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CLIMATE CHANGE AND DEVELOPMENT

CONSULTATION ON KEY RESEARCHABLE ISSUES

**SECTION 8
CONCLUSIONS
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1. Introduction

This section presents some conclusions on identifying key researchable issues and processes. It draws on material presented in the preceding sections, including the scoping study, regional and country-specific scoping studies and consultations, inputs from experts, questionnaire survey results and participation by the authors in some of the workshops. Whilst we have made a judgement on which overall points to emphasise, we must stress that different sectoral, stakeholder, regional and national groups will legitimately have their own priorities. Many of the climate issues will be context-specific. Materials in the preceding sections provide rich resource on this more detailed set of views.

2. Major Stakeholder Groups

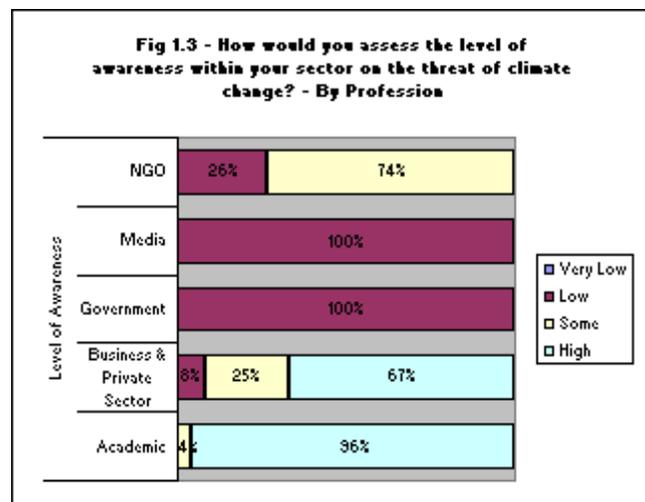
For the purposes of framing research questions on climate change and development and designing an appropriate research strategy to answer those questions, the following were considered to be the major stakeholder groups:

- (i) Researchers and academics, distinguishing between those located in developed countries and those located in developing countries.
- (ii) Policy makers at national, regional and local levels.
- (iii) Resource managers and sectoral planners, for example in the water, agricultural, coastal zone, energy sectors, etc.
- (iv) Local governmental or non-governmental institutions involved in natural resource management or working in climate sensitive areas, such as areas prone to floods or droughts.
- (v) Vulnerable communities, such as fishers, farmers, pastoralists, women, etc.
- (vi) Media, including both print and electronic forms of outreach.

The LEAD survey allowed a breakdown of awareness amongst different stakeholder groups.

There are very significant differences when we break down the answers to Question 1 by the profession of the respondents.

All the professionals from Media (9) and Government (28) state the awareness in their sector to be Low. In stark contrast, 96% of Academics (48) put the awareness in their sector as High. Also of some interest is the high number (16) of Business and Private sector representatives who say that say



awareness in their sector is High – 67%. In comparison, a similar percentage of NGOs 74%, (25), say that awareness within their sector is Some. None in this sector characterise awareness as High.

3. Geographic Focus

The geographic focus of the scoping exercise was confined to South Asia (with a particular focus on India), East Africa (with a particular focus on Kenya) and West Africa (with a particular focus on Senegal). Large parts of the developing world including important countries and regions such as China, Brazil and all of Latin America were therefore excluded. Some particularly vulnerable countries such as the small island states were also excluded from the regional and country specific scoping exercises. However, results from the three regions and countries provide a broad enough range to make some useful generalisations. Moreover, methods used for the regional and country specific scoping studies may be replicated in other areas should this be of interest.

Climate change scenarios derived from modelling are often only available at regional scales and rarely at country level. Some actions to deal with the impacts of climate change may therefore need to be done at the regional scale. Adopting a multi-country regional geographic focus allowed this consultation to use these scenarios and investigate the appropriate focus for regional research.

On the other hand, policy making is still conducted mostly at the national level, and sometimes at the sub-national level. This consultation therefore also looks at single country processes in order to link potential climate change impacts with research topics which could feed into policy making at national level.

Many climate change impacts that affect the most vulnerable groups will occur at a very local level. These groups and their representative institutions also need to be brought into the analytical framework. This was not possible throughout this scoping exercise, although the workshop reports illustrate efforts made to bring in representatives of such groups wherever possible.

Resource managers and sectoral planners, for example in the water, agricultural, coastal zone and energy sectors, operate at a level between the local community and national policy makers. Such individuals were well represented in nearly all of the regional and country specific consultations and workshops.

Media stakeholders were not well represented in the regional or country specific reports, but they were represented in the LEAD survey.

3.1. Global Geographic Priority Areas

Scoping the literature reveals that the following geographic areas or countries are particularly sensitive to climate change impacts:

- (i) Small island developing states (identified in the UNFCCC)
- (ii) Least developed countries (identified in the UNFCCC)
- (iii) Africa (based on IPCC assessments and poverty criteria)
- (iv) Asia (based on IPCC assessments and poverty criteria)
- (v) Coastal zones (identified in both the IPCC and the UNFCCC)
- (vi) Semi-arid and arid zones (identified in both the IPCC and the UNFCCC)
- (vii) Mountain ecosystems (identified in both the IPCC and the UNFCCC)

These are therefore priority adaptation areas, which need research on impacts, vulnerability and adaptation. These will need to be focused on specific types of location.

3.2. Priority Locations Within the Three Regions

Within the three regions examined in this consultation, the following list of priority locations is offered, but is not:

- (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

Table 1: Priority issues to included in climate change vulnerability assessment and adaptation

Issues	Sector	Region	Time scale
Vulnerability mapping	All sectors: agriculture, water, land, forests, coastal areas, fragile natural ecosystems, health	Macro and micro level assessments	Short to medium term
Impacts of sea level rise on coastal ecosystems	All sectors	Vulnerable coastal areas	Medium term
Impacts of climate change on wetlands	Soil, water, flora and fauna, biodiversity		
Impact of rising snow line on grazier communities	Fragile ecosystems	Specific case studies in hilly terrains	Medium term
Impact of climate change on sensitive ecosystems including coral reefs and mangroves	Fragile ecosystems	Gulf of Kutchh, A&N island, Sunderbans	Medium term
Impacts of extreme climatic events e.g. droughts, floods, cyclones	All sectors	Pilot studies at micro and macro level	Medium to long term
Melting of glaciers and its impacts on stream flows and water availability	Water	Selected glaciers in the country	Medium term
Community based natural resource management for climate change adaptation	Agriculture, land, forests, water, wetlands	Pilot studies at village and district level Implementation	Medium term Medium to long term
Role of IT in climate change adaptation	Agriculture, aquaculture, natural disaster management	A few pilot studies and field-testing.	Medium term

		Implementation in a few cluster of villages	Medium to long term
Nexus between climate change, poverty, livelihood and sustainable development	All sectors	Macro level	Medium to long term
Awareness generation and capacity building on climate change vulnerability and adaptation issues	Agriculture, water, land, forests, coastal areas, fragile natural ecosystems (mangrove, coral reefs, wetlands, fresh and marine water resources etc.), health	District / state / country (micro and macro level)	Medium term

Delhi Workshop Report, 2005, p-

- (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

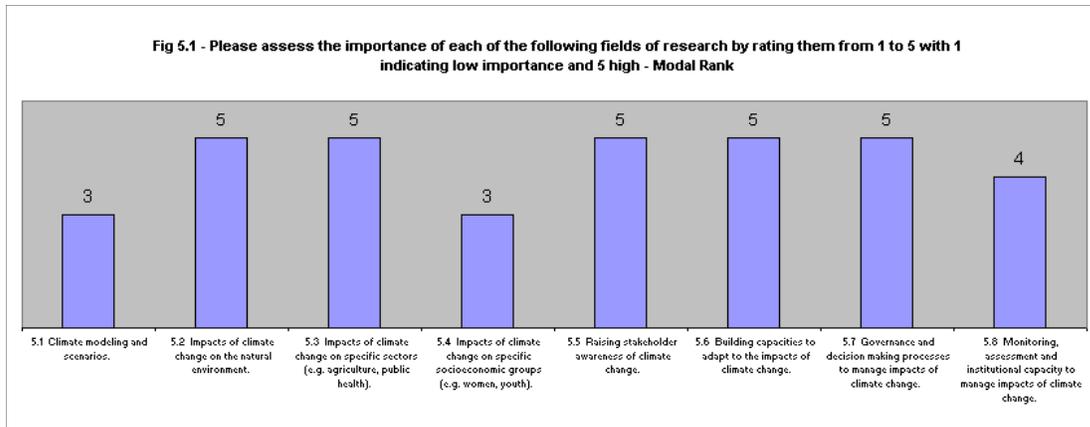
- (iii) West Africa:
 - a. Semi-arid lands in the Sahelian countries
 - b. Coastal zones in Senegal and Gambia
 - c. Floodplains in Gambia and Senegal

4. 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 (see India scoping study, p-).

However, there is also a strong case for not waiting for more regional or national scale models which can generate climate change impacts at a finer scale over a period of 50 to 100 years. 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. The next challenge will be to enhance the capacities of target groups, such as resource managers, planners or communities, etc. to adapt to both current climate variability as well as future climate change. The different sections of this consultation, particularly the LEAD survey, clearly indicate that research and action on adaptation to climate change need not wait for better climate scenarios.

Figure 1: The relative importance of different fields of climate change research



LEAD Survey Report, p-

5. Development Linkages

Climate change impacts will cross a broad range of development sectors and activities. 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 (Delhi Workshop Report, p- and Nairobi Workshop Report, p-). At the global level this requires linking climate change to the Millennium Development Goals (MDGs). 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.

5.1. Global and Regional Development Linkages

At the global level, the highly sensitive links between climate change impacts and the MDGs have been highlighted in both the literature reviews and the consultations. These point out that climate change should not only be a concern of the ‘environment MDG’ (MDG7), but is also relevant to many of the other MDGs. This includes those related to poverty reduction as well as water, sanitation etc. Yet there is no recognition of this within the MDGs framework.

Many of the MDG targets for 2015 are unlikely to be met due to the potentially adverse impacts of climate change across the globe. Research questions and gaps in current knowledge include identifying exactly how the MDGs, individually and collectively, might be affected by climate change and determining specific adaptations which could help meet the MDG targets as well as build resilience to the impacts of climate change.

At the regional level, impacts are likely in areas such as the Sahel in Africa or the Ganges Brahmaputra river basin in South Asia. This may require action at the multi-country or regional scales. Where there are appropriate multi-country institutions, such as the South Asian Association for Regional Cooperation (SAARC) in South Asia, the CILSS in West Africa or NEPAD in Africa, these institutions may be key partners in multi-country regional research efforts.

Adaptation Research Needs: The Aggregate Potential of Adaptation

How could aggregate net benefits of adaptation be measured? Adaptation might be factored into general equilibrium models of the global economy so that total climate impacts with and without adaptation could be estimated. In such an exercise different assumptions about the amount and kind of adaptation could be tested. It might also be possible to measure the costs and benefits of adaptation empirically in specific localities or by sectors up to the global scale. The considerable data and measurement problems involved seem to have largely inhibited this research. It is not about time for the adaptation research community to begin thinking more seriously about the aggregate potential of adaptation?

Source: Ian Burton, section 2.3 Disasters

Risk-based approaches

It is now possible to use a risk-based approach to adaptation decisions as the foundation for evaluations of the value of mitigation. This takes variable returns rather than just the mean into account. The idea would be to compute a 'willingness to pay' measure based on risk aversion for various levels of mitigation. For example, some studies are being conducted for possible dam projects (with various designs) in Ghana; many climate change scenarios would make the dams more productive. Mitigation would be potentially harmful (for example for some argue this for US agriculture). Nonetheless, uncertainty surrounding future climate still reduces the expected discounted utilities of the projects sufficiently to dominate the 'average' effect so that mitigation actually has some economic value.

Source Gary Yohe, personal communication 2005

An adaptation protocol

A useful research issue could be looking at the potential and drawbacks of an Adaptation Protocol. What could/should it include, would it be useful etc.

Source: Benito Müller, Oxford Climate Policy Institute, personal communication 2005

5.2. National Development Linkages

Numerous policy-making initiatives and instruments operate at the national level. These vary from country to country. However, most countries have some sort of central planning ministry, which prepares periodic development plans. For example, India has a five-year development plan. Many countries also are preparing National Sustainable Development Strategies (NSSDs) and Poverty Reduction Strategy Papers (PRSPs). The Least Developed Countries (LDCs) are currently preparing National Adaptation Plans of Action (NAPAs). These, and other, national strategies and plans provide potential policy 'hooks' on which to link research on climate change impacts and adaptation, through e.g.

offering opportunities for debate and expressing demand for planning and risk assessment.

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). An example is the work by Mohan Munasinghe using the Action Impact Matrix (AIM) methodology to link climate change impacts to development in Sri Lanka.

5.3. Sectoral Development Linkages

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, health and ecosystems. In the case of the energy sector, although it is of major relevance for poverty and development, as well as for its emissions of greenhouse gases (and mitigation efforts), it was not considered in this review as it is of less relevance to the impacts and adaptation issues which were the primary focus of this exercise.

Determining the cause of a changing environment

In a developing country like Bangladesh, we need to determine the actual environmental change happening under a changing climate. It has been said that increasing salinity in the southern part of Bangladesh has been caused by the impact of the Farakka barrage on the River Ganges in India. At the same time, it has been said that climate change could increase salinity in the southern part of Bangladesh. Several similar issues are attributed to climate change as well as other causes. We need to determine the actual reasons for changing natural characteristics in areas vulnerable to climate change.

Source: Anisul Kabir in section 2.4 Coasts

Some of the major findings for the different sectors in the different regions are given below:

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

Based on regional reports for South Asia (p-), East Africa (p-) and West Africa (p-)

Some results of the ranking of importance of climate change the different sectors by those consulted in the different regions is shown below.

Ranking of importance of climate change to sectors in the three regions

Sector	S. Asia	W. Africa	E. Africa
Agriculture and food	1	1	1
Water	2	1	3
Costal zone management	3	3	6
Health	-	2	2
Energy	6	4	5
Disasters	5	-	4
Biodiversity	4	-	2

Nairobi, Delhi and Dakar Workshop Reports

Confident differentiation of the rankings by different stakeholder groups was not possible in all three regions, but an example from East Africa is shown below.

Ranking of importance of climate change to sectors by different groups 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	-

East Africa Report (p-)and Nairobi Workshop report (p-)

The LEAD Survey results showed a similar result for a broader range of regions.

Most affected by climate change - rank within region

	Disaster Management	Agriculture and Food Security	Public Health	Water Resources Management	Other Natural Resources	Peace and Security	Infra-structure
Africa	4	1	3	2	5	6	7
Asia Pacific	3	2	5	1	4	7	6
Eastern Europe	1	2	3	4	5	7	6
Europe	3	1	4	1	5	7	6
Latin America	5	1	4	2	3	6	7
North America	3	1	6	2	5	4	7
South Asia	3	2	4	1	5	6	7

LEAD Survey,(p-)

The breakdown of the rank within region show agriculture and food security to be ranked first within four regions and second within three; similarly, water resources management was ranked first by three regions and second by three. A significant difference was that Eastern Europe ranked water resource management fourth, with disaster management the sector most likely to be affected by climate change.

All regions followed the trend of placing infrastructure and peace and security as either the sixth or seventh most important except North America which had peace and security in fourth. Other natural resources were placed fourth or fifth by 6 of the regions; Latin America however put it as the third most likely to be affected.

Public health was third or fourth most likely to be affected for all regions with the exception of Asia- Pacific (fifth) and North America (sixth). In placing disaster management fifth Latin America were some way lower than all the other nations.

Similar results were also obtained from the LEAD survey for different professions responding.

Mean rating ranked within Profession

Most significant impact of climate change - rank within profession

	Increased poverty	Degraded environmental resources	Increased risk to economic investment	Health impacts or loss of life	Damage to infrastructure	Migration or displacement of populations
Academic	6	1	3	2	4	5
Business & Private Sector	3	1	6	2	4	5
Government	1	2	3	4	6	5
Media	2	1	5	3	6	4
NGO	2	1	5	3	6	4

Degraded environmental resources were, on average, rated as the most significant impact of climate change by all professions except government, which placed it second. Increased poverty was first or second for Government, Media and NGO and third for Business and Private Sector. Academics rated it as the least significant impact of CC. Academics and Business and Private Sector both placed health impacts and loss of life as their second most significant impact, Media and NGO third and Government fourth. Academics and Government rated increased risk to economic investment third; the others ranked it fifth or sixth. Damage to infrastructure was rated as the least significant impact of the six by 3 of the professions.

5.3.1. Agriculture and Food Security

The agriculture and food security sector in most developing countries is clearly the sector 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 540 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”.

Agriculture was also the sector most cited by both researchers and policy makers in each of the three regions where consultations were held. In some regions and countries (e.g. India and Kenya) there are already existing agriculture research institutes (e.g. the Indian Council for Agriculture Research in India and the CGIAR institutes in Kenya) which are already involved in looking at climate change impacts on particular crops (e.g. wheat and maize) as well as particular vulnerable zones (e.g. semi-arid and arid lands). Thus the research on agriculture and climate change impacts is ready to be mainstreamed into the research community dealing with those sectors (Delhi and Nairobi Workshop Reports).

Some specific research issues were identified in the different regions, as shown below. These form a rich resource which should be revisited as and when research is being planned in those regions.

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, p-

West Africa and Sahel

Technologies and supportive policy for resilient agricultural systems: Addressing the entangled issues of food insecurity, poverty and environmental degradation in the Sahel is a matter of great urgency, especially with the prospect of climate change. One salient aspect of climate change, however, is that nobody knows exactly the magnitude (and sometimes direction) of the changes in climate variables, especially precipitation. Climate models are based on scenarios and can, at best, give a range of possible (sometimes conflicting) outcomes. This can make the design of adaptive options for the future a difficult task. The focus, therefore, should be on how to develop a mix of no-regret technology options and policies geared at promoting the emergence of productive, sustainable, and flexible agricultural systems that show enough resilience regardless of the direction and magnitude of climate change.

Exploring current adaptive methods and strategies: Another important question is how relevant are the adaptive

methods and strategies that are used now and how effective they will be in coping with both current stresses and with the occurrence of climate change. Whereas modelling exercises have allowed us to have a better understanding of the likely behaviour of cereals and other crops when the climate changes in the future, there has been little emphasis on tree-based systems. For instance, agroforestry provides a rich set of promising technologies that can (biophysically and economically) buffer against current climate variability and food/income risks, but little is known about the possible impacts of higher temperatures, increased atmospheric carbon dioxide and shift in rainfall pattern on the agroforestry tree species on the one hand, and on their interactions with food crops on the other hand. For example, in a drier or warmer climate tree–crop competition for water could intensify. What will be the trade-offs between this type of effect and positive impacts such as microclimate effects and soil protection? The research community, together with policy makers and development agencies, should start to think about this kind of outcome. Otherwise, there is a high risk of losing the gains of agricultural research to climate change. Given the facts that the lives of millions of people are at stake, and that research is a medium- to -long-term process, we can hardly afford to adopt a wait-and-see attitude.

Source: Serigne Kandji, ICRAF

- Which livelihood systems are most vulnerable in the Sahel and what makes them most vulnerable? Understanding the nature of vulnerability and impacts is a first and necessary step towards developing effective and sustainable adaptation strategies for the region.
- What is the mechanism through which a household or vulnerable group becomes vulnerable? Vulnerability is a process through time and efforts should be made to understand the dynamics of vulnerability. While the physical sciences have recognized the need to set up monitoring stations to collect temporal data on climate, we also need to set up human monitoring stations to collect data on human systems to be able to monitor human systems in a bid to understanding temporal nature of vulnerability.
- What is impact of climate change on socioeconomic development in the West African Sahel? Climate change is not the main problem facing the Sahel; it is one of the many stresses. However, it has the capability of reversing the modest socioeconomic gains that have been achieved in the past decade. The achievement of the Millennium Development Goals can be hindered by climate change. It is therefore important that research be conducted on the implications of sustained droughts in achieving the Millennium Development Goals.

Source: Tony Nyong, University of Jos, Nigeria

- 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 CO₂ 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 Report,p-

Bangladesh

- Information available on the climate change impacts on agriculture requires validation in order to generate packages of adaptation measures for agricultural production.
- A working group should be formed involving all relevant organizations GOs and NGOs so that the required data/information could be collected/generated. A National facility should be developed to conduct phytotron (plant growth chamber) experiments under simulated climate change scenarios.
- Since climate change and sea level rise will have adverse effect on the ecosystems, many important germplasm are likely to be destroyed. Research should be initiated to preserve the vulnerable species of crop, fisheries, and livestock. Genetic tolerance to adverse environment/improvement must be achieved in order to have sustainable food security and development. Research should be undertaken for screening of genotypes for withstanding adverse edaphic, environmental, and climatic conditions; and also developed/introduced low moisture consuming crops/cropping patterns.
- In combating agricultural vulnerability to climate change and sea level rise, remote sensing and GIS technologies should be used.

Source: Z. Karim, Arannayk Foundation, and S.G. Hussain, Bangladesh Agricultural Research Council

Traditional Farming Systems, Agrobiodiversity and Climate Adaptation

Critical Problems / Questions:

- What is the agrobiodiversity composition and pattern in traditional farming systems, their interactions with ecosystem goods and services at the landscape level, and local knowledge and customs that promote the use, management and conservation of natural resources for sustainable rural livelihoods and risk alleviation?
- What biophysical and socio-economic threats, and policy, regulatory and institutional distortions (national / provincial), challenge the sustainability and hence adaptability of traditional farming systems, and what critical countervailing reforms are needed for revitalizing their adaptive capacity?
- How can linkage to niche markets promote the sustainability of traditional farming systems, agrobiodiversity conservation and adaptive capacity to environmental changes?

Priority Research Areas:

- Rotational or shifting agriculture: agro-forestry with hill rice (South East Asia, Eastern Himalayas, Southern India, Madagascar); with maize (Latin America); with sorghum and millet (East, Southern and West Africa)
- Flood plain and irrigated agriculture: recession agriculture (most floodplains); wet rice, aquaculture and small livestock husbandry (China, South East Asia, India, Amazon basin); floating rice (Bangladesh, Nigeria, Chad); maize, root crops and small livestock husbandry (Chinampas in Mexico and the Andes; Waru-waru in the Andes); coastal taro-based systems (Pacific islands); stone fruit-based systems (eastern Mediterranean and Trans-Caucasian regions); oasis-based systems (Middle East, North Africa)
- Multi-layered home gardens in the tropics (China, South East Asia, Papua New Guinea, India, East and West Africa, Amazon basin)
- Pastoral transhumance: semi-arid regions (West and East Africa, India, China, Mongolia); mountainous regions (Alps, Carpathians, Andes, Pamir and Himalayan chains); tundra-taiga regions (Russian Siberia, Yukon)

Source: Professor José Ireneu Furtado, Imperial College of Science, Technology and Medicine

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 are required to capture the regional dimensions of change.

Source: TERI, India scoping study

5.3.2. Water Resources

Water resources and their vulnerability to climate change impacts was the second most cited sector in most of the regional consultations (Regional Reports for South Asia, East Africa and West Africa). However, the amount of knowledge and prior work on specific impacts varied from region to region (with more being done in South Asia than in Africa).

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 technical capabilities (either themselves or have access to such 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).

Some of the specific research ideas for the water in the different regions are shown below.

East Africa – Climate change and Water - Research themes/problems

- Impacts of climate change on inland waters; possibility of salvaging (fisheries, land use changes - Lake Jipe-river Lumi)
- Hydrological modelling (Inter-basin water transfer, HEP)
- Water harvesting and storage
- Mapping of ground water resources
- Artificial ground water recharge.
- Transboundary management of water resources
- Impacts of liberalization on the water sector / water governance
- Improving irrigation performance
- Climate induced land use change and impacts on river basins
- Impact on aquatic biodiversity
- Early warning systems - floods
- Impacts of climate change on Indigenous irrigation management systems
- Water quality for drinking

Source: Nairobi workshop report

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 .p-

Integrated Assessment of Vulnerability to Climate Variability and Change on the Gambia River Basin

Capacity for integrated assessment of the impacts of climate change and means to adapt to it: It is a priority to initiate, develop and implement a collaborative research program between institution(s) in developed countries with the objective of developing and strengthening the capacity of the relevant scientists and institutions of the states in the integrated assessment of the impacts of and adaptation to climate change on the watershed of the River Gambia.

The program would combine research – determining the degree of vulnerability of the watershed of the Gambia River Basin – with developing and strengthening the scientific and technical capacity of institutions and individual scientists of the OMVG member states. The program would also:

1. establish the institutional and other practical arrangements required for the implementation of the Project and for the enhancement of the future and sustainable collaboration in climate change and watershed management;
2. enhance the scientific and technical capacities of scientists in OMVG States to assess the impacts of climate change, and identify and design cost-effective adaptation response measures that will serve as input to the development of effective policies;
3. develop and strengthen networking of collaborating institutions and scientists; and
4. contribute to the success of the global assessment of the climate system

Adaptation measures would then be identified and integrated into the national policies of the countries. The program would also enhance the comprehensiveness of the IPCC assessments by developing and expanding the information base on impacts, adaptation and vulnerability of the watershed of the Gambia River basin.

Source: Bubu Jallow, Department of Water Resources, Gambia

Studies of water risk assessment at different scales, including trans-boundary and regional adaptation and mitigation, including strategic plans for the world's large basins, such as the Limpopo, Yangtze, and the Nile Basin, are a high priority.

Source: Katrina Brown and Neil Adger, Tyndall Centre, see section 2.2 Water

5.3.3. Coastal Zone Management

Coastal zone management came up as an important sector in a few countries and regions, namely in South Asia (India and Bangladesh in particular) as well as Tanzania in East Africa, and Gambia and Senegal in West Africa (Regional Reports for South Asia, East Africa and West Africa).

Some of the specific research themes that were identified are shown below:

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,p-

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,p-

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, p-

Climate change, coastal communities and development

- What are the main ways in which coastal communities historically and at present deal with physical hazards such as flooding?
- What impacts do such events and processes have on coastal communities and are some affected more than others? Here one could examine gender, caste, class, ethnic, occupational impacts.
- What short-term measures in rehabilitation and recovery have been implemented to deal with such events and processes?
- What changes need to be made to international, national and local institutions to deal more effectively with such events and processes (Long-term disaster management and preparedness)?

Source: Dr Bob Pokrant, see Section 2.4 Coasts

Coastal Erosion: A Major Concern for Pacific Island Communities

Most small islands and coastal zones of the Pacific are already under stress from human activities. Majority of Pacific island communities' leave near the shores and carry out hotel and other businesses developments along the coast. The eroding of coast lines do threaten these major businesses and while they may have the means to adapt they transfer the coastal erosion problems to communities close-by who do not have the necessary means and resources to be able to cope. For small low-lying atoll national such as Kiribati where land is a scarce commodity, with parts of the island only 400 m in width, there is need to do something about it or people will simply be displaced.

Source: Taito Nakalevu, see Section 2.4 Coasts

5.3.4. Disaster Management

Climate-related disasters such as floods, cyclones and droughts are recurring problems familiar to people and countries in each of the regions studied. In most countries there are existing institutional and other mechanisms in place to deal with early warning, relief and rehabilitation and recovery after such disasters occur. Although some of them have proven quite successful in the past (e.g. the cyclone warning system in Bangladesh), most of them are not necessarily working efficiently even in relation to current climate hazards, and are likely to be unable to cope with future hazards exacerbated by climate change (Delhi Workshop Report).

Therefore, working with existing institutions to deal with climatic hazards due to current climate variability, in a way which 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). A research topic might include identifying what has worked best in achieving this particular kind of strategy.

Some of the specific themes for research identified in this sector are shown below.

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, p-

5.3.5. Ecosystems

Specific ecosystems were identified as being of importance in a few of the regions and countries assessed (Regional Reports for South Asia and East Africa). These included wildlife reserves in Kenya and Tanzania and mountain ecosystems in Nepal (and Bhutan).

Some specific themes for further research are shown below.

East Africa – Biodiversity - Research themes/problems

- Shift in ecosystem boundaries-ecosystem fragmentation
- Current challenges including human/ wildlife conflicts need to be addressed.
- Sharing of benefits with communities neighboring conservation areas.
- Impacts on important biodiversity reserves
- Value of agricultural biodiversity in coping with climate variability and potential CC
- Biodiversity hotspots

Source: Nairobi workshop report, p-

Ecosystems – Key Research Questions

- Resilience: What makes ecosystems resilient to climate change? How can increased ecosystem resilience to climate change support human adaptive capacity?
- Vulnerability hotspots: Where are the 'hotspots' for ecosystem and human vulnerability in the event of climate change? In forested areas (Macqueen et al. 2004)? Or desert areas where non-linear climate induced changes could impact dryland livelihoods? Or coral reefs (coral reef bleaching could severely affect the livelihoods of coastal communities) and fisheries?
- Management practices: In biomes/ecosystems that are particularly vulnerable to climate change, what ecosystem management practices can help cope with such changes and create the most positive outcomes for human welfare?
- Policy coherence: How can we increase high-level governance, policy and institutional coherence between multilateral environmental agreements and development processes with a view to supporting activities which alleviate poverty and provide benefits under the main multilateral environmental agreements?
- Financing: How can we shift investment and funding towards projects with multiple livelihood, biodiversity and climate change benefits (or at least projects which do no harm in these additional contexts), as opposed to initiatives (such as large hydropower schemes), which might meet one goal, but which have significant negative impacts on ecosystem integrity, biodiversity, climate change mitigation or adaptation, and local livelihoods.
- Community-based strategies: How can we increase and improve support for 'bottom-up' approaches rooted in existing community-based strategies for managing resources and reducing vulnerability to climatic shocks?
- Disseminating lessons: How do we use what we already know about biodiversity, climate change and poverty/livelihoods to generate action and change on the ground for the benefit of poor people? Lessons learned on the importance of engaging with and supporting local governance, the importance of local, national and international political processes (Bass et al. 2005), and the key role of access to land and resources, need building on.
- Strategies that work: Debt relief, supporting good local governance or securing commitment from high-income nations to change consumption patterns and reduce greenhouse gas emissions may have greater ultimate 'pay-offs' in terms of providing livelihood, biodiversity and climate change benefits than, for example, investing in activities to make the CDM operational. How do we prioritise activities and efforts?

Source: Hannah Reid and James Mayers, IIED , 2005

5.3.6. Health

The potential impacts of climate change on human health are amongst the least well known of climate change impacts, although a few studies have been carried out (e.g. in Bangladesh on floods and in Kenya on Malaria). Nevertheless, such impacts were identified in several regions as being a major information gap (e.g. Dakar Workshop Report).

Some specific themes for research are shown below.

Research Needs on the Health Impacts of Floods

Few et al. (2004) "make the following recommendations for the design of epidemiological studies that investigate the health impacts of floods: control groups for comparison with non-flooded populations; use of longitudinal data, or routine data in order to gain information on pre-flood levels of disease; use of objective measures of disease outcome; and improved use of routine surveillance information. Priorities for future research include:

- the impacts of flooding on long-term mental health in both industrialised and developing countries;
- the impact of flooding and heavy rainfall on diarrhoeal disease, and the main routes of transmission;
- indirect mortality attributable to flooding (in addition to immediate deaths from drowning); and
- impacts on health from the disruption of health services and other life supporting systems."

Source: Few, R., M. Ahern, F. Matthies and S. Kovats (2004) Floods, Health and climate change: a strategic review. Tyndall Centre for climate change research. Working paper 63.

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, p-

Health Research Priorities

- Studies on diseases caused by the environment (infectious diseases, allergies, etc.)
- GM foods and how they affect human and environmental well-being
- Studies of water-related diseases

Source: Dakar Workshop Report, p-

5.3.7. Energy

Energy is a key development sector for all developing countries, and is related to climate change both from the aspect of emissions of greenhouse gases as well as from possible impacts of climate change on the sector. However, as this study looked at impacts of climate change on sectors as they related to poverty reduction specifically the energy sector was not a major focus of the scoping study.

Some themes with respect to energy were identified through the exercise (mainly in West Africa).

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, p-

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

Pathways of decarbonisation for emerging economies

Research in this area should examine transitional decarbonisation pathways in key developing countries and develop assessment tools for mitigation technologies. Consideration of prospects for ‘clean’ development in countries poised to become major emitters, including China, India and Brazil, is vital.

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, p-

5.4. Cross Sectoral Issues

A number of key issues cut across sectors and needed to be dealt with separately. These included gender as well as security related issues.

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
-
- 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, p-

5.4.1. Vulnerability

The issue of vulnerability to climate change is a key cross-sectoral issue that keeps coming up in all the literature and consultations. Some attempts have been made to map the most vulnerable regions of countries from climate change impacts (e.g. “Hot spots”) as well as from other stresses (e.g. in India). Such mapping of vulnerability has been done (in many regions and countries) for different hazards (e.g. floods, cyclones, droughts, etc) and can be combined with potential climate change impacts.

Some suggestions for researchable themes are shown below.

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, p-

5.4.2. Gender

Most vulnerability to climate change studies to date, and discussions conducted under the current exercise focused on vulnerable regions or groups, but seldom differentiated within groups (e.g. on the basis of gender or age). However, 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 (see section XXX on gender).

Some specific researchable themes are shown below.

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

5.4.3. Security and conflict

Conflict and security are issues that constrain development in many regions of the world (especially in Africa). Many of these conflicts are being fuelled by competition for natural resources, which are likely to become more severe with climate change. Although adaptation to climate change is likely to be a low priority in situations where conflict has already broken out, in other locations where there is still no conflict it may be possible to intervene and thus prevent such conflicts from occurring. This is particularly important in parts of Eastern Africa (e.g. in Sudan and Ethiopia) as well as in some other countries and regions (e.g. Nepal in South Asia).

5.4.4. Funding

Funding for adaptation to climate change is a growing area of international financial mobilisation (e.g. through the Marrakech Accords of the UNFCCC). However, it is still far from clear what is the best use of those funds which are identified for assisting the most vulnerable countries (and most vulnerable people within most countries) to adapt to the potential impacts of climate change.

Fair adaptation planning – developing guidelines for identifying and implementing adaptations that are legitimate and sustainable

A short-term research need is for guidelines that demonstrate how governance is central to adaptation, particularly where governments are considering long-term decisions on adaptation options that ultimately affect every citizen and stakeholder within their jurisdiction. Developing sustainable adaptation planning through legitimate and participatory planning has urgency and high returns for the developing countries presently engaged in this exercise.

Source: Katrina Brown and Neil Adger, Tyndall Centre

5.5. Local and Community-Based Issues

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. In terms of adaptation responses, those consulted assert that it is not necessary to distinguish between possible future impacts of human induced climate change and possible impacts of natural climate variability. The implication of this is that it may not be necessary to wait for more accurate forecasts of climate change at the micro level in order to start to build resilience (and adaptive capacity) of the vulnerable communities. It is very clear that helping to build the resilience, particularly of poor and vulnerable communities, to cope with the adverse impacts of climate variability in the short to medium term will also help build resilience against climate change in the longer term.

Vulnerability of fisheries and fishing communities to climate change

Fisheries represent a significant proportion of nutrient intake and employment in coastal areas in the developing world. While vulnerability of both fisheries and fishing-dependent communities is driven by external stresses and by underlying structural factors, the quantification and measurement of these driving forces has not been undertaken. The benefits of research in this area would be a more precise targeting of adaptation action and interventions to the most vulnerable fisheries systems.

Source: Katrina Brown and Neil Adger, Tyndall Centre

6. Building Capacity to Conduct and Use Research

Generating and using information requires capacities amongst both the generators of knowledge (researchers) and the users of knowledge (policy makers, managers or

communities). One important component of designing an appropriate research strategy, therefore, is to consult with potential target audiences in order to ascertain their views and priorities. In the scoping study, representatives from the research users were included and their inputs taken on board in each of the regional and national scoping studies and consultations. Many appreciated DFID's efforts to consult with them and were happy to provide inputs (see Nairobi and Delhi workshop reports). Many also felt that potential target groups should be included in the research group of any future research projects conducted in their country or region. This would help guide the researchers and also ensure better uptake of the research outputs. Such target groups might include policy makers, managers or communities.

Research and Development of the curriculum on climate change for basic education in The Gambia

Education plays a critical role in the development process as it helps in the dissemination and assimilation of development information including information on climate change. Similarly, public awareness is another critical factor in implementing the UNFCCC. The understanding of the public of issues relating to climate change will help them play their role and influence policy and the decision making process.

Generally speaking, climate and climate change issues are absent in the educational system of The Gambia. The subject of climatology is treated under geography. All environmental issues are treated under the Social and Environmental Studies (SES) component of the school curriculum. Weather and climate elements are not treated in the required depth.

Source: Fatou Gaye, personal communication 2005

6.1. National Governments

National governments need information on potential climate change impacts on the national economy, health of the population, natural resource base, and the distribution of those impacts between different social groups. This is to ensure that national level policy-making can be kept informed of those impacts and wherever possible take appropriate proactive measures, including adaptation. With a few exceptions, however, most national level policy-makers are largely unaware of the potential climate change impacts. They therefore need simple appropriate information to raise their awareness. This might involve policy briefs, seminars or workshops. Once they understand the links between development and climate change, then more detailed technical information may become useful to them.

6.2. Local Communities

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. Ensuring messages about climate change impacts and adaptation reach them is a difficult challenge, which will require work on methods of communication. This might involve media and non-governmental organisations (NGOs) or community based organisations (CBOs), which have established links with vulnerable communities.

6.3. Natural Resource Managers and Planners

Most developing countries have a reasonable core of professional planners and managers in some of the key sectors. 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. Even where they are strong, the various cohorts of professionals are usually unaware of the potential impacts of climate change on their respective sectors. Once they are made aware, however, they are usually quite capable of absorbing the kinds of technical information that may be generated from research (see the Delhi workshop report). For the near term uptake of research results they would therefore form excellent target groups.

6.4. Regional Bodies

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.

6.5. Research and Training Institutes

There are numerous university departments and national research institutions as well as some international research institutions, such as CGIAR, located in developing countries. Most of these are governmental, but some are also non-governmental. These institutes are a useful source of scientific and technical human resources. However, they often have few financial and other resources to conduct the kinds of research they have the potential capacity to do. Unleashing this untapped capacity should be a major aim of any international research funder (see the Nairobi workshop report). There also seems to be a disconnect between research institutions and sectoral management institutions in several regions.

7. Research Priorities

The following *criteria* were used in this consultation to judge research priorities:

- (i) Enables adaptation or enhances adaptive capacity
- (ii) 'Climate-proofs' development
- (iii) Targets climate variability

- (iv) Targets climate change
- (v) Targets both climate variability and climate change
- (vi) Informs policy formation
- (vii) Informs policy implementation
- (viii) Propensity for research outputs to go to scale

Importance of sectors and cross-sectoral information needs

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)

Rankings amongst different fields of research for each region and professional group were also obtained from the LEAD survey.

Mean rating ranked within region

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
Asia Pacific	7	2	2	8	6	4	1	5
Eastern Europe	7	5	3	8	3	5	1	2
Europe	7	6	3	8	1	5	3	2
Latin America	7	6	3	8	2	5	1	4
North America	7	4	4	8	4	1	2	3
South Asia	8	2	4	6	4	1	3	6

The overall mean ratings, impacts of CC on *specific socio-economic groups and climate modelling and scenarios* are ranked as being low across all regions (seventh or eighth almost exclusively). As a whole, respondents from Africa place 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 also rate the impacts of CC on specific *sectors* (e.g. agriculture, public health) and impacts of climate change on the *natural environment* as important, ranking them joint second.

Governance and decision making processes to manage impacts of climate change is the most highly rated by Asia Pacific, Eastern Europe, and Latin America and is second or third for three of the other seven regions.

Building capacities to adapt to the impacts of climate change is, on average, rated the number one most important field of research by respondents from North America and South Asia – but is only of a middle order importance (fifth or sixth) in the other regions.

On average European respondents have ranked *raising stakeholder awareness* of climate change as the most important field of research while Latin America placed it second and in Eastern Europe rate it third.

Mean rating ranked within Profession

Importance of each field of research - rank within profession

	5.1 Climate modelling and 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 socio-economic 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 and decision making processes to manage impacts of climate change.	5.8 Monitoring, assessment and institutional capacity to manage impacts of climate change.
Academic	7	3	1	8	2	4	5	6
Business & Private Sector	7	2	1	8	6	5	2	2
Govt	8	5	2	7	6	1	3	3
Media	2	4	3	8	4	7	1	6
NGO	8	6	3	7	5	2	1	3

Impacts of CC on specific socio-economic groups and climate modelling and scenarios are ranked as the *two least important fields* of research across professions with the

exception of those respondents from the Media – who on average rank Climate modelling and scenarios as the second most important field of research.

Impacts of CC on specific sectors (e.g. agriculture, public health) ranks highly with across all sectors – first within Academics and Business and Private Sectors, second within Government, third within Media and NGO.

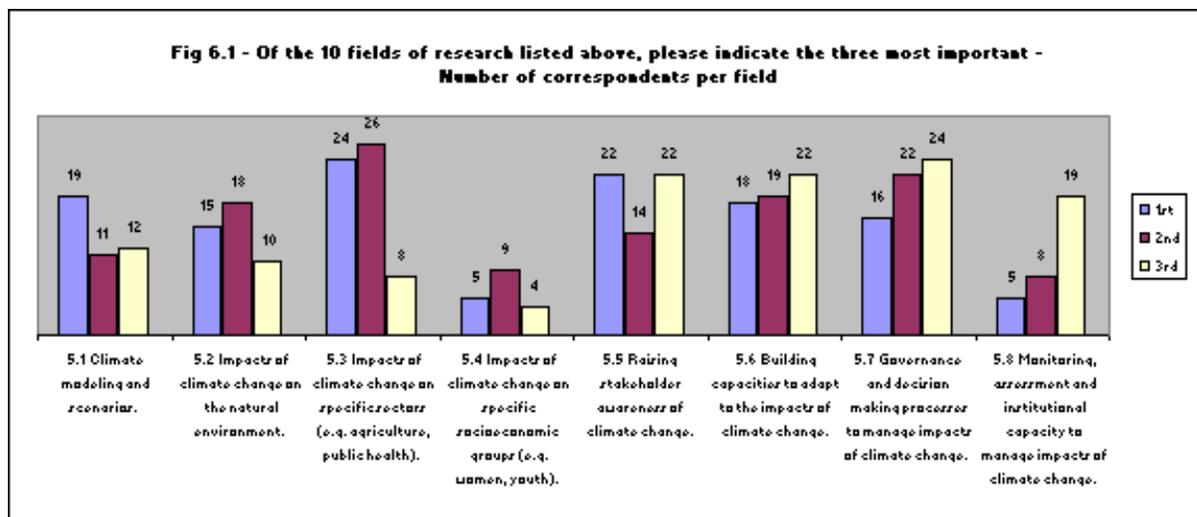
Media and NGO both place Governance and decision making processes to manage impacts of climate change as the most important field of research. Business and Private Sector and Government also place it highly (second and third consecutively). On average Academics had it as the fifth most important field.

Stakeholders from Government were alone in making. Building capacities to adapt to the impacts of climate change the number one most important field of field of research. NGOs had it second, but the remaining professions placed it fourth, fifth and seventh.

Academics were the sole profession to rate Raising stakeholder awareness of climate change highly, but this field averaged second overall.

Of the ten fields of research suggested in the LEAD survey the following were selected to be of greatest significance.

Overall Rating



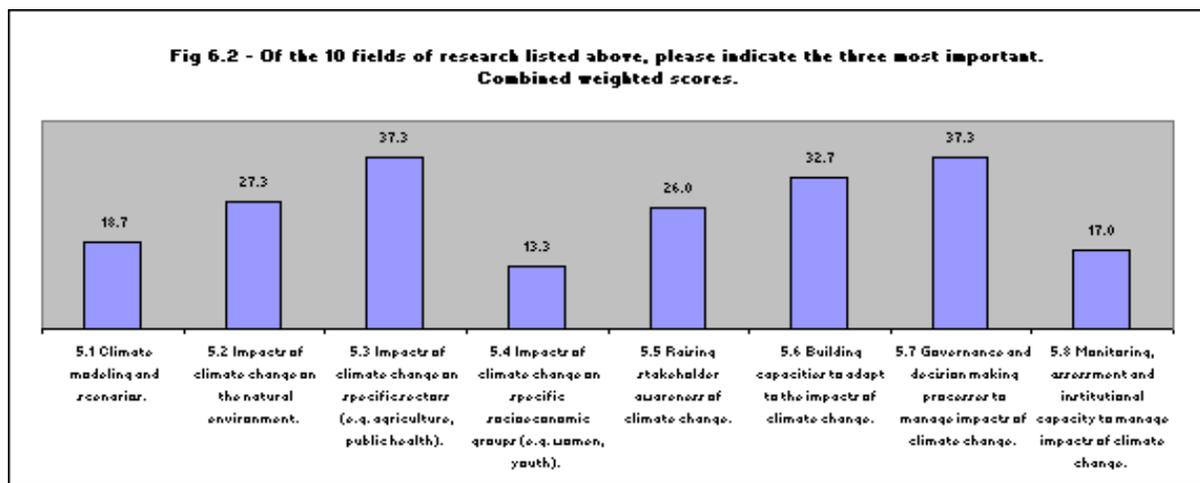
Question 6 asked the respondents for their top three most important fields of research, in order of importance. Fig 6.1 shows how they ranked by field. Fig 6.2 shows a combined score for each field using a simple weighting of one for first two thirds for second and one third for third.

The combined weighted scores suggest that *Impacts of CC on specific sectors* (e.g. agriculture, public health) and *Governance and decision-making processes* to manage

impacts of climate change are regarded as the two most important fields of research by all the respondents to the survey.

Building capacities to adapt to impacts of climate change is rated the third most important field of research. Raising stakeholder awareness of climate change and impacts of climate change on the natural environment are rated close fourth and fifth. Climate modelling and scenarios and monitoring, assessment and institutional capacity to manage impacts of climate change are sixth and seventh.

Impacts of CC on specific socio-economic groups (e.g. women and youth) was by some way ranked the least most important of all the eight fields of research, with almost third of the two highest scoring fields.



8. 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. This should be on a relatively long-term basis, at least for five years rather than just a year or two. Many consultation participants had had experience of international collaborative research with developed country researchers (almost invariably funded by the parent country of the developed country researchers). But research priorities identified under such exercises were not always felt to be those prioritised by the developing country researchers themselves (see Delhi workshop report).

8.1. 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.

8.2. 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 rather than focusing only on generating new research findings on the assumption that such findings would somehow be automatically taken up by the appropriate target groups. For example, in the East African region much work has gone into developing seasonal weather forecasts and disseminating these to national level policy-makers and to farmers in semi-arid areas. While much has been learned and achieved in the process, full success in terms of ensuring appropriate messages reach intended target groups has not yet been achieved. This is because many forecasts have a ‘not-very-high probability’ and more importantly perhaps because of the challenges of effectively communicating what probabilistic forecasts actually mean to the target groups (see the Nairobi workshop report).

8.3. 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. For example, water reservoirs can be designed for use over the next 50 years, or flood protection structures are built to withstand a one in a hundred year flood event. If appropriate research is conducted to provide such resource managers and planners with the tools and methods for incorporating climate change risk assessments into their normal planning and design activities they are relatively well placed to adopt research results into their normal practices (see the Delhi workshop report).

Linking research outputs to local or community-based groups is more difficult. Messages should contain appropriate technical content and they should also be disseminated through appropriate social and institutional channels. This will ensure the message is viewed as credible and thus increase the likelihood of its uptake (see the Delhi workshop report).

8.4. 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. Village elders can also be used to effectively communicate scientific messages, which will then have the chance to prove they are at least as good as traditional messages. The Delhi workshop also highlighted

the how traditional community responses to disasters can be used to design large scale social insurance schemes.

8.5. 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. They may also include a local community organisation, for example a group of farmers or pastoralists for livelihoods related research. Forming links with appropriate target institutions can also be done at the multi-country regional level for issues that are trans-boundary in scale. For example, the ICPAC in Eastern Africa covers a number of countries and would be suitable target institution for regional scale research projects in this area.

9. Opportunities to Collaborate with or Support Ongoing Initiatives

Several ongoing activities on adaptation to climate change are currently occurring or will commence in the next few years. These present opportunities for cooperation and/or support. A few of these are mentioned below. This list is by no means exhaustive nor is it a list of recommended initiatives.

9.1. National Adaptation Plans of Actions (NAPAs)

Over the next two years, almost 50 of the Least Developed Countries (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 a research project or programme with the LDCs, using the NAPAs as an important national policy-making hook, could encourage quick research uptake into national policy-making.

9.2. Consultative Group on Agriculture Research (CGIAR)

The CGIAR has many research centres located around the developing world. Many are in the same regions which are likely to be impacted by climate change. The CGIAR has also been running a 'Climate Change Challenge Programme' (see Activities Review), which has developed some interesting and useful insights, particularly on crop and livestock

management in semi-arid and dry lands. 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. [how better to link this CG work to local groups?]

9.3. 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 (see Activities review). 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. Supporting such a project has the advantage of knowing that management and quality control infrastructure already exists and has proven itself to be effective. Extending the project would therefore be relatively easy.

9.4. RING/CLACC

The Regional and International Networking Group (RING) 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 (see Activities Review). The RING has a climate change programme which 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 Least Developed Countries 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. The advantage of this programme is that it is working through well-established and credible developing country institutions, which have experience of working at the nexus of climate change and development issues, with a strong focus on poverty reduction.

9.5. 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 (North Africa, Sahelian Africa and Eastern Africa) 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 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.

9.6. ICPAC

The ICPAC project has been working in the IGAD East African region for a number of years. It provides seasonal weather forecasts to policy-makers and farmers (see Nairobi workshop report). 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.

9.7. NEPAD

The New Partnership for Africa's Development (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.

9.8. 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.

In conclusion, the kinds of collaboration which have characterised this DFID-led exercise of assessing research needs should continue as and when DFID structures and implements its own climate change research programme.

10. References

Section 2: Sectoral issues - IIED

2.1. Agriculture and food security

- 2.2. Water resources
- 2.3. Natural disasters
- 2.4. Coastal zones
- 2.5. Health
- 2.6. Ecosystems
- 2.7. Energy

Section 3: Cross-sectoral issues - IIED

- 3.1. Security
- 3.2. Gender

Section 4: South Asia region - TERI

- 4.1. South Asian regional scoping study
- 4.2. India scoping study
- 4.3. Delhi Workshop report

Section 5: East Africa region - ACTS

- 5.1. East Africa regional scoping study
- 5.2. Kenya scoping study
- 5.3. Nairobi workshop report

Section 6: West Africa region - ENDA

- 6.1. West Africa scoping study
- 6.2. Senegal country scoping study
- 6.3. Dakar workshop report

Section 7: Survey - LEAD

- 7.1. Overview

- Annex I Activities review
- Annex II East African activities review
- Annex III West African activities review
- Annex IV Survey comments on question 4.1
- Annex V Survey comments on question 5
- Annex VI West African bibliography