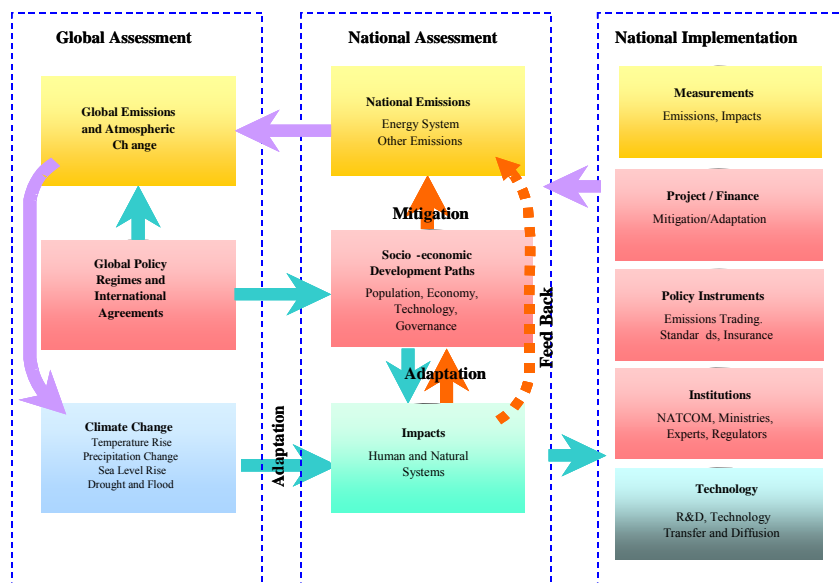
A Development Perspective of Impacts and Adaptation for Human Settlements, Energy and Industry

Dr. Manmohan Kapshe, Maulana Azad National Institute of Technology, Bhopal

In India, few impact studies have been done, in the last 5 years, and adaptation studies are fewer. The regional diversity and geographical differences make it difficult to arrive at a common framework for impact assessment and adaptation strategies. Most impact assessments are sectoral in nature. It is difficult to integrate studies such as agricultural or coastal assessments as it is difficult to convert economic damages, in individual sectors, into economic indicators.

There is a limited capability to characterize and parameterize long term interactions between the economy, society and environment. Studies of climate change impacts are normally, restricted to a place, at a particular time. They do not have a long-term perspective and are based on assumptions that are derived from developed world perspectives. The inability to characterize discontinuities and extreme events; weak behavioral interfaces; and the distance between analysts and policy makers are other limitations.

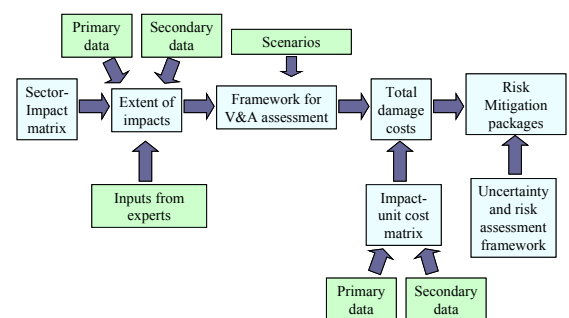
National Level Integrated Framework



The National Level Integrated Framework uses global and national assessments. These include studies on adaptation and mitigation, for NATCOM.

The analytical framework, used in a study of the energy sector to develop a sector impact matrix, used primary and secondary data along with inputs from experts in the field, to determine the extent of impacts. FRA scenarios and later, scenarios those developed for Indian conditions were used to arrive at a suitable vulnerability and adaptation framework. The impact-unit cost matrix, which factors in change of unit costs under different climate parameters, was used to calculate costs of damage.

This may not be feasible in all studies. Linking impacts to climate variability was necessary to arrive at the economic cost. The uncertainties and risks that exist in each sector were examined to arrive at risk



mitigation packages. These adaptive strategies could be used, along with insurance, if available, in other sectors.

Major projects have environmental impacts. A case study of the Konkan Railways used an innovative approach to develop a sector matrix. A reverse impact matrix was developed which had environmental variables and project components. The study aimed to find the effect of one on the other and their interaction. A qualitative analysis was undertaken, along with the Konkan Railway officials, to find out how changes in climate parameters such as temperature, rainfall, sea level rise or extreme events would affect project components. Rainfall caused landslides, and was of concern as there was a link between traffic volume and landslides. The only possible tool was maintenance. The probability of landslides, increased if rainfall exceeded 200 mm in 24 hours, due to the geology of the region. Since 200 mm of rainfall was established as a parameter, the creation of infrastructure to withstand higher rainfall or variability and reduce landslides, had to be examined. An increase in the mean number of days with 200 mm of rainfall or in the variability made the system more vulnerable. Currently 20% of repair and maintenance costs are for tracks, tunnels and bridges. These are due to climate related reasons. An accident on 21st June 2003 night, resulting in over 50 deaths, was caused by a landslide. Consequent to the accident, the maximum permissible speed of trains was reduced from 120 Km/h to 75 Km/h. Traffic has been disrupted for an average of 5 to 7 days, annually. This has decreased after 120 vulnerable spots were identified and a mechanism for early warning was installed. *Raksha Dhaga* is a thread which communicates movement of rocks or landslides, after which maintenance work begins. This proves that non-technological mechanisms can work effectively.

Present vulnerable regions in the northern zone. This is the caption. Rainfall patterns show that such events are likely to occur more frequently and with higher intensity, in the future.



During a study of the building sector and air-conditioning, a hundred year modeling showed that impacts of climate change on energy capacity would not be severe. The increase in demand for cooling would be compensated by the reduction in demand for heating, in Northern India. The additional energy demand will be 13 GW over the normal projections in 2100. Electricity demand will increase by 64 TWh in 2100 due to the building, irrigation and transport sectors. The energy mix will remain unaltered and will continue to be mainly coal-based. As energy is derived from coal, emissions will increase. In 2100, carbon emissions will increase by 13.5 million ton, especially in the power and transport sectors. The cumulative increase of emissions will be 710 MT.

There are also, uncertainties in socio-economic factors, such as population growth, urbanization and economic and social development. Fertility and mortality rates across the region are rapidly changing. Natural disasters such as cyclones, floods and droughts result in migration, which is an important parameter for impacts of population. The high rate of urbanization is causing pressure on existing infrastructure. There is a change in energy resource use pattern with an increase in transportation and air-conditioning. The level of economic and social development varies due to regional diversity.

There are commonalities in the settlements, energy and industry sectors. Impacts are directly associated with climatic extremes, rather than averages. Coping with gradual changes has been observed. Abrupt climate changes are not anticipated by normal response planning and only normal climatic changes are taken into account. The impacts are substantively different for developed or industrialized regions and less

developed regions. The negative impacts of climate change pose risks of higher economic damages, in developed or industrialized areas. There are higher human damages, in less developed areas. In human settlements, flooding causes destruction of infrastructure, in rich areas and loss of lives in poor areas.

Studies have shown that adaptation strategies include: facilities and linkages against extreme weather-related events; contingency planning such as stockpiling; changes in financial mechanisms to increase resiliency; increased efficiencies in thermal conditioning, specially in buildings and automobiles; relocation and industrial restructuring; and planning for likely increase in energy demands. Adaptation by industry will be associated with marginal adjustments to changes in climatic parameters. Security of transportation and other linked infrastructure along with risk financing and mitigation are also adaptation measures.

The conventional perception was that development was a threat to climate and climate change was a barrier to development. This has changed and it is recognized that pathways that achieve national development goals are climate-friendly and development is the driving force for addressing climate change challenges.

Climate policies and actions need to be driven by national development targets and agreed goals, within existing international agreements. Development and climate frontiers must be extended through innovation in: technology and institutions; regional cooperation; targeted technology and investment flows which are a constraint for developing countries; and alignment of stakeholder interests.

Managing transition must consider changes in: socio-economics indicators such as urban or rural; gender ratio; migration; and life styles. It must also consider development indicators such as income, equity, literacy, health infrastructure, housing, vehicles and appliances. Changes in political systems including institutions, laws and policies must also, be taken into account. In the energy sector, there will be changes in the supply side of fossil fuels which include conventional fuels such as coal, gas and oil along with unconventional fuels such as oil and gas. There will be changes in renewable energy, bio-technology and solar energy. Large hydropower units with multi-purpose schemes and nuclear power, which includes fission with zero waste and fusion, must be taken into account. Changes on the demand side will include efficient appliances, substitutions such as information for transport and advanced technologies such as fuel-cell, storage, hydrogen, economy and bio- engineering. Technology for adaptation includes logistics, such as pipelines; transmission and distribution of electricity and decentralized utilities; and information like wireless and nanotechnology. Consumption and life-style changes include conservation such as substitutions and recycling; city planning, architecture and building codes; and sustainable habits or traditional practices. At the environmental level, awareness through pressure groups; income-effects such as Kuznets phenomenon; laws and regulations including global agreements and national policies; and technology such as zero-effluent processes and recycling processes, must be evaluated.

The key issues are: contribution of development to mitigation impact and adaptation policy; linkages of impacts and adaptation across sectors; impact of mitigation on the energy system, an example is coal; co-benefits of different emission mitigation pathways; the water-energy-food nexus; role of development policies to enhance adaptive capacities; adaptation to continuous change and extreme events; risk and uncertainty assessments; the role of technologies; the role of economic instruments such as insurance which moves towards a climate focus like crop insurance; and institutional mechanisms, such as communities, civil society and government.

There is a need to: identify critical needs for policy formulation in the local context as specific areas have specific needs; customize local legal and policy frameworks; study the level of exposure to climate change

impacts and to establish thresholds; examine economic indicators of damages and costs; develop an analysis framework, to work as broad guideline, with the flexibility to accommodate situation specific changes, since this makes integration possible; develop a community response mechanism; and internalize adaptation approaches in development processes for effective implementation.

DISCUSSIONS

Dr. Chatterjee, WII

There are a number of policies in India at the national, state, district and panchayat levels, though there is the capacity to implement these policies is lacking. This applies to other environmental issues which have been implemented after interventions by the judiciary. Capacities need to be developed so that policies formulated from practices are implemented effectively. Policies alone will not help; an enabling environment is required for effective implementation.

Four presentations were based on surveys. In Coping with Extreme Climate Events: Policy Implications, class difference in terms of land ownership and how these affect vulnerability were stated unlike the others which made no references to class, cast and gender differences. These presentations have not included all the results and have used land-holding as the criteria for vulnerability analysis. In the TERI study, the sample did not cover the lower income groups, alone as this alone would not be representative of the whole village. Random sampling was based on land-holding with a focus on marginal small farmers and the landless. Caste is very relevant in Andhra Pradesh and is reflected in food intake and educational impacts as the child who leaves school first, is determined by gender. These have been included in the study, though not in the presentation. While policies do require an enabling environment, it is equally important for enabling mechanisms and supporting market structures. In Gujarat there are strong milk cooperatives and milk marketing federations, which play a key role in facilitating adaptive capacity. The report on the study in of the Sabarmati and Mahanadi river basins is ready. Two issues of Science and Culture have published details of most of the study. The public distribution system, which has been included in the study, is considered very important.

In the Sabarmati River Basin people have better coping capacities than in the Mahanadi River Basin the better coping capacities in the less vulnerable Sabarmati River Basin was the starting point. An explanation could be the coping capacity better which are observed later in different indicators. There is a need to be careful in the selection of indicators for vulnerability assessment. Indicators such as deaths due to floods are not applicable in drought prone areas. However more research needs to be carried out to decide on indicators and the possibility of a common measurement framework, which will enable comparisons of different studies, perhaps through a checklist. The criteria used in the TERI study have considered impacts of the frequency and intensity of extreme event and how these are changing. This is important when you consider the vulnerability of the site. There has been no comparison made between sites as they were chosen due to their vulnerability to droughts or floods and as both frequency and intensity of these are changing in the study area. These mapping exercises and tools give you a broad indication of hotspots. The physical site identification process proved that macro level data from the census is not truly representative of the ground reality. Even within a district there are differentials such as villages downstream are more vulnerable and this sampling was carried out, in the World Bank study. Differentials were included within overall vulnerability indicators. The link between micro and macro is important.

There is a need to link adaptive capacities and adaptation strategies to existing policies. There are numerous policies being implemented and some which are not being implemented so well, in different areas, some with more difficulties than others. There are mechanisms, schemes and public funds allocated to address these difficulties. Case studies to identify vulnerability, potential coping mechanisms and adaptation capacity, need to examine existing schemes and how to make best use of these. Good estimates alone are not enough, interventions either by government or NGOs need to be examined to establish whether the design of the policy is flawed and if this is due to design at the district headquarters

or the state capital, delivery, implementing institution or technology transfer. Political is also important as some areas receive more attention than others. This is what micro-studies have to establish since implementation, policies and monitoring varies and these have to be linked. There are many schemes including those for employment and food security and perhaps, very little money goes to each. There may be too many schemes with overlapping objectives and these may need to be strengthened or merged for better focus.

Chairperson's Summary

The awareness of policy makers to include climate change as a dimension while formulating policies and the enabling environment is very important. Some communities have taken charge of their own destinies and have proved to be more successful than top-down policy intervention. The climate change community has to integrate better with the development community and also the disaster management community. Some progress is being made in this area and this has to be strengthened. Each policy maker is interested in the financial implications of adaptation measures and cost effectiveness and studies have to address this issue to compel policy makers to recognize this as an emergent issue which needs to be addressed in his policy making exercise.

SESSION V

Adaptation to Climate Change: the Outlook in Brazil

Dr. Luiz Gylvan Meira Filho, Institute for Advanced Studies, University of São Paulo

There is a time lag between emissions of GHGs and the maximum climate change. This time lag is between 40 and 50 years for carbon dioxide and nitrous oxide; and 20 years for methane, approximately. The same is true for emission reductions; even drastic emission reductions today will only decrease climate change 40-50 years from now. It follows that, in order to decrease the magnitude of damages caused by climate change, it will be necessary to adapt to it and this has nothing to do with international negotiations. Adaptation is one option of response to climate change. The three others are: inaction which will lead to damages; adaptation, when possible; and mitigation. The optimal decision will be a combination of these. All countries rule out inaction. Adaptation and mitigation are necessary because we cannot change energy use overnight. Therefore, the best possible combination must be found and this requires countries to define their national interests. To arrive at the national interest, discussions within the society are needed. It cannot be a bureaucratic decision. The IPCC and international negotiations deal fundamentally with the sharing of burden for damages, adaptation costs and mitigation measures. This is in addition to capacity building and sharing of experience. It must be decided who pays for the damages and the burden of mitigation efforts in addition to capacity building and sharing of experiences. However, the treaty fundamentally deals with negotiations, which decide the part of the burden on each country. The physical fact remains that the atmosphere sees total emissions, and while it is not possible for some countries to mitigate these effects, it is possible for some to adapt. This needs consensus among countries. This is the context in which climate change is relevant at all levels, including negotiations.

Brazil covers an area of 8.5 million sq meters, has less than 200 million inhabitants and large forests. It uses very clean energy based on hydropower and ethanol. Bio-diesel is a new source. Iron and steel are manufactured with renewable charcoal. Normally coke is made from coal, but in Brazil, eucalyptus is used. It can also be made from elephant grass and bamboo.

The key aspects of adaptation in Brazil are that it is fundamentally not possible, in many cases, as the impacts of climate change are on unique and sensitive natural ecosystems. The need is to develop better forecasts of regional climate change. Climate change must be included in short-term predictions, with an emphasis on adaptation in the agriculture and water resources sector. The Center for Weather Prediction and Climate Studies (CPTEC) was established with the help of the Institute for Tropical Meteorology, Pune, in the 1970s, in Cachoeira Paulista and does some modeling. The Chinese Meteorological Agency is doing similar work. Simulation shows that replacement of Amazonian forests with pastures, in South America, will release 60 gigatons of carbon, and this is equivalent to about 10 years of emissions. The centre has studied the regional effect of climate change upon precipitation in the Amazonian basin. In Brazil precipitation is due to evapotranspiration. Half the water comes from elsewhere. This is based on the forest size and is also hydrological. If this effect is reduced, there is less water to transpire. As climate changes, there will be a decrease of precipitation, in the eastern portion of the Brazilian Amazonian forest. The tendency will be for the edges of the forest to move towards a savannah type of vegetation and since the time scales for this shift are relatively short, adaptation will not be possible. There will also be biodiversity loss.

The change in precipitation regimes will change the levels of waters in all the river basins. This is particularly relevant to a country, which generates all its electricity from hydropower. Hydropower plant designs have a basis in statistics, on water flow and precipitation. These changes need to be taken into account to optimize planning and operation of hydro-electrical power plants.

The research community is taking an interest in climate change in the agricultural sector, with a view to developing varieties that will adapt better to the changing climate. In the health sector many studies on malaria have shown that adaptation measures are difficult.

Northern Brazil is semi-arid and has the highest relative inter-annual variability of precipitation in the world. The result is a quasi-periodic drought and the population is ill-equipped to cope with climate change. Adaptation may become more difficult and an increase of predictive capacity is essential, to maximize possibilities of adaptation. The tragedy of New Orleans shows that though predictions were made, the community did not react. However, improved predictions are not sufficient, as it is very difficult to separate adaptation to natural climate variability from adaptation to climate change. This is because climate is the statistics of the variables that describe the actual state of the atmosphere.

Who will pay for adaptation and its quantification, costs impacts and cost of adaptation measures is a policy issue. For rational decision making the estimates of costs associated with impacts of climate change and with adaptation measures are essential. These must be compared with the costs of mitigation. The distribution of the costs is also important. Brazil is not as active as India in the adaptation area in negotiations.

Vulnerability and Adaptation assessments in China

Dr. Wei Xiong, Dr. Yue Lin, Dr. Erda Lin, Institute of Environment and Sustainable Development in Agriculture, Chinese Academy of Agricultural Sciences

Background

China began to assess the impacts of and vulnerability and adaptation to climate change since 1990, and studies were concentrated on four areas, which were closely linked to the economy. These were water resources, agriculture, terrestrial ecosystems and coastal zones. It was decided that international and national cooperation was needed to resolve issues related to climate change. The National Coordination Committee on Climate Change (NCCC) was established to deal with these issues and consisted of members from 12 ministries including National Development and Reform Commission (NDRC), Ministry of Foreign Affairs of China (MFPRC), Ministry of Agriculture of China (MOA), Ministry of Finance of China (MOF), China Meteorological Administration (CMA), State of Environmental Protection Administration (ZHB) and Ministry Of Sciences and Technology (MOST). Climate change research and projects, which were carried out by research organizations belonging to member ministries, were mainly funded by MOST. Some were funded by international agencies. These included a climate scenarios training, held in the Huang Mountains for members of the national and local government, and institutions. There was also, a climate change capacity building conference in Lijiang, Yun Nan, where experts and policy makers from Canada, UK, USA and China participated.

Methods and tools

The methods used were a top-down approach of using climate change scenarios, to develop models and other ways, which would allow the impacts of climate change to be examined. This would help understanding sensitivity of sectors and their vulnerability to climate change. This enabled an integrated assessment of sectors to climate change. Some bottom-up approaches for adaptation, and the potential capacity for adaptation, were studied in this context.

Tools

Observation and experiments

Observation; and practical experiments for sensitivity and analogies were among the many experiments conducted. These included: different types of field management for GHG emissions and crop yield; climate change in the last 1,000 years in China; experiments in response of rice to warming and high carbon dioxide levels; and recording climatic and environmental data of the Guliya ice cap.

Indicators and GIS

Studies used agro-climatic indicators for the geographic shift to establish the safe northern limit for winter wheat, in Northeast China, in the next 50 years. Indicators were also used for vulnerability of water resources.

Statistical Models and Expert Estimation

These used historical data, references and statistics to conclude the relationship between climate and the system; and deduce the impacts of future climate impacts, on the system. This method has been used often in China. Experts also, developed adaptation options for each location and situation. This method helped to obtain weighted indicators. .

Process-based Models

A number of models have been used to assess the impacts of climate change and adaptation. These include: Dssat – crop model, a decision support system for technology transfer; APSIM –crop model; CEVSA ecosystem model; and VIC hydrological model. There were 3 stages of simulations of vulnerability and adaptation. In the first, static GCMs were used along with stochastic weather generators, to simulate the impacts of climate change. Slide 11 shows crop changes in different scenarios. During the second stage, the Transient General Circulation Models (GCMs) were used with different CO2 emission scenarios by stochastic weather generators, to assess impacts of climate change and vulnerability. Slide 12 shows inundated flood areas under different scenarios in North China, and how enhancement of infrastructure reduces vulnerability. During the third stage, a Regional Climate Model (RCM) – PRECIS and Model were used to assess the impacts and adaptation under IPCC, SRES scenarios and slide 13 shows wheat yield change in 2050s under A2 scenarios, frequency of drought in 2080s under B2 scenarios, NEP distribution in 2080s under B2 scenarios and runoff in 2080s under A2 scenarios. The different models were then, combined with indicators, for sensitivity and vulnerability analysis. The classification method used water availability and population, to classify the sensitivity of wheat to climate change.

Vulnerability value = yield change rate× water availability factor× GDP factor × population factor× other factors

Classification of the vulnerability of wheat to climate change

Vulnerability	Highly vulnerable	Moderately vulnerable	Slightly vulnerable	Not vulnerable
Yield change rate	Yield reduction >20%	Yield reduction 10%~20%	Yield reduction <10%	No yield reduction

Economic Models

One model was based on research on costs and economic consequences, of the changed climate, in agriculture. Another was a data analysis model of climate change, grain prices and international trade. The third was an economic input-output models, in combination with assumptions of climate change. The fourth used mathematical models to assess the costs of climate policy and adaptation options.

Apart for studies of the four sectors, the SPUR 2 model was used, for simulation of over-ground biomass and livestock weight, under climate change scenarios. The over-ground biomass will increase by 13.3% and 23.1% under GFDL and UKMOH climate change scenarios, respectively. The livestock weight will also increase by 4.7% and 5.2%, under these two scenarios. The values decrease by 3% for over-ground biomass, and by 8.8% for livestock weight, under MPI climate change scenarios.

For the vulnerable natural ecosystem, the IMAGE, Holdridge, GREEN models were used to conclude what impacts would be on natural ecosystem, such as forests and grasslands; Tibet; lakes and wetlands; and the panda population, under different climate change scenarios.



IGSNRR, CAS, 1998



Yan C.R., 2004, CAAS, CAS



Mangrove ecosystem, CRAES



Coral ecosystem, HAU

In the integrated assessment climate change, for rice pests (*chilo suppressalis*), and rice production, three GCMs scenarios – HadCM2, ECHAM4, MaxPI – were used. The CERES-Rice crop (*Chilo suppressalis* Walker) CSW model was used to assess rice production, under different climate scenarios, and different pest population scenarios. Pest population will increase due to climate change, and combined with higher temperature, will result in a decrease of rice yield by 8%~25%.

In an integrated assessment of the agricultural water cycle and agricultural production in China, crop yield based estimates suggest production increases are possible because of warming and CO₂ enrichment. But the expected moisture deficit indicates that there are serious threats to the stability and adaptability of China's food production system. The change of agricultural water resources associated with climate change, and their implications for agricultural production are of concern.

Socio-economic scenarios show primary energy demand, will continue to be coal-based. New energy sources, including hydro-electricity and nuclear power, will be developed. Arable land area will decrease due to population growth, urbanization and economic development. Grain supply and ecology will be causes of concern. Technological advancements will increase grain yield, though the rate will be lower than in the previous 50 year period. A gap between grain supply and demand will begin to emerge from 2010. Around 2040, this gap is estimated to be 77 million tons or about 11.7% of the total demand.

Challenges

1. Calibration and validation of models is important for vulnerability and adaptation, and extreme events. Most have been introduced by developed countries and are unsuitable for Chinese environments. There is a need for standard models, calibration and validation manuals or methods to reduce uncertainties. Quantitative criteria for calibration and validation of models, needs to be established.

2. The assessment of extreme events and climate disasters is influenced by extreme events, rather than mean climate change. There is no effective method or tools to address this.

3. There are uncertainties in climate change and socio-economic scenarios; and models such as CO₂ fertilization effect. Uncertainties include agricultural policy, international trade, price and technology improvement, along with scale and data processing.

4. The natural and social dimensions of climate change makes it difficult to determine whether impacts are due to climate change or human activities. It is necessary to integrate human factors into vulnerability and adaptation assessment, particularly adaptation assessment.

5. Adaptation measures are qualitative and not practical. These are restricted to measures, such as conservation of water in agriculture and cultivating disease-and pest-resistant varieties, even in IPCC reports. Performance and cost-benefit analysis have not been done and options, often do not relate to local situations.

The way forward is an integrated assessment, where vulnerability and adaptation assessments are incorporated into sustainable development of the region. This must include mitigation of greenhouse gases, which requires more international cooperation.

Adaptation Experiences in South Africa

Ms. Lwandle Mqadi, SouthSouthNorth Group

South Africa has the most sophisticated free-market economy in the African continent. Though it occupies only 3% of the continent's surface area, it accounts for approximately 40% of industrial output, 25% of Gross Domestic Product (GDP), over half of generated electricity and 45% of mineral production. At the same time, South Africa has one of the most unequal societies in the world. This is a major development challenge for South Africa. In South Africa there are a lot of areas called townships, which are similar to slums in Brazil.

Appendix A – map of South Africa with major cities and an economic overview



The major programmes are the Reconstruction and Development Plan and the Anti-poverty Programme, which addresses land reform and food security through the Integrated Sustainable Rural Development Strategy (ISRDP) and infrastructure development and service delivery through the Urban Renewal Programme (URP). South Africa has a national, provincial and local government. Within local government, issues of sustainable development are addressed by the Integrated Development Plan which integrates the ISRDP and the URP. All environmental policies such as NEMA, Water Act, Air Quality and Disaster Management Act, are implemented within these programmes. These environmental policies are considered to be very good and indicate that climate change and adaptation can be integrated into development strategies. However, implementation, so far, has been difficult.

In response to climate change predictions, the 1st National Communications has been submitted to the UNFCCC and preparations for the second are underway. There is also intensive climate change research aimed at improving climate forecasts and predicting impacts within the water, agriculture, biodiversity and health sectors. The reason for the focus on these sectors is that they are key vulnerable sectors, as the Initial National Communications had highlighted. The 1st National Communications identified issues and the National Climate Change Response Strategy (NCCRS) was launched in 2004 to address these. This strategy has provided a comprehensive framework for dealing with climate change issues in South Africa. Within this strategy, principles were outlined to guide South Africa's response to climate change and they are consistent with national priorities and strategies on sustainable development, which implicitly includes adaptation.

As part of current policy initiatives the Departments of Agriculture and Water Affairs and Forestry are developing a climate change response strategy. Local authorities are initiating climate change adaptation plans and strategies as part of the Integrated Development Plans.

Some of the learnings at the policy level are: that key national and local developmental programmes have focused mostly on provision of infrastructure for basic services, in both rural and urban areas; integration of climate change, as part of service delivery using current developmental strategies is crucial; and bottom-up solutions and opportunities for the integration of climate change risk management, at the household level, still need to be prioritised.

South South North Group (SSN) is trying to ensure that all good policies at the national level shift to local levels. It is currently developing a methodology for identifying community-based activities for adaptation to climate change. Community based projects in the urban and rural water sector; and the agricultural sector have been identified and are under development. The main aims of the SSN programme are to develop and apply a generic methodology for identifying, designing and implementing Community Based Adaptation (CBA) Projects; establish partnerships with various stakeholders; and develop robust methodologies to evaluate and monitor overall project development processes. Stakeholders include non-governmental organizations; community based organizations; research institutions with a focus on climate change science, which are willing to disseminate their work to local levels, and also learn at this level; local authorities, who are essential for implementation; and other a range of specialists.

These CBA initiatives are driven by understanding of climate change; vulnerability and climate change; adaptation to climate change; adaptive capacity and sustainable livelihoods; poverty and poverty alleviation, and whether development strategies are working; and the sustainability of community-based projects in the context of South Africa.

First mapping of climate change in vulnerable regions/areas was carried out. This was done on the basis of the UNFCCC, IPCC's Third Assessment Report, Regional Level Impact Assessment Report and Country Level Impact (Vulnerability and Adaptation) Assessment Report. However, interpretation was difficult, as the information was not user-friendly for policy makers and those working on the ground. The next step was mapping poverty at national and sub-national levels, across socio-economic and occupational groups, using existing country level data sets and census figures. The aim was to understand poverty at all levels. Available information showed a lack of strong linkages between poverty issues and environmental issues. This may be true all over the world. This was followed by overlaying climate change and poverty to select hotspots with the highest rates of poverty, to predict the effect of climate change. After this, potential project partners were selected from the hotspots. Institutional mapping was done to find out who was working in the area and what was being done. It also enabled SSN to match information collected and work on the ground; and whether people knew what was being done. This information was shared with partners for conceptualization of possible CBA Projects through Project Identification Notes (PINs). A range of potential project activities were formulated.

The project design needed the perceptions of the community on the vulnerability assessment exercise, in the context of the sustainable livelihood framework analysis. This included an understanding of local perceptions of vulnerability, the range of key vulnerabilities and the range of climate related vulnerabilities, such as climate change science, extreme weather, climate variability, which were facing the target community. Existing coping and adaptation strategies needed to be examined along with the adaptive capacity required. Short-term needs had to be reconciled with long-term goals. The design also involved analysis of the role of institutions, which includes communities and people, and communities within

communities. The key potential project activities or interventions were then prioritised. After which, the formulation of the pilot project design document was completed, targeting dedicated adaptation funding agencies. The current study was enabled through COP funding and the mandate included the receipt of funding for the intervention.

There is a need to define an adaptation to climate change project and to evaluate its financial feasibility along with incremental costs. There was also the need for interpretation of climate change science at local levels and creation of symbiotic relationships. Institutional arrangements and processes at local levels must be understood. Practitioners need to assess the integration of adaptation to climate change issues into urban issues, with a focus on integrated demand management. Projects must be designed in accordance with current sustainable development policies. It is important to work in concert with the development community, who has considerable experience and understanding, at the local level to drive adaptation to climate change initiatives.

Adaptation: Perspectives and Experience from the European Commission

Ms. Abigail Howells, DG Environment, European Commission, Belgium

The Third Assessment Report of the IPCC predicts that global increase in temperature could be between 1.4 and 5.8° Celsius, by 2100. The thermal expansion of oceans and melting of glaciers and ice caps and ensuing sea level rise is expected to worsen, and have impacts on coastal areas and water resources. The global msl is projected to rise by 0.09 to 0.88m between 1990 and 2100. The consequences include coastal erosion, floods and sea-water ingress. Melting ice sheets in Greenland could cause sea level rise of 7 meters and which will result in the shutting down of the Gulf Stream, which is responsible for the mild climate in Europe. Scientific research is being carried out to decide whether Europe will become a cooler place. There has been increased precipitation over land by 5-10%, over the 20th century, and a decrease in the Mediterranean and North and West Africa. The middle and high northern latitudes have observed an increase in heavy precipitation events and extreme weather events such as storms, floods, droughts and heat waves. These will become more frequent, more severe and more costly. The impacts on human health will include increased fatalities through changes in the spread of vector-borne diseases and food and water-borne pathogens. The heat wave in Europe caused 45,000 deaths in 2003. Disruption of ecosystems due to fires, droughts, pest infestation and invasion of species, could lead to the extinction of 25 % of mammal species and 12 % of birds.

The situation is slightly different for some parts of Europe. The projected temperature increase between 1990 and 2100 will be in the range of 2°C and 6.3°C. Variations in precipitation will be observed. Northern Europe will be wetter and the south will be drier. Mediterranean countries have experienced these impacts and very severe forest fires in Portugal and Spain have destroyed a large proportion of forests. The annual costs due to flooding could increase to 100-120 billion €, by 2080.

The European Union established the European Climate Change Programme to identify measures, which would require the 15 states who were members before 2004, to cut GHG emissions by about 8 per cent, to the 1990 level, by 2012 in accordance with the Kyoto Protocol. Forty two innovative measures to reduce greenhouse gas emissions were identified and some of these have been implemented. The best known of these is the Emission Trading Scheme (ETS), which allocates a share of GHG emissions to large installations, which can be traded. This is recognized as an innovative measure, which could be adopted in other parts of the world. In February 2005, the European Commission published *Winning the Battle against Climate Change* which outlined several key elements of the European climate change strategy, after 2012, to reduce vulnerability to impacts of climate change.

The second phase of the European Climate Change Programme was launched in 2005, to review progress and consider future mitigation measures for GHG emission reductions, in the context of carbon dioxide, transport, aviation, carbon capture and storage. Five distinct work groups have been created to address these issues and one will focus on impacts and adaptation. The workgroup objectives are to improve Europe's resilience to climate change impacts; encourage integration of adaptation into European climate change policy; identify good practices in development of adaptation policy; and foster learning through a vast stakeholder engagement process, which will include policy makers, research organisations, NGOs and businesses. Ultimately, it aims to define the role of the European Union in adaptation policies. One of the challenges of adaptation is facing uncertainty. There are long time-frames involved, scenarios which may not prove to be right and uncertainty in the scale and effect of impacts. Both, reversible and irreversible losses, such as ecosystems, are inevitable. Adaptation is required at the local level or regional level and its reconciliation with national policy has to be examined. Legislation needs to be carried out at

the regional or local level, and whether public or private, must be stakeholder driven, rather than enforced. Another challenge is allocating costs for the implementing these measures. The cost of climate proofing all human activity will be extremely expensive and the best options need to be examined. It will be necessary to: avoid inefficient use of resources as compared to other options; adaptation that is ineffective, with scenarios that do not appear; and shifting vulnerability from one sector to another. There are economic, ethical and political considerations, which include analysis of long-term impacts and costs of immediate adaptation options; equity; and distributional benefits, such as protection of those less able to adapt in comparison to those with resources.

Successful adaptation can be simplified into a concept with three levels. The first is preparation to adapt, which requires building capacity through research, awareness, creating policies and ensuring sound monitoring. The second is to alter existing plans to manage climate risks and also, take advantage of new opportunities. Priorities, along with appropriate low cost situations and measures need to be defined. There are existing frameworks and it needs to be examined if they can be used effectively, before disaster responses are considered. The third level involves implementing adaptation actions. These should be cost-effective and cost benefit analyses may be necessary. There may be additional criteria for existing frameworks, modifying infrastructure may be needed and processes may have to be altered.

The work group on impacts and adaptation has accorded priority to 10 sectors. A series of stakeholder engagement exercises are currently taking place, and are expected to be completed by June 2006. The meetings deal with impacts on the water cycle and water resources management; marine resources, coastal zones and tourism; human health; agriculture and forestry; biodiversity; regional planning, industrial and public infrastructure, and structural funds; urban planning and construction; development cooperation; the role of the insurance industry; and building national strategies for adaptation in country reports. The session to adopt individual status reports will be held in September 2006.

The work group's research activities include identifying cost-effective adaptation strategies through a call for proposals for the 7th Framework Programme. The 6th Framework Programme of the Director General for Research is currently underway.

Three two-day workshops will be held in December 2006, to consider the effect of climate change on European Union citizens; scenarios of climate change at the regional and sub-regional level in the European Union; improving the resilience of European society and economy using climate modeling to build cost effective adaptation strategies; and economic assessment of adaptation strategies.

Sectoral meetings are currently being held and the status reports for each of these, will soon be ready. A Green Paper on Adaptation will be launched at the European Commission Conference on Adaptation in November 2006.

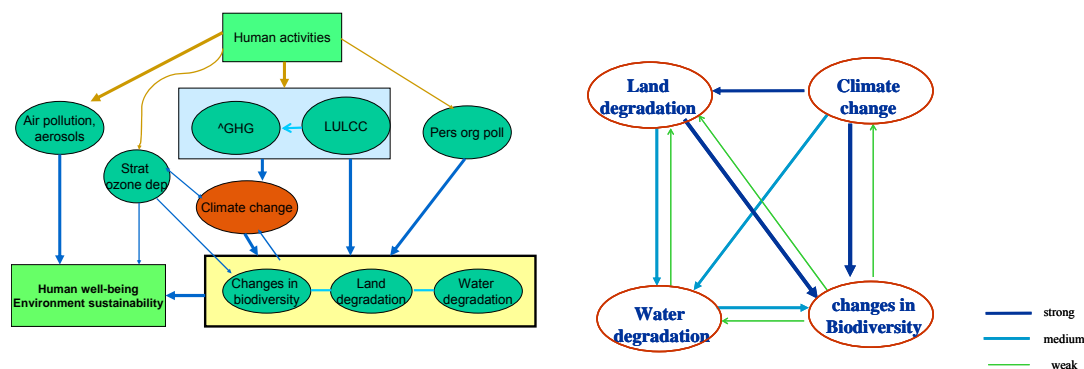
Adaptation – learning from case studies for adaptation policies and sustainable development

Dr. Habiba Gitay, World Resources Institute, USA

The multiple pressures of human activities on landscapes, ecosystems and society lead to impacts on ecosystems, ecosystem services and human well-being. This erodes natural and human capital. Adaptation includes measures and responses, to modify human activity to reduce these impacts. This approach has been used for cases studies, which have been done and are underway, while trying to develop an adaptation strategy. These are mainly focused on water and agriculture.

Human activities include increases in population; demographic changes due to affluence and a younger generation with changing aspirations; changes in consumption and production patterns; and technology changes. These cause GHG emissions and affect Land Use Land Cover Change (LULCC), which has an impact on GHG emissions, again, and exacerbates climate change. There are other changes, which have been examined by IPCC, and studied at the regional and national level. Some of these, such as ecosystem organic pollutants, will have to be considered in the future. Most of these, including ozone depletion and air pollution cause climate change.

In the landscape of watersheds and human society there are changes occurring in water, land and biodiversity. Figure 1 shows the interactions between changes in biodiversity and land and water degradation climate change and Figure 2 shows linkages with each other.



These interactions affect not only, human well-being, but the sustainability of the environment, as a whole. The challenge arising from dealing with adaptation responses is not as easy, as is assumed.

The ecosystem provides direct and indirect services. Provisioning is a direct service and includes food, fresh water, fuel wood, fiber, bio-chemicals and genetic resources. Indirect services provide cultural or non-material benefits derived from ecosystems and these may be spiritual, recreational, aesthetic, inspirational, educational, communal and symbolic. However, there are important supporting systems without which the ecosystem can not continue and these will also, affect humans survival, in the long-term. Technological solutions can help only, in the short-term. The benefits obtained from regulation of ecosystem processes are through climate regulation, which helps disease control, flood control and detoxification. Supporting services that maintain the conditions for life on earth include soil formation, nutrient cycling and pollination.

It is therefore, necessary to minimize the impacts of the multiple human activities for environmental sustainability. Response options for developing policies are economic; legal and institutional; social and behavioural, not only in terms of communities but also individuals and households; and science,

technology and technology transfer. Any or all of these, can be part of adaptation in the short-term and long-term. The role of the individual and institutions is particularly important.

The approach to adaptation will have multiple stages. During the initial stage, a set of case studies focused on water and agriculture in different parts of the world. The areas included India, China, and also developed countries, where challenges in adaptation, still exist. It is important to learn from networks, from the north to south, as well as south to south. The focus should be on water and agriculture within a specific landscapes and not separately.

A series of questions has been developed, to analyse situations on the ground prior to planned adaptation, in the future. It will draw on information available from case studies of networked institutions. These include the current status of the ecosystems, ecosystem services and human well-being. It will also, examine policies and evaluate whether they can be implemented or if they are in conflict, with each other. Multiple pressures, and not just climate change, that affect ecosystem landscapes and human societies, need to be studied. The response to these pressures and climatic extremes by individuals, households, formal and informal institutions also, was studied. Projected changes need to be considered with scenarios, which can be used. It needs to be examined, whether present responses can cope with future pressures and adaptation in the short-term, medium-term and long-term.

Scenarios will be developed as required, and they may be envisioned as different worlds. This has been done by IPCC at the global level. Scenario development needs to incorporate aspirations of people, at the local level, along with sustainable development plans at state, national and regional levels. It should include projections of how pressures such as LULCC, population and consumption patterns are changing; and climate change projections. Scenario development must include present and future aspirations.

The first stage of the multiple stage approach will include awareness creation, along with information generation and dissemination. This may help in planning which is underway and decision-making at the state level.

One of the biggest challenges is the involvement of the private sector, as it is likely to spend 60% of the money, according to a World Bank analysis, required for adaptation. Their work should not be in isolation. Another challenge is if there are enough tools and methods that have been developed or modified, to implement adaptation on the ground. These should be integrated into policies, and make it more permanent than the usual 3 or 5 year project period. One of the biggest challenges is the resources, in terms of funding cases studies and building a network for case studies, similar to BASIC. Another important factor is the resources for research in the development context.

Work must be carried out in specific landscapes, one of which is watersheds. Pilots should promote learning-by-doing and understanding in the present context, and what will happen in the future, both medium and long-term. Multiple pressures needs to be included, rather than focusing on climate change, as climate change is exacerbating them. This is expected to be dominant in the future. The stress on ecosystem services and interactions between them, in space and time, must be considered. Scenarios and storylines need to be developed, as this approach has been found to be useful. Adaptation should be used as a vehicle for addressing multiple pressures and indirect drivers or root causes, and move towards sustainable development. Sustainable resource management is necessary, for developed and developing countries rather than addressing adaptation in isolation.

SESSION VI

EMERGING ISSUES

Dr. A. K. Gossain, Indian Institute of Technology, Delhi

Adaptation is not a new process. In the case of large structures like dams, procedures are in place, where studies are conducted and design aspects incorporate adaptation measures. The increasing pressure and changing adaptation options require different actions at different levels. The watershed management programme works at the local level. Irrigation projects are underway. Each of these interventions use a common resource, water and a mechanism is needed for integration into both. The National Water Resource Policy states that it will use an integrated approach and a river basin approach. A mechanism does not exist for integration. In India, water is controlled by the state. Unless rivers pass through more than one state and there is a dispute between the states, the central government does not intervene. At the state level, there are many departments which decide on usage of this resource. These are the irrigation department within which, are the minor irrigation department and major irrigation department and there is no convergence of their actions. They often, do not know what the other is doing. The government expenditure is Rs.24,000 crores or Rs.7,000 per hectare on watershed management, in a 5 year plan. NGOs who submit projects for approval do not fully understand the needs of the local communities. Each community aims to receive the maximum funding possible. While watersheds are connected, externalities are not considered. Authorities dealing with water resources include the local authority for domestic water consumption, hydropower and fisheries departments. There is no mechanism for convergence of information to arrive at scenarios or options. This is a need for integration as mainstreaming will not be possible if initiatives work in isolation.

Supported by DFID, Indian Institute of Technology, University of Newcastle and Winrock International India, worked on two watersheds in Himachal Pradesh and Madhya Pradesh. Modeling and GIS approaches were used to find out, who benefited at the local level at each watershed and how each household benefited over a five year period. The study also tried to show the connectivity level of each watershed. It compared earlier and current flow and the effects upstream and at the bottom level. It examined equity and studied environmental flow, which have to be established for flow at the lower level. Some water systems are facing closure. There will be sea water ingress into coastal areas and damages later. However, at the national level, household information is not available since census data aggregates information. The project included discussions with local land departments. The project aimed to establish a common database of all projects in Himachal Pradesh.

Large projects need the government to certify that they are environmentally sound and this requires a national information base. Approvals are often, granted on the basis of data provided by project planners. There is no independent mechanism to check the data of these planners. There are currently, more than 5,000 construction projects being planned and an information base to certify these is not available. It is important to build these databases to understand implications of interventions.

Dr. Kalipada Chatterjee, Winrock International India, New Delhi

Case studies

There are numerous case studies on infrastructure development and sectoral development. There are also, climate change impact studies in different regions and across different sectors. These two processes will provide reliable data and a data bank can be developed for sharing. Lessons learned and data collected can be examined so that appropriate adaptation measures are mainstreamed.

Policy formulation and capacity building

In India there are plenty of policies. It has one of the best environmental policies. However, policies are not implemented or are implemented due to pressure from the Supreme Court. Perhaps, policies are not implemented as the capacity for implementation has not been developed. There is a need to develop this capacity.

Adaptation cost

Adaptation is a costly process. The international mechanism of 2 percent of CERs, as stated in Article 12 of Kyoto Protocol, is not enough. This is especially true in a country like India. Another international mechanism should be considered. The delegates to COP and SBSTA should carry a brief from each country about the fund requirements and kinds of installments. Implementation is very important for learning. While India is considered a rich country, its resources are reserved for the main item of the development agenda, which is poverty eradication and better quality of lives. Diversion of these funds will decelerate growth and is not desirable.

Research

There is a need is for more research. Case studies alone are not enough. Groups must be identified who have experience in research and can deliver. India has initiated a number of studies after the Ministers Declaration during COP 8 when adaptation became an issue as a response to climate change. Given resources, India will be able arrive at solutions for mainstreaming climate change policies and to ensure that adaptation is a component of all development activity.

Dr. Priti Kumar, World Bank, India

Adaptation has been an issue at the World Bank for the last two or three years, and a team is working on it in Washington and India. In 2004, Winrock commenced a regional review of adaptation strategies in India, in collaboration with the World Bank. Soon after, the bank was requested by the Ministry of Environment and Forests, Government of India, to conduct a more comprehensive study on vulnerability and adaptation strategies and the issues and options that could be taken forward. This study was launched in May, 2005 with the objective of mainstreaming climate change considerations into the development process and to arrive at a common understanding of issues and options which currently do not exist and which will help dialogue within the government and also with the World Bank.

The study focused on three vulnerable states – Orissa, Maharashtra and Andhra Pradesh which were prone to extreme climate events like drought and floods. Maharashtra and Andhra Pradesh have a history of farmer suicides due to crop failure and coastal Orissa is struck by cyclones very often. The river basin approach was used and the study focused on the Pennar basin in Andhra Pradesh, the Godavari basin in Maharashtra and the Mahanadi basin in Orissa. The study, conducted in collaboration with TERI and RMSI – which has extensive experience in climate modeling, aimed to understand coping strategies at the community level. It also aimed to do extensive integrated modeling and understand how climate impacts the agriculture and water sectors. Modeling is likely to generate policy options, since it has economic modeling scenarios built in. An example is enabling understanding of optimizing farm behaviour and response based on irrigation, size of land holding, ease of access to markets given an initial scenario. The study also aimed to understand, considering two emission scenarios specified by IPCC, impacts on runoff, temperature and rainfall among other factors.

It was decided to use a decision management tool which could be used later by the state and central governments. Andhra Pradesh was hit by drought in 2004, during the study period, and the state government requested the bank for more specific work in the state. This was done and the bank and an action oriented pilot program is underway.

The pilot program involved working with communities in two drought prone districts, Mehboobnagar and Ananthpur, to help them develop and implement adaptation plans based on a menu of options, which takes into consideration indigenous knowledge as well as expert inputs. The project aims to understand methods for strengthening agriculture extension services, managing common water resources and sharing; and providing economic support tools such as weather insurance – which has still not developed enough for acceptance..

One of the key constraints was diversifying livelihood options. While farmers are willing to shift from paddy cultivation to less water intensive crops such as oil seeds, markets for these have to be developed. The issue of institutional capacity building also needs to be examined. This is one of the first projects of the World Bank in the area of climate change and adaptation. Quantification was very important and a series of pre-project and post-project monitoring surveys are being carried out to understand added-value impact on focused interventions to reduce vulnerability.

One of the advantages of the bank working on adaptation is that it works across sectors like energy, transport, infrastructure, agriculture and rural development. This will help mainstream climate change and adaptation into each of these sectors. In the energy and infrastructure sector, a program is being developed, jointly with the Government of India, for hazard risk management. It is a demand driven program, which focuses on coastal areas in India and will develop early warning systems for cyclones,

emerging sea response planning and more institutional capacity building. The environment group of the bank is trying to develop an adaptation component within the infrastructure of this program.

A major constraint is that adaptation is multi-sectoral and testing at the ground level involves multiple ministries such as the ministries for agriculture, transport and rural development and not necessarily environment. At the stage of generating knowledge, there is acceptance by the ministry of environment since this can be used in areas such as the National Communications. However, it is difficult to convince both, state and central governments the need for a cross-sectoral approach to adaptation. This is due to the numerous programs that exist in each sector such as programs for drinking water, watershed management, food for work, soil moisture conservation and employment guarantee schemes. These programmes work in a very disparate manner with ill-defined implementation structures and without a geographical focus. The World Bank considers adaptation as improved delivery of focused interventions which takes into account synergy between programs. Convergence in government programs has been found to be lacking.

The bank will continue to generate knowledge for options on a policy framework, which the government can use. The issue of how community level pilots link up with development policy and planning continues to remain. Pilots are very small efforts and it is hoped that an adaptation pilot can be implemented to improve the resilience of communities. Another issue is scaling up of pilots to larger projects and programs. Outcomes may be used to lobby for infrastructure or economic policy.

Ms. Veena Sreeram Rao, CAPART

CAPART is an organization that funds NGOs for development projects in rural areas, especially projects where rural technology is a component. Sources of subsistence in rural are reducing due to poverty and population growth. The lack of awareness, empowerment and sustainable livelihoods along with ignorance lead to incorrect practices in management of land, water, forests and bio-wastes. Numerous studies have established that climate is changing. Temperatures are rising, greenhouse gases are increasing and glaciers are receding. The complex relationship between people and the environment has been discussed at policy levels at national and international fora.

In India, the pressures on the environment are multiple, heterogeneous and related to poverty and development. About 40 years rural communities were encouraged to cultivate land, dig tube wells, use pesticides and chemical fertilizers and forgo traditional practices in order to achieve greater productivity and self-sufficiency. Now these communities are being told to do exactly the opposite, to conserve the environment. There is an overload of information at the rural level regarding gender, child, girl-child, literacy and empowerment. However, the sole concern of the rural poor is survival and not impacts, on the environment in the future.

Adaptation has to be integrated into existing programmes. The poor want immediate relief and income generation is very important to them. Programmes such as watershed management are composite programmes that have brought change into the lives of people and are eco-friendly. Rainwater harvesting programmes provides safe water and address health issues. CAPART would like to universalize them. Sanitation is a major issue where programmes are not working. There are sound programmes on vermi-composting, biogas and afforestation. A GIS mapping of projects on the ground needs to be done to make sure that there is a programme in every area.

There is no concerted effort to seek innovation. CAPART intends to establish a centre, which will network with institutions and stakeholders to build a knowledge base that will be shared. It will undertake dissemination and encourage to research, especially in fuel and energy. Biogas programmes have to be streamlined so that it is used in more rural households. This requires a viable community system, as cattle are required. CAPART is not as large as the government and its thrust is more on pilot projects than programmes. However, it will build an environment friendly component into all its programmes, especially for drinking water, fuel and sanitation, which will have to be part of any income generation activity. There is an excellent system of SHGs and VRCs at the rural level. These need to be strengthened and used for information dissemination as communities trust them. PRIs are trusted in some areas and are not in others. The grassroots level is complex with strengths and opinions differing in different areas.

There is considerable global interest in India, which will unleash its potential in the next 20 or 30 years. The amount of GHGs that are will be released over the next 20 years is being calculated. It is necessary to learn from the experiences of the developed countries and use the huge corpus of ancient wisdom, which was ignored in the process of industrialization to unleash India's ecological power.

Dr. Amit Garg, UNEP, Risoe

Practice is based on historical trends and learning. Ancient wisdom is used to cope with some of the difficulties that people face in the context of precipitation and temperature. However this may not be enough to cope with climate change. Therefore, linking practice to policy and then, policy to practice again, in a cyclical manner is very necessary. Policy makers and researchers have access to better information, which can create knowledge and get a more holistic picture of likely events in the future and this should be used for providing guidance to the people who will be most affected. Farmers are sensitive to immediate changes in markets and the climate regime, while policy makers and researchers are not always sensitive to these issues and sometimes actions come too late.

In this loop of practice to policy and policy to practice what is required are products. These products may range from insurance services for crop failure in a region to making check dams in a region. There are a plethora of products available and these are available in each sector. Policies and initiatives could be considered as products as is advance information on monthly rainfall patterns which communities require. In the area of energy, biofuels is a product. In India, there are vast areas of arid land where biodiesel crops could be cultivated, which will provide employment to people and help mitigation as these are renewable crops that are an alternative to fossil fuels in the transport sector. Since impacts are site-specific, products also have to be site specific. This requires much focused research. The involvement of any sector is lacking in the adaptation debate. Rural super markets are a new initiative, in rural clusters, which market a limited number of products which include seeds which have been proven and very specific fertilizers for which there is demand. Credit is also controlled and the business is conducted mainly through cash. These have been very successful and more initiatives like these are needed, where the benefits may be received by farmers, from the weaker sections of society. The government could even consider subsidizing these efforts. The insurance sector have created a tool that will cover 100 of the 540 districts in India, this year, where based on climate information an index will be created to provide compensation for crop loss if rainfall is less than 10 % or 15 %. These are very specific products and more of these are required.

Dr. D. Parthasarthy, Indian Institute of Technology, Mumbai

IIT has a Continuing Education Programme for practitioners such as engineers, builders, government officials and planners at different levels. Adaptation can be mainstreamed by integrating it into existing education programmes on infrastructure development, development, construction and transport, among other sectors. Insights gained over time may be imparted to create knowledge, which can be taken into the field. Governance issues must also be considered for adaptation. Mechanisms, policies and regulations to handle the adverse effects of the floods in Mumbai were in place. Most were not implemented as people were unaware of the environmental implications of certain development policies. The entire development of the city of Mumbai ignored the issues of mitigation and adaptation. It is important that continuing education programmes be imparted to people at all levels in the government. This will help mechanisms, policies and regulations to be implemented.

It is also, important to incorporate adaptation to climate change into existing courses, especially for engineering students and this has begun with a fiat from the Supreme Court. Environmental Sciences are now, included in the engineering curriculum. Starting new courses in adaptation to climate change will not be useful as students will feel that an unnecessary course, has been imposed upon them. It is better to integrate it with existing courses such as metallurgy, physics or civil and chemical engineering. IIT Bombay has a field laboratory, where in a particular block close to Mumbai, villages are adopted in a sequential manner. This started with a small check dam and is now moving into renewable energy. Students from different departments such as science, resource engineering, environmental science and civil engineering and students try to apply what they have learned in these areas. This process enables them to start understanding issues of poverty, vulnerability, environmental pollution, sustainable development and adaptation. Similar innovations will help mainstream adaptation into education.

Educational institutions can provide training and research support for development strategies and programmes to include an adaptation component. In Maharashtra, suicides have occurred due to small amounts of money. Microfinance and SHGs play a significant role in this area. A small grant of less than a US\$ 1,000 helped a village set up a vermiculture and vermicompost plant, which helped the shift to organic fertilizers. It is important to bring climate change into development plans and train donors, engineers and other development agencies so that they can include it in their programmes and projects.

Decentralized planning is necessary. Most of the work done in the area of climate change is at the macro level, national or global level. There have been few community interventions. As countries, especially India, move towards decentralized planning, the size of units, used for planning, will have to change. Currently these are nation, state, district, block and village or zones such as agro-ecological zones and demographic zones. A technology project in Maharashtra, found that a village, district or state is not an ideal unit for planning in terms of economy of scale and resource utilization. A block is more appropriate for planning. The spatial demarcation of appropriate areas for interventions for vulnerability reduction and adaptation enhancement needs to be examined.

For mainstreaming adaptation, or even sustainable development into governance, education or other areas, it is perhaps better understand processes at all levels rather than measuring or quantifying indicators. More micro-level studies are needed for a better understanding of risk and vulnerability.

DISCUSSIONS

Institutions operate at the global national and state levels and means have to be developed, perhaps in the form of incentives, to promote interaction between institutions with possibly the World Bank can act as a facilitator. Many studies continue to remain just studies. Some times, they are reflected in action in some ways. However, governments who are the action takers or managers continue to operate using conventional procedures, which may not be valid in the changing face of technology and society. Technology includes tools and methods that are evolving. Some are quite simple and should be embedded in their work culture. Information does not require any tool. The first level is data. The first step is for departments to share baseline data, which is vital for understanding the status of issues. This only requires convincing departments that they need to share data. Training for a week is not enough to for replicating learnings. The technology gap is so large that there is a need for a mechanism for demonstration and working them to a certain extent. Tactical backups must be available for a certain period. This needs initiatives at both, state and national levels. There is a mechanism established through the initiative Department of Space and the Department of Science and Technology called the National Space Database Infrastructure (NSDI). The actual implementation has not taken place though it will shortly, be showcased in one state.

Another aspect is ownership. Adaptation policies and responses and watertight compartments of different institutions can be addressed if adaptation measures are owned by affected persons who can take initiatives to cut across institutions and talk to each other to find solutions for their own benefit. Ownership and generation of ownership is very important in adaptation measures. The whole development issue does not make sense if institutions are unable to interact. This is a challenge, particularly while implementing adaptation measures because the area is so multi-sectoral. The World Bank has made some inroads into building institutional capacities and developing interaction and the approach is to be as collaborative as possible. In knowledge based work and studies there is ownership, especially in the environment ministry because they want to develop their own knowledge base. The bank is establishing linkages with research and professional agencies. Action oriented interventions depends on different ministries such as the rural development or water resources ministry. In Maharashtra, a very vulnerable state, the bank organized an inter-sectoral brainstorming session, which involved secretaries of at least eight ministries such as planning, water resources, revenue, rural development and agriculture. This was to assess the interest and proactivity, and examine evidence of successful work across these institutions, with the objective of building a dialogue within them. In Andhra Pradesh, the Rural Development Ministry who are working in the block, local and community levels and get all the institutions into a programme. In Orissa, the Revenue Ministry who is responsible for relief and rehabilitation is interested in monitoring, tracking, early warning systems and interventions in flood prone areas. This effort proved that it takes a lot of effort to gauge interests of different ministries.

It is critical to get the interest of the big institutions and ministries along with strengthening the communities themselves. This will enable communities to hold institutions to account and ensure that interventions take place. The interventions may have to be redone due to the speed of changes in technology and human society. Communities must be aware, understand the mandate and intentions of institutions and make them accountable. Interventions often, depend on individual choices such as water based interventions or migration in drought prone areas. Creating adaptation products such as the carbon market commodities that have mobilized a large number of actors in the private sector, international and financial institutions and motivated individuals who retain their lifestyles and buy carbon offsets to start the transition towards change. The India team could think about buying and investing in adaptation credits of some kind and develop the baselines that go with these. Empowered community based organisations such as the

Panchayati Raj institutions, *gram sabhas* or block level organisations should undertake interventions and this needs micro-planning. Small farmers are involved in carbon trading in a very small way. In Bihar, there are new varieties of corn and sequestering of carbon is taking place. The farmers can use rural super markets for trading. There are products, though these are very scattered and have to be scaled-up. Attitudinal change, awareness, education and empowerment at the local level are important factors. These will form part of the recommendations for mainstreaming adaptation. Very often adaptation in institutions depends on the core team involved and once this change, the level of interest changes, even at the departmental level. Adaptation takes place at the community level and they should be involved. Products to be traded in adaptation markets have to be decided upon.

Mainstreaming adaptation into the development process needs to prioritize action at different levels especially the community level and it includes ownership and financing. Cross-benefit analysis is very important, as projects may be too expensive and lack resources for projects, for making working recommendations.

Knowledge, which survives, defines frontiers and the defined area of adaptation overlaps other areas. If we want this knowledge to survive adaptation and its interaction with these issues have to be defined. Young people with basic and secondary education are better prepared to face this problem in the future and the two tasks are to define adaptation policies and initiatives clearly and invest more on education.

Chairperson's Summary

In India, there continues to be a high degree of poverty, hunger and malnutrition and it has the largest share of these in the world. The hungry and the poor are the worst polluter and the distressed area in Maharashtra, Orissa and Andhra Pradesh indicate the divide between urban and rural areas. Climate change is affecting people and is being used by different people in different ways, including the government. Those who are most affected are the poorest of the poor who do not have the power, resources and entitlements. Climate change cannot be separated from market forces and energy trading, power and decentralized or micro-planning have to consider this. Agriculture and health are two of the many sectors, which impact climate which in turn impacts sector that include agriculture, land, biodiversity and water. Policies for each of these sectors can be managed much better than climate policy, even though they are components of climate policy. The management of climate change is the other side of adaptation. Human interventions have evolved. New ways of managing climate change must be established and mainstreamed into national policy of adaptation to take care of those who are vulnerable to climate change. A system must be developed so that the number of ministries dealing with the issue of climate change. The highest level of decision makers have to be sensitized. Information of climate change must be provided at the village level. Funds should be given directly to district level.

ANNEXURE I

List of Speakers, Chairpersons and Panelists

Dr. Kinsuk Mitra

President
Winrock International India
788, Udyog Vihar, Phase V
Gurgaon 122001
Haryana
Tel: +91-124-4303868
Fax: +91-124-4303862
Email: kinsuk@winrockindia.org

Dr. Farhana Yamin

Research Fellow
Institute of Development Studies
University of Sussex
Brighton, BN1 9RE, UK
Tel: (0) 1273 606261
Fax: (0) 1273 621202
Email: f.yamin@ids.ac.uk

Ms. Abigail Howells

Incharge, Adaptation
Environment Directorate-General
European Commission
BU-9 06/139
B-1049 Brussels
Belgium
Email: Abigail.HOWELLS@cec.eu.int

Dr. Jyoti Parikh

C-50, Asian Village Complex,
Khelgaon, New Delhi-110049
Phone: +91-11-26495522,
Tel/Fax: +91-11-26495523
Email: jparikh@irade.res.in

Shri Naresh Dayal

Additional Secretary, MoEF
Paryavaran Bhavan
CGO Complex, Lodi Road,
New Delhi -110 003
Tel/Fax: +91-11-24361712
Email: ndayal@nic.in

Dr. Ajay Mathur

President
Senenergy Global Pvt Ltd
9th Floor, Eros Corporate Tower
Nehru Place
New Delhi 110 019
Phone: +91-11-4180-5501
Fax: +91-11-4180-5504

Dr. Anand Patwardhan

Department of Science and Technology (DST)
'A' Wing, Vishwakarma Bhavan, Shaheed Jeet
Singh Marg
New Delhi 110016, India.
Phone: +91-(0)11-26592600, 26867764
Fax: 26961158, 26528227, 26863866
E-mail: edtifac@tifac.org.in

Ms. Olga Pilifosova

Programme officer
Adaptation, Technology and Science Programme
UNFCCC secretariat
Phone +49 228 815 1428
E-mail: opilifosova@unfccc.int

Ms. Fareeha Y. Iqbal

Climate Change Team, ENV
Rm MC 4-221B, Mail stop MC 4-410
The World Bank
1818 H St. NW, Washington, D.C. 20433
Ph: +1 202 458 0140
Fax: + 1 202 522 2130
Email: fiqbal1@worldbank.org

Mr. G. Srinivasan

Director, Department of Science and Technology
Technology Bhavan,
New Mehrauli Road,
New Delhi - 110016
Tel: +91-11-26567373
Fax: +91-11-26864570, 26862418
Email: srinidst@nic.in

Dr. K.C. Mishra

Director
National Insurance Academy
25, Balewadi, Baner Road,
NIA PO,
Pune 411 045
Tel: 91-20-7292382 – 83/ 7292393
Telex: 0145 – 7357 NIAP IN
Fax: 91-020-7292392
E-mail: kcmishra@niapune.com,
niapune@vsnl.com

Dr. Balgis Osman Elasha

Climate Change Unit/Higher Council for
Environment & Natural Resources (HCENR)
P.O.Box 10488
Khartoum/Sudan
Tel +249 183 786903
Fax : +249 183 787617
Email : balgis@yahoo.com

Prof. N. H. Ravindranath

Centre for Environmental Sciences
Professor, IISc
Bangalore - 560 012
Tel: +91-80-23341838, 23601455, 23341838,
23601838, 23600985, 23092506, 09845076348
Fax: +91-80-23601428, 23600683
Email: ravi@ces.iisc.ernet.in

Dr. Subodh Sharma

Advisor, MoEF
Paryavaran Bhavan
CGO Complex
Lodi Road, New Delhi
Pin: 110 003
Tel & Fax: +91-11-24360861
Email: subodh.sharma@natcomindia.org

Dr. P. K. Aggarwal

41829370
Division of Environmental Sciences
Room No. 215, Indian Agricultural Research
Institute
NRL Building, Pusa, New Delhi – 110012
Ph: 25841866, 26148615 (R)
Mobile: 9810261230
E-mail: pramodag@vsnl.com

Dr. Pushpam Kumar

Institute of Economic Growth
University of Delhi Enclave
North Campus, Delhi -110007
Phone: +91-11-27667-288/365/424;
Fax: +91-11-27667410
Email: pk@iegindia.org

Ms. Preety Bhandari

Director, Policy Analysis Division
The Energy and Resources Institute (TERI),
Darbari Seth Block,
IHC Complex, Lodhi Road
New Delhi – 110 003
Tel: +91-11-24682100
Fax: +91-11-24682144
Email: preetyb@teri.res.in

Prof. Joyashree Roy

Reader, Department of Economics,
Jadavpur University, Kolkata - 700 032
Tel: +91-33-24146666
Fax: +91-33-24127905
Email: jroy@cal2.vsnl.net.in

Ms. Suruchi Bhadwal

Area Convenor, Centre for Global Environment
Research
The Energy and Resources Institute (TERI),
Darbari Seth Block,
IHC Complex, Lodhi Road
New Delhi – 110 003
Tel: +91-11-24682100, 24682144
Email: suruchib@teri.res.in

Dr. Sai Bhaskar

AFPRO, Hyderabad
Email : saibhaskarnakka@gmail.com

Ms. Aditi Dass

Winrock International India
788, Udyog Vihar, Phase V
Guirgaon 122001
Haryana
Tel: +91-124-4303868
Fax: +91-124-4303862
Email: aditi@winrockindia.org

Dr. Manmohan Kaphse

Department of Architecture and Planning
Maulana Azad National Institute of Technology
Bhopal - 462 007

Madhya Pradesh

Ph: 0755-3097071, 2670416, 238902, 2671376,
09893064696,

Fax: 0755- 2670562, 2670802, 2671175

E-mail: mkapshe@yahoo.com,
kapshe@sancharnet.in, kapshe@manit.ac.in

Dr. Gylvan Meira Filho

University of Sao Paulo, Brazil

Email: lgylvan@uol.com.br

Dr. Xiong Wei

Environment and Sustainable Development for
Agriculture

Chinese Academy of Agriculture Sciences

12 Zhongguancun South Street

Beijing 100081

China

Tel: +86-10-62119681

Fax: +86-10-62119681

Email: xiongw@ami.ac.cn

Dr. Lwandle Mqadi

The SouthSouthNorth Group-Southern Africa
Office

138 Waterkant Street

Greenpoint - 8001

Tel: +27 21 425 1465/4

Fax: +27 21 425 1463

Email: lwandle@southsouthnorth.org

Dr. Habiba Gitay

World Resource Institute

Washington DC, USA

Email: HGITAY@wri.org

Dr. R. B. Singh

Member, National Commission on Farmers

2nd Floor, National Agriculture Science Complex,

Dev Praksh Shastri Marg,

Opposite Dusghana Bus Stop,

Near Todapur Village, New Delhi – 12

Tel: +91-11-25869320 (O)

+91-11-26136450 (R)

9810230037 (M)

Fax: +91-11-25848061, 25869319

Email: ncf@nic.in

Smt. Veena Sreeram Rao

Director General, Council for Advancement of
People's Action and Rural Technology CAPART,
India

India Habitat Centre,

Zone-VA, 2nd Floor,

Lodhi Road, New Delhi-110 003

Tel: 24642390 Extn: 103

Fax: 24633546

Email: capart@caparthq.delhi.nic.in

Mr. Shambhu Singh

Director

Department of Science and Technology,

Technology Bhavan,

New Mehrauli Road,

New Delhi - 110016

Tel: +91-11-26567373

Fax: +91-11-26864570, 26862418

Email: shambhuin@yahoo.com

Dr. A.K. Gosain

Deptt. Of Civil Engineering

Indian Institute of Technology, Delhi

Hauz Khas

New Delhi 110016

Ph: 26591186, 26597289,

Fax: 26581117

E-mail : gosain@civil.iitd.ernet.in,

gosain_iitd@hotmail.com

Prof. D. Parthasarthy

Department of Humanities and Social Sciences

Indian Institute of Technology Bombay

Powai, Mumbai- 400076

Ph: 022- 25767381, 25722545 Ext 7381

Fax: 022-25723480, 25767350

Mobile: 09821650680

Dr. Kalipada Chatterjee

Winrock International India

788, Udyog Vihar, Phase V

Guirgaon 122001

Haryana

Tel: +91-124-4303868

Fax: +91-124-4303862

Email: kalipada@winrockindia.org

Ms. Priti Kumar

World Bank

Lodhi Estate

New Delhi

Dr. Amit Garg

Senior Economist

UNEP Risoe Center

Frederiksborgvej 399, DK – 4000

Roskilde, Denmark

Ph: +45 4677 5169

Fax: +45 4632 1999

ANNEXURE II

List of Participants

Shefali Juneja

Associate - Regional Disaster Reduction Advisor,
Bureau for Crisis Prevention and Recovery,
United Nations Development Programme
(UNDP)
55, Lodhi Estate,
New Delhi – 110 003
Tel: +91-11-24628877
Email: shefali.juneja@undp.org

Ms. Radha Ayala

Emergency Analyst
United Nations Development Programme
(UNDP)
55, Lodhi Estate,
New Delhi – 110 003
Tel: +91-9810402937
Fax: +91-11-249627612
Email: radha.ayala@undp.org

Mr. Virender Sharma

Adviser, DFID India
B-28, Qutub Institutional Area
New Delhi - 110 016
Tel: +91-11-26529123
Email: V-Sharma@dfid.gov.uk

Ms. Usha Rao

Program Analyst
United Nations development Programme (UNDP)
55, Lodhi Estate,
New Delhi – 110 003
Tel: +91-11-24628877
Fax: +91-11-24627712
Email: usha.rao@undp.org

Dr. B. Mukhopadhyaya

India Meteorological Department
Mausam Bhawan,
Lodhi Road, New Delhi – 110003
Tel: +91-11-24611842
Fax: +91-11-24611792

Dr. Naveen Kalra

Head, Agriculture Physics Division
Indian Agricultural Research Institute (IARI)
New Delhi 110012
Tel: 91 -11 – 25841178
9811183743 (Mobile)
Email: naveenkalra11@rediffmail.com,
nkalra@iari.res.in

Dr. D.C. Uprety (PI-V&A)

National Fellow, IARI
Division of Plant Physiology
Indian Agricultural Research Institute
NRL Building
Pusa, New Delhi – 110012
Ph: 25846107, 25782815,
Fax: 25766420, 25751719
E-mail : dc_uprety@yahoo.com

Prof. K.G. Saxena

School of Environmental Sciences
Jawaharlal Nehru University
New Delhi - 110067
Ph: 91-11-26717676, 26167557, Extn: 4305,
2643-9129 (R)
Fax: 6172438, 6165886
Email: kgsaxena@mail.jnu.ac.in,
Saxena2002in@yahoo.com

Dr. Sandhya Rao

Deptt. of Civil Engineering
Block 4, Room No. 207
Indian Institute of Technology, Delhi
Hauz Khas, New Delhi 110016
Ph: 26596448, 26581524 (INRM), 20900989
Fax: 26581117
E-mail: sandhya@civil.iitd.ernet.in,
sandhya.delhi@gmail.com

Ms. Anamika Arora

Deptt. of Civil Engineering
Block 4, Room No. 207
Indian Institute of Technology, Delhi
Hauz Khas, New Delhi 110016

Ph: 26596448, 26581524 (INRM), 20900989
Fax: 26581117

Ms. Puja

Deptt. of Civil Engineering
Block 4, Room No. 207
Indian Institute of Technology, Delhi
Hauz Khas, New Delhi 110016
Ph: 26596448, 26581524 (INRM), 20900989
Fax: 26581117

Mr. Prakash Rao

(Senior Coordinator, Climate Change and Energy
Programme)
WWF-India,
Secretariat,
New Delhi (IN) Main Office
Tel: +91 11 41504794

Mr. Sudipto Chatterjee

Winrock International India
788, Udyog Vihar, Phase V
Guirgaon 122001
Haryana
Tel: +91-124-4303868
Fax: +91-124-4303862
Email: sudipto @winrockindia.org

Dr. R. K. Mallick

ERM India Private Limited
Project Management Unit
G-3, Delhi Blue Apartments
2, Factory Road
Safdarjung Ring road
New Delhi -1100 029 (India)
Phone: + 91-11-26103044
Fax: +91-11-26103046
Email:

Dr. Subroto Bose

ERM India Private Limited
Project Management Unit
G-3, Delhi Blue Apartments
2, Factory Road
Safdarjung Ring road
New Delhi -1100 029 (India)
Phone: + 91-11-26103044

Fax: +91-11-26103046

Ms. Sumita Dasgupta

Program Coordinator - Rainwater Harvesting,
41, Tughlakabad Institutional Area, New Delhi-
110062, INDIA
Tel: +91 (011) 29955124, 29955125, 29956394,
29956401, 29956399
Fax: +91 (011) 29955879
E-mail: cse@cseindia.org

Dr. A. K. Bohra,

Head, National Centre for Medium Range
Weather Forecasting
Department of Science & Technology
A-50, Institutional Area, Phase-II
Sector-62, NOIDA - 201 307
Tel: +95120-2403622
Fax: 0120- 2400062
Email: akbohra@ncmrwf.gov.in

Dr. L.S. Rathore

National Centre for Medium Range Weather
Forecasting
Department of Science & Technology
A-50, Institutional Area, Phase-II
Sector-62, NOIDA - 201 307
Tel: +95120-2403622
Fax: 0120- 2400062
Email:

Ms. Preety Malhotra

British High Commission
Programme Management Department
Chanakyapuri
New Delhi - 110 021
Tel: +91-11-26872161,
Fax: +91-11-26870065
Email:

Mr. Clifford Polycarp

Programme Manager - Climate Change &
Energy
British High Commission
Programme Management Department
Chanakyapuri
New Delhi - 110 021

Tel: +91-11-26872161,
Fax: +91-11-26870065
Email: 'clifford.polycarp@fco.gov.uk'

Dr. Deborah Petterson

First Secretary – Energy & Sustainable
Development
British High Commission
Programme Management Department
Chanakyapuri
New Delhi - 110 021
Tel: +91-11-26872161,
Fax: +91-11-26870065
Email:

Ms. Nicola Murray

Head of Programmes
British High Commission
Programme Management Department
Chanakyapuri
New Delhi - 110 021
Tel: +91-11-26872161,
Fax: +91-11-26870065

Ms. Ulka Kelkar

The Energy Resource Institute
Bangalore

Ms. Subudhi Banthia

The Energy Research Institute
Darbari Seth Block, IHC Complex,
Lodhi Road, New Delhi – 110 003
Email: subuddhi_18@yahoo.com

Ms. Sreeja Nair

The Energy Research Institute
Darbari Seth Block, IHC Complex,
Lodhi Road, New Delhi – 110 003
Email: sreejan@teri.res.in

Ms. Kadambari Anantram

The Energy Research Institute
Darbari Seth Block, IHC Complex,
Lodhi Road, New Delhi – 110 003

Mr. Anish Chatterjee

Email: anish.chatterjee@gtz.de

Ms. Monali Ranade

UNDP
Lodhi Estate
Email: monali.ranade@undp.org

Ms. Damera Vidya

IRADe
Asian Village Complex,
Khelgaon, New Delhi-110049
Phone: +91-11-26495522,
Tel/Fax: +91-11-26495523
Email:

Ms. K. Swarna

C-50, Asian Village Complex,
Khelgaon, New Delhi-110049
Phone: +91-11-26495522,
Tel/Fax: +91-11-26495523
Email:

Mr. Vikram Roy

Advisor
Economic Section
European Union
65, Golf Links
New Delhi – 110 003
Tel: +91-11-24629237, 2462-9238
Tel: +91-11-5219 5223, 5219 5219
Email: Vikram.roy@cec.eu.int

Ms. Meeta Ajit

Programme Associate,
TIFAC.
Ph: +91-011-26592702, 52525702
Email: meeta.a@tifac.org.in,
ajitmeeta@yahoo.com

Mr. Prabhat K. Gupta

Deputy Director & Head,
Analytical Chemistry Section,
National Physical Laboratory,
Dr. K.S. Krishnan Road,
New Delhi-110012, India
Tel.: (O) +91-11-25734649
Fax: +91-11-25726938
E-mail: prabhat@mail.nplindia.ernet.in

Dr. M. K. Tiwari

Deputy Director
Radio and Atmospheric Sciences
National Physical Laboratory
New Delhi 110 012

Mr. I. P. Abrol

Centre for Advancement of Sustainable
Agriculture
National Agricultural Science Centre (NASC)
Complex
DPS Marg, Pusa
New Delhi 110 012

Ms. Veena Joshi

Swiss Agency for Development & Cooperation
C/o Embassy of Switzerland
Chandragupta Marg
Chanakyapuri,
New Delhi - 110 021

Ms. Preeti Kapuria

University of Delhi Enclave
North Campus, Delhi -110007
Phone: +91-11-27667-288/365/424
Fax: +91-11-27667410
Email: preeti@iegindia.org

Mr. Vikram Dayal

IEG, University of Delhi Enclave
North Campus, Delhi -110007
Phone: +91-11-27667-288/365/424
Fax: +91-11-27667410
Email:

Mr. Subhash Dhar

Public Systems Group, IIM Ahmedabad
Vastrapur,
Ahmedabad
Gujarat – 380015
Tel: +91-79-26324827
Fax: +91-79-26306896
Email:

Mr. Sashikant Chopde

Winrock International India

788, Udyog Vihar, Phase V
Guirgaon 122001
Haryana
Tel: +91-124-4303868
Fax: +91-124-4303862
Email: sashikant@winrockindia.org

Ms. Mamta Borgoyary

Winrock International India
788, Udyog Vihar, Phase V
Guirgaon 122001
Haryana
Tel: +91-124-4303868
Fax: +91-124-4303862
Email: mamta@winrockindia.org

Ms. Sharmistha Bose

Winrock International India
788, Udyog Vihar, Phase V
Guirgaon 122001
Haryana
Tel: +91-124-4303868
Fax: +91-124-4303862
Email: sharmistha@winrockindia.org

Dr. Chhemendra Sharma

Winrock International India
S-212, 2nd Floor
Panchsheel Park
New Delhi
Tel: +91-11-26013876
Email: cchemmendra@winrockindia.org

Ms. Amrita Bordoloi

Winrock International India
788, Udyog Vihar, Phase V
Guirgaon 122001
Haryana
Tel: +91-124-4303868
Fax: +91-124-4303862
Email: amrita@winrockindia.org

Dr. Sumana Bhattacharya

Winrock International India
S-212, 2nd Floor
Panchsheel Park
New Delhi

Tel: +91-11-26013876
Email: sumana@winrockindia.org

Ms. Swati Lal

Winrock International India
S-212, 2nd Floor
Panchsheel Park
New Delhi
Tel: +91-11-26013876
Email: swati@winrockindia.org

Ms. Sumana Dutta

Winrock International India
788, Udyog Vihar, Phase V
Gurgaon 122001
Haryana
Tel: +91-124-4303868
Fax: +91-124-4303862
Email: sumanad@winrockindia.org

Dr. K. Narayanan

Associate Professor
Department of Humanities and Social Sciences
Indian Institute of Technology Bombay
Powai, Mumbai- 400076
Ph: 022- 25767381, 25722545 Ext 7381
Fax: 022-25723480, 25767350
Mobile: 09821650680
E-mail : knn@hss.iitb.ac.in

Ms. Catherine Warburton

IMBEWU Enviro-Legal Specialists (Pty) Ltd
1st Floor, Block 6
Albury Park
Corner Albury Road and Jan Smuts Avenue
Dunkeld West
Sandton
Tel: 011 325 4928
Fax: 011 325 4901
Cell: 082 890 6459
E-mail:catherine@imbewu.co.za

Mr. Darren Swanson

Project Manager
International Institute for Sustainable
Development - IISD
Email: dswanson@iisd.ca

Tel: 204.958.7746
Email: dswanson@iisd.ca

Dr. Teng Fei

Room C402, Energy Science Building
Tsinghua university, 100084, Beijing, China
Fax : 0086 (0)10 62771150
Email: tengfei@mail.tsinghua.edu.cn

Mr. Erik Haites

Margaree Consultants Inc.
120 Adelaide Street West, Suite 2500
Toronto, Ontario M5H 1T1
Canada
Tel: 416 369 0900
Fax: 416 369 0922
Email : EHaites@margaree.ca

Mr. Paul Curnow

Senior Associate
Baker & McKenzie
AMP Centre
Level 27, 50 Bridge Street
Sydney NSW 2000
Tel: +61 2 9225 0173
Fax: +61 2 9225 1595
Email: paul.curnow@bakernet.com

Dr. P. Das,

Dpty Director Gen.,
Agr.Extension Division, ICAR
Krishi Anusandhan Bhavan - I,
Pusa Road, New Delhi
Tel: +91-11-2584 3277, 2584 4960,
Fax: +91-11- 25842968

Mr. J. Marcovi

Universidade de Sao Paulo
Phone: 55 11 3091 58 43
Email: jmarcovi@usp.br

Mr. Jiahua Pan

Senior Fellow and Deputy Director
Research Centre for Sustainable Development
Chinese Academy of Social Sciences
907 CASS Building
5 Jiannei Dajie 100732 Beijing

Tel: 0086 10 8519 5788; 8519 5353
Fax: 00 86 10 8511 9035
Email: jjahuapan@163.com;
panjiahua@hotmail.com

Ms. Julie Middleton

Palmer Development Group
Postnet Suite #259, Private Bag X30500,
Houghton, 2041, South Africa
Tel 011 484 9992
Cell: 082 546 0260
Fax 011 643 1423
email Julie@pdg.co.za
www.pdg.co.za

Mr. Matt Coyne

Climate Change Policy Adviser - Emerging
Economies
DEFRA
Rm 3/B6 Ashdown House
123 Victoria Street
London SW1E 6DE

Tel: 0207 082 8921
Fax: 0207 082 8143

Mr. Rob Bradley

Senior Associate
Climate, Energy and Pollution Program
World Resources Institute
10 G Street NE, Suite 800
Washington, DC 20002
USA
+1 202 729 7645
Email: rbradley@wri.org

Mr. Zhuang Guiyang

Research Centre for Sustainable Development
(RCSD)
Chinese Academy of Social Sciences (CASS)
Address: Room 1502# of CASS Building,
No.5 Jianguomennei Dajie,
100732, Beijing, China
Tel: 86-10-85195788
Fax: 86-10-85119035

ANNEXURE III

Presentations