

# CLIMATE CHANGE and SUSTAINABLE DEVELOPMENT

## SUMMARY OF THE SCOPING STUDY<sup>1</sup>

### EXECUTIVE SUMMARY

The International Institute for Environment and Development together with the Regional and International Networking Group members in India, Kenya and Senegal carried out a consultation exercise to identify the priority research and policy issues for the most vulnerable countries and communities in different regions in the South.

The main findings of the scoping study are:

- Priority geographic areas in terms of likely climate change impacts are: South Asia - semi-arid lands (India and Pakistan), coastal zones (Bangladesh, India and Sri Lanka), mountainous areas (Nepal, Bhutan and N. Pakistan), floodplains of major rivers (India and Bangladesh); East Africa - semi-arid lands (Kenya, Sudan, Ethiopia, Eritrea and Tanzania), coastal zones (Kenya and Tanzania), floodplains (Kenya, Sudan and Uganda), mountainous areas (Kenya, Uganda and Tanzania) and West Africa- semi-arid lands in the Sahelian countries, coastal zones and floodplains (Senegal and Gambia).
- Climate change impacts and adaptation require 'mainstreamed' into development planning and practice from the global to national and local levels. Critical research questions and knowledge gaps relate to information about how climate change impacts may hinder achievement of national development objectives and how adaptation may help these objectives to be achieved. Linkages to other multilateral environmental agreements (MEAs) are also needed.
- NAPAs<sup>2</sup> and other national strategies and plans provide potential policy 'hooks' on which to link research on climate change impacts and adaptation offering opportunities for debate and expressing demands for planning and risk assessment.
- There is a case for enhancing capacities to use climate models at regional scale within the key regions in the developing world. In addition, the current generation of impact scenarios could be used to trigger research on adapting to shorter-term climate risks.
- The consultation process identified both key cross-sectoral issues and those sectors within which climate change research is most urgently required. Understanding vulnerability and

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<sup>1</sup> This document was prepared from outputs prepared by IIED consultants. Parts that are underlined signify recommendations from the report.

<sup>2</sup> National Adaptation Plans of Action

exploring ways to enhance poor people's adaptive capacities are considered to be the highest priority for cross-sectoral research. Priorities for sectoral research vary across regions. However, agriculture and food security, water and human health are important across Africa and South Asia (the scoping study has revealed many sub-themes within these sectors).

- Capacity development to conduct and to use climate change research was prioritised. Multi-country regional institutions have a mandate to work on regional issues, often including environmental issues, most of them lack the resources to generate the information needed to guide policy-making at the regional level. National level policy-makers were found to be largely unaware of the potential climate change impacts. Local communities while being the most vulnerable to the impacts of climate change, are also the most difficult to reach in terms of appropriate messages.
- Research organisation and management needs to address how best to:
  - a) promote South-South Collaborative Research especially between Asia and Africa;
  - b) link research to policy-making giving emphasis on getting research messages to appropriate target groups;
  - c) link research to practice;
  - d) link research to existing local knowledge of climate related hazards;
  - e) link research to appropriate target institutions (GOs as well as civil society) to ensure research uptake.
- Opportunities to collaborate with or support ongoing initiatives include:
  - a) National Adaptation Plans of Actions - linking research with the LDCs, using the NAPAs could encourage quick research uptake into national policy-making,
  - b) CGIAR - has been looking at establishing a 'Climate Change Challenge Programme'.
  - c) AIACC/START - the Assessment of Impacts and Adaptation to Climate Change in multiple regions and multiple sectors is currently seeking funding for a second phase;
  - d) Sahara and Sahel Observatory - limited capacity to date to integrate climate change issues into activities as little analytical work has been carried out in the region;
  - e) ICPAC - successful network of scientists from the meteorological services and works with agricultural researchers and extension people in E Africa.
  - f) NEPAD - has developed an environmental strategy, which includes a climate change component.
  - g) NETCCIA – India study climate change and agriculture and WB study on adaptation,
  - h) RING/CLACC - programme focuses on vulnerability and adaptation.

## **SUMMARY**

The International Institute for Environment and Development together with the Regional and International Networking Group members in India, Kenya and Senegal carried out a consultation exercise to identify the priority research and policy issues for the most vulnerable countries and communities in different regions in the South.

### **1. OBJECTIVES**

- To establish what developing country stakeholders regard as the most urgent research needs in relation to climate change and its implications for poverty reduction and sustainable development;
- To identify what research other funders have supported, or are supporting, as well as where there are gaps;
- To provide a clear definition of the researchable problems.

### **2. METHODOLOGY**

**Expert Advisory Inputs** - An Expert Advisory Group of approx 20 people, mainly from the South as well as in the UK advised on the main issues and the consultation exercise itself.

**Review of consultations to date and available literature** - An initial review of the available literature on climate change and the poor is to be carried out and presented in the form of a preliminary literature report. The review will also address the interaction of risks and vulnerabilities.

**Case Studies** - A major part of the exercise consisted of three regional (South Asia; East & Central Africa; and West Africa) and country case studies (India; Kenya; and Senegal) to enable more in-depth information to be collected and assessments made. Three national and three regional workshops were held in the selected countries and regions for discussion and validation of the synthesised research priorities faced by those countries and regions.

**LEAD survey** - The information needs of potential user groups and communities in the South was elicited through a survey of the LEAD network. This took the form of an email questionnaire and priority-ranking exercise.

### **3. FINDINGS**

Whilst the scoping team have made a judgement on which overall points to emphasise, they stress that different sectoral, stakeholder, regional and national groups will legitimately have their own

priorities. Many of the climate issues are context-specific. Materials in the different sections of the scoping study report provide rich resource on this more detailed set of views.

### **3.1 Geographic focus**

The geographic focus of the scoping exercise South Asia, East & Central Africa, and West Africa excluded some particularly vulnerable countries such as the small island states. However, results from the three regions and countries provide a broad range of information from which to make useful generalisations.

Scoping the literature reveals that the following geographic areas or countries within those prioritised by the scoping are particularly sensitive to climate change impacts:

- (i) South Asia:
  - a. Semi-arid lands, primarily in India and Pakistan
  - b. Coastal zones, primarily in Bangladesh, India and Sri Lanka
  - c. Mountainous areas, primarily in Nepal, Bhutan and northern Pakistan
  - d. Floodplains of major rivers, primarily in India and Bangladesh
- (ii) East Africa:
  - a. Semi-arid lands in Kenya, Sudan, Ethiopia, Eritrea and Tanzania
  - b. Coastal zones, primarily in Kenya and Tanzania
  - c. Floodplains in Kenya, Sudan and Uganda
  - d. Mountainous areas in Kenya, Uganda and Tanzania
- (iii) West Africa:
  - a. Semi-arid lands in the Sahelian countries
  - b. Coastal zones in Senegal and Gambia
  - c. Floodplains in Gambia and Senegal

### **3.2 Timescales**

Much climate change science focuses on impact scenarios and is done using climate models. These models are increasingly being downscaled from global to regional levels. Such models operate over relatively long time scales, typically 50 to 100 years.

There is certainly a case for enhancing capacities to use climate models at regional scale within the key regions in the developing world. This has been done in India with the UK's Hadley Centre climate model.

There is also a strong case for not waiting for more regional or national scale models. It may be more productive to use the current generation of impact scenarios to trigger research on adapting to shorter-term climate risks. This can be done by assessing the risks of current climate impacts, such as floods, droughts or long term coastal zone salinity changes, on development plans, natural resources, vulnerable communities, etc.

### **3.3 Development Linkages**

The need to have climate change impacts and adaptation ‘mainstreamed’ into development planning and practice from the global to national and local levels has been identified as a priority in several of the consultations. At the global level this requires linking climate change to the Millennium Development Goals (MDGs). Critical research questions and knowledge gaps relate to information about how climate change impacts may hinder achievement of national development objectives and how adaptation may help these objectives to be achieved. Linkages to other multilateral environmental agreements (MEAs) are also needed (in particular to the Biodiversity and Desertification Conventions which have important overlaps with climate change impacts).

At the national level it requires linking climate change impacts and adaptation to national development plans such as the Poverty Reduction Strategy Papers (PRSPs). At the sub-national level it requires improved planning capacities and methods within the agriculture and food, water, forests, coasts and health sectors. At the local level the connection between climate change and poverty/development relates more to the livelihoods and vulnerabilities of specific communities and groups.

The LDCs are currently preparing NAPAs<sup>3</sup>. These, and other, national strategies and plans provide potential policy ‘hooks’ on which to link research on climate change impacts and adaptation offering opportunities for debate and expressing demands for planning and risk assessment.

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<sup>3</sup> National Adaptation Plans of Action

### 3.3.1 Sectoral Development Linkages<sup>4</sup>

The table below summarises the opinions of those consulted during the workshops as to the knowledge base on level of climate change impacts across sectors.

Sectors	Information/knowledge level on climate change impacts		
	South Asia	East Africa	West Africa
Agriculture and food security	Good (e.g. cereal crops in India - see India report)	Moderate	Moderate
Water resources	Good (e.g. floods in Bangladesh - see South Asia report)	Poor	Moderate
Disaster management	Good (e.g. flood management in Bangladesh - see South Asia report)	Moderate	Good (e.g. drylands management - see West Africa report)
Coastal zone management	Moderate	Moderate	Moderate
Health	Poor	Moderate (e.g. malaria in Kenya - see Kenya report)	Poor
Ecosystems	Moderate	Poor	Poor

Stakeholder groups varied in their ranking of the importance of climate change to different sectors. The table shows this for stakeholders in East Africa.

Sectors	Researchers	NGOs	Policy makers
Agriculture and food	High	Medium	High
Water	High	Medium	High
Disasters	Medium	High	-
Health	Low	High	-
Biodiversity	Low	Low	-

#### a. Agriculture and Food Security

This is the sector in most developing countries clearly most at risk from the impacts of climate change (IPCC, 2001). A recent report from the UN Food and Agriculture Organisation (FAO, 2005) states that “in some 54 poor developing countries, with a combined population of 2 billion, including 450 million undernourished people, production losses due to climate change may drastically increase the number of undernourished people, severely hindering progress in combating poverty and food insecurity”.

Some specific research issues were identified in the different regions (see for example Annex 1). These form a rich resource that needs revisited as and when research is being planned in those regions.

<sup>4</sup> The main sectors studied were chosen according to likely climate change risks as well as the availability and relevance of information to potential climate change impacts. These included agriculture and food security, water resources, disaster management, coastal zone management, human health and ecosystems.

#### b. Water Resources

Water resources and their vulnerability to climate change impacts was the second most cited sector in most of the regional consultations. However, the amount of knowledge and prior work on specific impacts varied from region to region - more done in South Asia than in Africa. As an example of the diversity of challenges identified Annex 2 sets out research priorities postulated at the India consultation workshop on climate change and water resources.

It was noted that planners and managers of water resources (e.g for irrigation, flood management and drinking water) in most of the regions have (access to) technical capabilities to include risk management regarding future climate change into their regular practices of designing water structures and measures. Thus, it would be relatively straightforward to develop climate risk management tools and methodologies for use in (large scale) water sector planning and management (Delhi Workshop Report).

#### c. Coastal Zone Management

The consultation revealed coastal zone management as an important sector in South Asia (India and Bangladesh in particular) as well as Tanzania in East Africa, and Gambia and Senegal in West Africa. Some of the specific research themes that were identified are shown in Annex 3.

#### d. Disaster Management

Working with existing institutions to deal with climatic hazards due to current climate variability, in a way that also enables them to adapt to potential future climate change, is a practical strategy for incorporating the climate change issue into disaster management and development. This is already being done in several countries and regions, such as in Bangladesh through the Comprehensive Disaster Mitigation Programme (CDMP), India (through the Drought mitigation programme) and in the Sahel (through the CILSS). Research might identify what has worked best in achieving this particular kind of strategy. Some other specific themes for research identified in this sector are shown in Annex 4.

#### e. Human health

The potential impacts of climate change on human health are amongst the least well known of climate change impacts. Few studies have been carried out e.g. in Bangladesh on floods and in Kenya on Malaria. Climate change impacts on human health were identified in several regions as significant information gaps (e.g. Dakar Workshop Report). Some specific themes for research are shown in Annex 5.

#### f. Energy

The scoping study looked at impacts of climate change on sectors as they related to poverty reduction specifically. Therefore, the energy sector was not a major focus of the scoping study. However, some themes with respect to energy were identified through the exercise (mainly in West Africa). These are shown in Annex 6.

### **3.3.2 Cross-sectoral development linkages**

Research priorities were also identified in themes that have developmental relevance across sectors. The East Africa workshop provided a listing of these (see Annex 7). The cross-sectoral themes where a consensus emerged on priority include: vulnerability and gender.

#### a. Vulnerability

Vulnerability to climate change emerges as a priority research theme from the literature and from consultations. Some attempts have been made to map the most vulnerable regions of countries from climate change impacts as well as from other stresses (e.g. in India). Such mapping of vulnerability should be done across regions and countries<sup>5</sup>. Further suggestions for researchable sub-themes in vulnerability are shown in Annex 8.

Many adverse climate change impacts will fall disproportionately on poor people. However, there are great knowledge gaps in terms of specifying exactly how, and more importantly where and when, those impacts will occur. The main approaches suggested to deal with this gap involve developing the capacities of local, national and regional level institutions to undertake long-term analysis of climate impacts and then link the findings to climate change projections.

#### b. Gender

In the opinion of certain members of the expert panel it is clear that within-group vulnerabilities will differ considerably, and will need to be addressed in any future research agenda that wishes to address the needs of the most vulnerable. Some specific researchable themes suggested are shown in Annex 9.

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<sup>5</sup> Note from CRD - Assessment of vulnerability is an area where research in India has advanced far more than in the other regions where consultation took place. Africa has much to learn from India in this regard.



### **3.4 Capacity development to conduct and to use research**

Generating and using information requires capabilities among both the generators of knowledge (researchers) and the users of knowledge (policy makers, managers or communities). The design of an appropriate research strategy need to appraise both the needs for research outputs and the capacity to utilise what is generated.

a. National level policy-making - needs to be informed of impacts and in order to take appropriate proactive measures, including adaptation. The consultation found that with a few exceptions, national level policy-makers are largely unaware of the potential climate change impacts.

b. Local communities - while being the most vulnerable to the impacts of climate change, are also the most difficult to reach in terms of appropriate messages. Their knowledge about climate change impacts may be quite low, but their knowledge of their own coping capacities and strategies in the face of climatic hazards and risks is high.

c. Professional planners and managers – expertise was found in certain areas. For example, Bangladesh is renowned for the quality and strength of its water resource managers, India for its agricultural professionals, and Kenya for its wildlife managers.

d. Multi-country regional institutions - exist in most parts of the developing world. These include ECOWAS in West Africa, OSS in north and West Africa, IGAD in East Africa, NEPAD in Africa as a whole and SAARC in South Asia. While many of these organisations have a mandate to work on regional issues, often including environmental issues, most of them lack the resources to generate the information needed to guide policy-making at the regional level. Given their existing mandates and their desire to fulfil their mandates, they may, however, be willing recipients of targeted research outputs. Such outputs could focus on regional issues requiring multi-country decision-making, such as in the Sahel in West Africa, Lake Victoria in East Africa and the Sundarbans in South Asia.

### **3.5 Research priorities**

The scoping study considered the relative need for research and information on climate change impacts across regions in cross-sectoral issues and in sectors. Findings are summarised in the table below.

Regions	Cross-sectoral			Sectoral					
	Disasters	Observation, EWS & forecasts	Public education & capacity building	Ag & food security	Water	Health	Energy	Forests	Fisheries
South Asia	High	High	High	High	High	Medium	Low	Low	Low
East Africa	Medium	Medium	High	High	Medium	Medium	Low	Medium	Low
West Africa	Medium	Medium	High	High	High	Medium	High	Low	Low

Source: Workshop Reports (high = mentioned several times, Medium= mentioned twice, Low = mentioned once)

The importance of different fields of research for each region were obtained from the LEAD survey. LEAD members were asked to say which were the most importance research themes for their region. Aggregated rankings within region are shown in the table below.

### **Importance of each field of research - rank within region**

	5.1 Climate modelling & scenarios.	5.2 Impacts of climate change on the natural environment.	5.3 Impacts of climate change on specific sectors (e.g. agriculture, public health).	5.4 Impacts of climate change on specific socioeconomic groups (e.g. women, youth).	5.5 Raising stakeholder awareness of climate change.	5.6 Building capacities to adapt to the impacts of climate change.	5.7 Governance & decision making processes to manage impacts of climate change.	5.8 Monitoring, assessment & institutional capacity to manage impacts of climate change.
Africa	8	3	1	7	4	4	6	2
South Asia	8	2	4	6	4	1	3	6

Respondents from Africa placed *impacts of CC on specific sectors (e.g. agriculture, public health)* as the most important field of research followed by *monitoring, assessment and institutional capacity to manage impacts of climate change* and then *impacts of climate change on the natural environment*. Respondents from Asia prioritised *building capacities to adapt to the impacts of climate change* followed by the *impacts of CC on specific sectors (e.g. agriculture, public health)* and *impacts of climate change on the natural environment*.

### **3.6 Research organisation and management**

During the regional and national consultation exercises, research organisation and support for research was discussed on a number of occasions. There was a clear view that existing developing country research groups should be supported to do research which they feel is a priority and that this should be on a relatively long-term basis, at least for five years rather than just a year or two.

a. Promoting South-South Collaborative Research - several consultation participants commented that whilst it was possible to find opportunities to participate in collaborative research activities with researchers from developed countries (south-north collaboration) it was more difficult to find opportunities or funding to participate in or organise collaborative research between researchers in developing countries. This was especially true across continents, for example between Asia and Africa.

b. Linking Research to Policy-Making - in a number of countries included in the scoping study it was reported that research conducted does not always reach the appropriate users. Such users might include national level policy-makers or natural resource managers, or community level groups such as farmers. It was generally felt that greater emphasis should be placed on getting research messages to appropriate target groups.

c. Linking Research to Practice - opportunities for linking research to practice are perhaps greatest in the water sector where water managers are used to making relatively long-term planning decisions.

d. Linking Research to Existing Local Knowledge - participants in the consultations often commented on the value of local people's knowledge of climate related hazards. The Nairobi workshop report describes how local / indigenous 'shamans' may not have accurate prediction capabilities, but can nevertheless be used as useful channels for information dissemination.

e. Linking Research to Appropriate Target Institutions - when conducting research in developing countries it is important to identify suitable institutions to conduct the research, such as universities or research institutes. But it is also important to ensure that the research is linked to an appropriate institution to ensure research uptake. Such target institutions may include government ministries, such as the ministry of water resources for a water sector related research project, or the ministry of agriculture for an agriculture related research project.

### **3.7 Opportunities to Collaborate with or Support Ongoing Initiatives**

This list is by no means exhaustive nor is it a list of recommended initiatives.

a. National Adaptation Plans of Actions (NAPAs) - over the next two years, almost 50 of the LDCs will be conducting their respective NAPAs. These are being funded by the LDC Fund created under the UNFCCC (at COP7 in Marrakech in 2001). The Global Environment Facility (GEF) is disbursing funds. Most LDCs are in sub-Saharan Africa and the others are in South and South-east Asia. NAPAs will be important instruments for national policy-making on adaptation to climate change. However, they are based on rough-and-ready procedures (according to UNFCCC guidelines) with relatively little scientific basis. They nevertheless represent a first step for each LDC to establish some in-country knowledge on adaptation to climate change. Linking research with the LDCs, using the NAPAs as an important national policy-making hook, could encourage quick research uptake into national policy-making.

b. Consultative Group on International Agricultural Research - many of the CG centres are in regions likely to be impacted by climate change. The CGIAR has been looking at establishing a 'Climate Change Challenge Programme'. Supporting such efforts would provide opportunities to utilize and build upon a sizable resource of existing scientific and technical human capacity already present in key vulnerable locations in developing countries.

c. AIACC/START - the Assessment of Impacts and Adaptation to Climate Change in multiple regions and multiple sectors (AIACC) project has been operating for about three years. The first phase has been managed by the START and Third World Academy of Sciences (TWAS) with funding from GEF and support from UNEP. AIACC has supported over 30 research projects covering around 60 developing countries in Africa, Asia and Latin America. It has also covered different sectors including agriculture, water, and health. The scientists participating in AIACC have produced numerous scientific papers. Several have also been selected to be Lead Authors in the preparation of the fourth assessment report currently being prepared by the Intergovernmental Panel on Climate Change (IPCC). AIACC is currently seeking funding for a second phase.

d. Sahara and Sahel Observatory (OSS) and CILSS - during the past ten years or so OSS has initiated a work programme in arid, semi arid and sub-humid areas in North, West and East Africa including long-term observations and networks focusing on land degradation issues. A series of biophysical indicators have been identified and collected. Each of the three sub-regions

needs to come up with a minimum set of indicators including biophysical, socio-economic issues that will help to assess their vulnerabilities to climate change and thus identify potential action for adaptation. In North Africa, the Union of Maghreb Arab organisation has a mandate to develop policies related to all environmental issues within member countries. In West Africa, the Comite Inter-etat de Lutte contre la Secheresse au Sahel, (CILSS) and in Eastern Africa, the Inter Governmental Authority for Development, are playing a similar role. These regional organisations have limited capacity to integrate climate change issues into their activities as little analytical work has been carried out in the region to date. These three organisations are all members of OSS and the outputs of any research activities conducted through OSS would therefore be integrated into their strategic work programmes.

e. ICPAC project - has been working in the IGAD Greater Horn of Africa region for a number of years. It provides seasonal weather forecasts to policy-makers and farmers. It has established a very successful network of scientists from the meteorological services and works with agricultural researchers and extension people working in countries in this region. It has an annual meeting where the groups get together to produce seasonal forecasts and then disseminate these to their target audiences. So far it has concentrated on short-term seasonal forecasts only but it has the capacity and interest to work on climate change linkages. It has the advantage of having a well-established reputation and large network in the countries in which it operates.

f. NEPAD - has developed an environmental strategy, which includes a climate change component. This in turn includes both adaptation as well as mitigation. NEPAD has the pan-African mandate to conduct a number of activities but lacks the resources to do so. A multi-African country research project/programme could be linked to NEPAD as a target institution.

g. NETCCIA

The government of India is taking forward a project by the Indian Council of Agriculture Research to study in detail the impacts of climate change on specific crops in the agriculture sector. There is also a related study on vulnerability and adaptation being supported by the World Bank and DFID in India.

h. RING/CLACC - The Regional and International Networking Group on sustainable development is a well established network of research and policy related institutes (all in the non-government sector), which have worked together for many years on issues related to all aspects of sustainable development. The RING has a climate change programme that focuses on vulnerability and impacts of climate change as well as on adaptation. The main activity of the programme relates to strengthening civil society in the LDCs on adaptation to climate change (the CLACC project) in which 12 LDCs (nine in Africa and three in South Asia) are included. The project works through NGO partners in each country and aims to build civil society capacity, particularly amongst the most vulnerable communities and groups.

## Annex 1

### East Africa – Agriculture and Food Security Research Themes/Problems

- Climate Forecasting (Developing reliable indicators, packaging and dissemination of information-RANET Programme), reliable models, scenarios and indicators.
- Downscaling global models
- Identification/development of appropriate/improved crop varieties
- Potential impacts of high temperatures to dairy industry
- Risk of pests and diseases
- Risk of land degradation (soil erosion especially areas of increased rainfall, desertification-Sudan)
- Public-private partnerships
- Hydro-climatic zoning
- Markets and relationship to poverty
- Most vulnerable sectors in society
- Post harvest storage/losses
- Coping strategies in relation to on-going change
- Social cultural impacts
- Policies and institutions that (dis)encourage adaptation strategies
- Community capacity to deal with challenges
- Efficient utilization of water for irrigation
- Land-atmosphere interactions
- Use of long-term daily climatic data to characterize and map the probability of success of agriculture in the context of climatic variability and climate change.
- Identify small scale income generating options
- Impact of shifting AEZ on crops/animals

Source: Nairobi Workshop Report

### West Africa and Sahel

- Control over water (desalinification techniques, effectiveness of artificial rain, studies on retention basins, etc.)
- Adaptation strategy for agro-forestry and analysis of the long-term sustainability of this in the face of climate change (and resultant temperature rises, increased CO<sub>2</sub> concentration, hydric stress, etc.)
- Research into reclamation of land degraded by salinification
- Analysis of how small farmers welcome the measures identified
- Devise strategy for prolonging the crop-growing calendar in the Sahel: review farming systems and try to design new ones so that land can be farmed for more than just the three years of the hot seasons)
- Improve methods for conserving and processing agricultural products
- Implement new knowledge in the form of better practices
- Raise awareness and spread word of climate change research findings

Source: Dakar Workshop

### India

Except for a few studies, most of the studies broadly discuss the physical extent of impacts and exclude entirely associated socio-economic linkages. Cross-sectoral linkages have been addressed but there is still scope for refinement in the methodologies that have been used. Changes in water availability under a climate scenario and socio-economic response to these changes would affect water requirements in future and its consequent impact on agriculture. Specific case studies require to capture the regional dimensions of change.

Source: TERI, India scoping study

## Annex 2

### India

- There is scope for carrying out experiments with different scenario runs to observe the range of expected changes and study consequent impacts.
- Impacts of these changes on ground water resources have not been studied at greater lengths. This would be important in the light that ground water resources constitute a major component of the total available water resources. Also utilisation of ground water resources is predicted to increase tremendously in the coming years to meet agricultural demands.
- Studies have focussed more on the physical aspects of changes ignoring the socio-economic aspects altogether. Human interventions related to dams and diversions under present-day conditions have not been considered. Also land use scenarios for the future have not been considered.
- Cross-sectoral impacts need to be linked and studied
- Impacts of climate change on natural disasters such as droughts and floods needs to be looked into
- Regional and local dimensions of vulnerability will have to be studied through a case studies based approach to highlight the micro-level implications of vulnerability. Modelling based approaches should be supplemented with case study based approaches for in-depth and detailed review. There is scope to carry out vulnerability studies in the identified vulnerable regions/ hot spots to assess current adaptive capacities of socio-economic systems to changing conditions. Policy review in these regions would further highlight the kind of strategies that need to be formulated for adaptation.
- Vulnerability mapping is required to highlight regions of high and low vulnerability in the country.
- Specific studies can be carried out in various watersheds to identify water-stressed regions.
- Only one model (SWAT) has been used for impact assessment. Assessment with other models like CropWat or ModFlow should be done and results compared
- Studies have not integrated availability with water requirements for domestic, irrigation or industrial needs across different spatial scales.

Source: India scoping study

## Annex 3

### Coastal Resources - Research themes/problems

- Estimate risk of erosion, salinity and temperature variations to predict sea level rise
- Risk of saline water intrusion in coastal aquifers
- Effect of climate induced sea level rise
- Effect on marine biodiversity
- The rich Somali currents

Source: Nairobi workshop report

### Research issues and gaps in climate change vulnerability and adaptation studies in India

- Vulnerability assessment for all coastal districts has been done taking into account most of the physical and social impacts. There is now a need to integrate this more strongly with the economic activities in coastal areas. Apart from physical changes, pressures from coastal tourism, agricultural activities, and impact on different communities in the Sunderbans and coral reefs need to be studied in greater detail. These pressures include farming (salt water intrusion both surface and ground water), fishing (decline in catch due to warming trends in sea surface temperatures), and other impacts on specific coastal ecosystems.
- Cyclone-related risks in coastal regions need to be assessed; and preparedness and relief measures to cope with such hazards should be promoted
- Specific case studies can be carried out as a second level assessment to study most of the aspects mentioned above.

Source: India scoping study



#### **West Africa: Coastal Zone Research Priorities**

- Develop models on the impact of climate change (sea level rises, etc.) on coastal structure and infrastructure, etc.
- Populate data bases further in order to build more reliable models
- Design adaptation strategies for coping with rising sea levels

Source: Dakar Workshop Report

#### **Annex 4**

##### **East Africa – Disasters - Research themes/problems**

- Mapping of both drought and flood risks (damage to economies and public health problems)
- Delinking climate change and disaster
- Disaster preparedness and early warning systems - thresholds for various systems
- Costing impacts of droughts and floods
- Existing coping mechanisms of communities
- Mechanism of extreme climate events

Source: Nairobi workshop report

#### **Annex 5**

##### **East Africa – Health - Research themes/problems**

- Development & Validation of predictive models for more targeted and effective control of climate sensitive diseases
- Socio-economic and political factors that help to address the problems (especially for most vulnerable groups).
- Role of agroforestry and reforestation in disease vector control/ medicinal value of plants
- Review of health policies
- Climate, agriculture and nutrition
- Health infrastructure
- Health Data rescue improving data management for Climate Related Diseases
- Climate and other diseases e.g. HIV/AIDS

Source: Nairobi workshop report

##### **Health Research Priorities**

- Studies on diseases caused by the environment (infectious diseases, allergies, etc.)
- Studies of water-related diseases

Source: Dakar Workshop Report

## Annex 6

### Energy - Research themes/problems

- Improving access to renewable energy technology.
- Hydrological changes, climate forecasting and HEP Generation
- Impacts of land use changes on biomass energy
- Energy policy review & reforms
- Review of energy codes based on extreme events
- Impacts on hydraulic structures

Source: Nairobi workshop report

### Fuel poverty, adaptation and mitigation for the poorest

Decarbonisation strategies have often had significant impacts on fuel availability for the chronically poor, particularly through changes in health and well-being. Analysis of the interactions between fuel use, health, technological change and gender and social aspects of decarbonisation strategies should focus on how the trade-offs between increased prosperity and consumption, and environmental health are negotiated.

Source: Katrina Brown and Neil Adger, Tyndall Centre

### East Africa – Energy Research Priorities

- Devise appropriate technologies relating to new and renewable energies, especially in rural areas
- Dissemination of energy-efficient policies
- Examine rational management of biomass resources and how they can be harnessed for fuel purposes
- Explore opportunities for investing in the promotion of more effective and energy-efficient power stations (technology transfer)

Source: Dakar Workshop Report

## Annex 7

### East Africa – Cross-cutting issues - Research themes/problems

- Indigenous Knowledge and how it can be used to build resilience to future climate change
- Equity in impacts and adaptation
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- Policy linkages of research
- Vulnerability of different location and groups to climate change impacts
- Science-policy/society linkages
- Land use change and linkages to climate change impacts
- Multidisciplinary research on impacts, vulnerability and adaptation to climate change
- Capacity building on adaptation to climate change
- 
- Socio-cultural/economic impacts

Source: Nairobi workshop report

## **Annex 8**

### **Research issues and gaps in climate change vulnerability and adaptation studies in India**

- Case study approach including people's perception on changes in observations to supplement modelling based studies
- Vulnerability mapping of the resource will help in delineation of resource-constrained regions
- Associated cross-sectoral linkages – impact on water linked to agriculture
- Climate change impact on natural ecosystems including mangroves, wetlands, marine ecosystems, coral reefs, and grasslands has not been assessed but examples from the literature have been cited.

Source: India scoping study

## **Annex 9**

### **Gender**

Authoritative research based on scientific empiricism on how gender issues can affect climate policy development is needed to address analytical gaps that exist in the literature. Closer attention should be paid to adaptation as a tool in reducing structural constraints and militating against the harmful effects of climate change. The role of policy to address gender imbalances and environmental management is equally important to set the tone, not just at the international level but at local and national levels where implementation is often lacking. Gender-related concerns have the potential to rock the very foundations of sustainable development and threaten the legitimacy of the climate regime. If policy makers and development analysts continue to ignore gender issues, they do so at their peril.

Source: Fatima Denton, ENDA

### **Gender impacts of both climate change impacts and of measures to reduce emissions.**

The impact of climate change and climate variability on different sections of society, particularly women, has largely been overlooked. Evidence from diverse fields suggests that women may have distinct vulnerabilities to climate change in poor countries. Research on quantifying and alleviating this element of vulnerability is vital to designing both mitigation and adaptation policies which alleviate impacts on the most vulnerable.

Source: Katrina Brown and Neil Adger, Tyndall Centre