Vulnerability and Adaptation to Climate Change and Variability:

The role of the Swiss Agency for Development and Cooperation

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Executive summary

Climate change affects the development process seriously, as it has impacts on its inputs as well as its outputs and outcomes of development and development cooperation. The United Nations Framework convention on Climate Changes highlights two avenues to address climate change: mitigation and adaptation. Adaptation looks at reducing the negative impacts and using new opportunities related to changes in the climatic system. As the poorer social groups tend to be more vulnerable to changes in temperature and rain patterns as well as to increases in extreme events, these groups need special support in adapting to climate change. Such support should be included in the bilateral cooperation.

Responding to this consideration, SDC/NRE asked the Climate Change Group of Intercooperation to undertake an assessment on climate change, adaptation and the impacts on the development cooperation, with special regard of the cooperation in the area of natural resource management. The goal of this assessment is to evaluate the effects of the Swiss bilateral cooperation on the adaptive capacity on a national, regional and local level in SDC's current countries of concentration. Corresponding to this goal we define three objectives

(1) To describe the level of understanding at the national level of and preparedness/awareness to climate change impacts at the national level; the meaning is different whether you put this at the end of the sentence or where I have placed it.

(2) To assess whether to which extend the a link between the adaptation priorities defined by each country assessed are inline with the actual SDC/NRE projects/program orientation or not; and

(3) To identify the main barriers towards constraints to the implementation of SDC/IC programs and their potential implications concerning vulnerability

The assessment considers 14 cooperation projects in 9 countries in Asia, Africa, Latin America and Eastern Europe.

The following are the general conclusions from the study:

- SDC priority countries have interest in climate change. Furthermore, adaptation to climate change is a priority for the development for some of them. However the institutional framework for adaptation and in general for activities with regard to climate change is not well coordinated at the national level or decentralised to the regions.

- According to the National Communication of the countries where the assessment was conducted following sectors are their priorities for adaptation:

    1. Agriculture and water
    2. Forestry
    3. Health

- Biodiversity seems to be relevant for all projects. Nevertheless, in general, there is little quantitative or qualitative information available on changes in biodiversity.

- Interest concerning environmental services appears to be high. However there is some confusion on concepts as well as a general lack of concrete experience on quantifying and valuing environmental services or in accessing corresponding markets

- Conflict concerning land tenure and land use rights seems to be the major institutional constraint for a sustainable management of natural resources. This is not a new understanding, however it has a big role in preventing the implementation of climate change mitigation and adaptation strategies.

- Bilateral cooperation projects are often inline with the adaptation priorities defined at the national level. However, due to the lack of awareness at the local level the potential for synergies is not realised or, even worse, the bilateral cooperation is reducing its activities in some cases in sectors that have been defined by the partner countries as a priority for adaptation. This is particularly the case of the forestry sector which, after water and agriculture has been identified as the second priority for adaptation in the countries covered by the survey.

Finally, we need to consider the differences in scale between the impacts of climate change and the size of the majority of the projects in the development cooperation. Climate change has impacts over mega-regions, while – in comparison – bilateral cooperation projects work over smaller geographical areas. Cooperation activities aimed at implementing climate change mitigation and particularly adaptation strategies should be aware of this difference and be planned accordingly.

Based on these conclusions, this report recommends ***to mainstream adaptation into the Swiss development cooperation as a cross-cutting issue***. To do se we recommend specific actions at four levels:

- Support **building capacities** of development practitioners for understanding vulnerabilities to climate change as well as for using synergies and implementing a wide range of adaptation measures in the framework of the development process
- Support developing countries in improving their **institutional framework** for adaptation in a coordinated manner
- Promote the design and outreach of **methods and tools for adaptation** that fit into the conditions and data availability of the developing countries
- Facilitate **pilot activities** that integrate adaptation to climate change into the overall development process

1 Introduction

Climate is one of the main factors affecting development at the local level (OECD, 2005). Resource-based livelihoods in developing countries are very sensitive to climate variability, and particularly to slow variations in temperature and rainfall, and to extreme events. For instance, a given climate determines the selection of specific types of crops and tree species as well as the timing of the agricultural activities. Extreme events can also reduce the availability of both goods and services from agricultural and forest lands. As rural livelihoods are highly dependent on such goods and services, their vulnerability is likely to increase even with a slight change in climate variability. Increments in the emissions of greenhouse gases (GHG) due to human activity over the past two centuries have accelerated changes in the climatic system (IPCC, 2001). For this reason, these current changes are referred today as *human-induced* climate change. There has not yet been a thorough assessment of the impacts of this change on natural resources and local communities, in the different regions where the Swiss Agency for Development Cooperation (SDC) is active.

The United Nations Convention on Climate Change (UNFCCC) recognizes human-induced climate change and the importance of reducing its adverse effects through mitigation and adaptation. ***Mitigation*** refers to the possibility of reducing GHG's emissions or of enhancing GHG's sinks. ***Adaptation*** to climate change refers to any adjustment, in a given social-ecological system, in response to actual or expected impacts caused by climate change and which is aimed at moderating or harming its negative impacts and/or at exploiting opportunities created by this change (IPCC, 2001). As the poorest are considered to be the most vulnerable (African Development Bank et al, 2003), the extent to which adaptation could/should be incorporated in bilateral cooperation needs to be analysed.

Defining the extent and the impact of human-induced climate change is difficult and uncertain. Consequently, and among other challenges, it has not yet been possible to forecast climate change scenarios at the local level, including future frequency, magnitude and spatial occurrence of extreme weather events such as floods, cyclones and droughts. However, local communities are already suffering from the consequences of unexpected changes in climatic variables as well as of the increment of these extreme events (see research on Canadian arctic communities facing climate change: e.g., Berkes and Jolly 2001, Krupnick and Jolly 2002). To cope with and adapt to this situation of uncertainties and rapid changes, developing countries need to improve their ability to adjust to climate change and climate variability so that they can moderate potential damages and/ or take advantage of opportunities. This process is understood as the improvement of the *adaptive capacity* of a given social-ecological system. Building adaptive capacity requires an approach that considers the national as well as local contexts. From the national perspective, it is necessary to coordinate policies among vulnerable sectors (e.g. agriculture, energy, infrastructure, health and forestry). From the local perspective, it is imperative to build up adaptation based on an understanding of the impacts on livelihoods, including the impacts on land tenure and user-rights, access to natural resources, management practices, etc. Further a monitoring scheme should be developed to follow changes towards increasing adaptive capacity.

The SDC Natural Resources and Environment section (SDC/NRE) prepared, with the support of Intercooperation's Climate Change Group (IC/CCG), an *Orientation on Climate Change Issues in the Fields of Natural Resource Management, Livelihoods and Food Security* (2004). This orientation recognizes that reducing the vulnerability of local communities to climate change and variability should be included in bilateral cooperation's objectives (with a special focus on groups

affected the most by poverty[2]). This new orientation requires a better understanding of the potentials of including vulnerability and adaptation to climate change in development cooperation. To do so, a first step would be to assess the linkages between existing cooperation activities and existing and expected vulnerabilities. Based on this knowledge, the second step should be to formulate concrete recommendations on further steps to systematically help to increase adaptive capacity in the SDC partner countries. The IC/CCG undertook the present study on selected SDC/IC programs and projects to provide initial answers to these challenges. These projects are in different stages of implementation, from relatively new projects to some that have lasted for a long?(e.g. PASOLAC). The assessment presented here is based on responses from 14 projects/programs in nine of SDC's partner countries. All projects/programs have been funded by SDC/NRE and have been implemented by IC. The present analysis and conclusions are based on responses to a questionnaire completed by IC/SDC project managers or IC delegations, as well as on the expertise of IC/CCG.

This report is organized in six sections. Following this introduction, the rational for the study and methods used are described (section 2). Then, a review of the main concepts surrounding the discussion on adaptation to climate change clarifies the scope and limitations of this study (section 3). Further, the main findings on the effects of cooperation projects on communities' adaptation to climate change are outlined (section 4). Finally, the main challenges and opportunities for bilateral cooperation concerning adaptation to climate change are discussed in the conclusions (section 5) and concrete recommendations are formulated on further steps for SDC to systematically help increase the adaptive capacity in its partner countries (section 6).

[2] Note that many projects included in this report are aimed at reducing poverty, a concept that refers to dimensions of deprivation. In general, it is the inability of people to meet economic, social and other standards of well-being (OECD, 2001). We also use the term "livelihoods" when we want to highlight the existing assets a community has and which are their basis for increasing resilience and adaptation capacity.

2 Rational and Methods

2.1 Purpose and context of the study

The purpose of this study is to get an initial understanding of the effects of cooperation projects and programs, financed by SDC/NRE, and implemented by IC, on community adaptation to climate change. Within this context, and for the purpose of simplification, two major elements were especially considered: natural resources and society. In this report, natural resources include water, agricultural land, forests and air. Society includes: a) the social groups targeted by Swiss bilateral cooperation, and which are directly or indirectly affected by climate change and variability; and, b) the institutions (i.e. the set of formal and informal rules and norms regulating tenure and uses of natural resources and their resulting goods) representing such groups and regulating their relationships (Robledo and Forner, 2005). Correspondingly when we use the term "social-ecological system an integrated system of society (i.e. social groups and institutions) and its natural environment is meant

Figure 1 illustrates how the relationship between these two components, natural resources and society, also defines the management of such resources. In that sense, a specific management can be understood as a function of the requirements of a society in terms of fulfilling its (basic) needs and the potential goods and services that a given resource can provide. Climate variables (e.g. temperature or extreme events) affect the two elements of the system. Not considered in this assessment are other areas of development cooperation (e.g. humanitarian aid or support to peace processes), which are outside of the scope of the Natural Resources and Environment Section of SDC (NRE).

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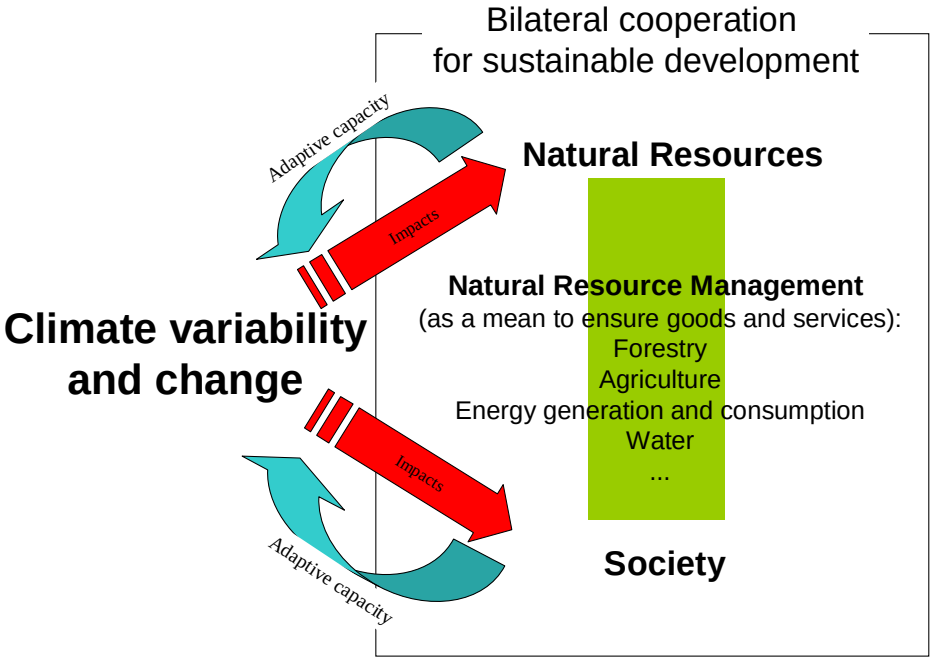
Figure 1: Analytical context of the study



2.2 Hypothesis and objectives

This assessment builds on the hypothesis that SDC/IC projects in natural resource management during the last 30 years could have some effects resulted either in unplanned contributions towards climate mitigation and adaptation, or, conversely, inadvertently in reduced capacity of systems to adapt. In order to test this hypothesis, the goal of this assessment is to evaluate the effects of Swiss bilateral cooperation on the adaptive capacity at national, regional and local level in SDC's current countries of concentration. Corresponding to this goal we define three objectives

(4) To describe the level of understanding at the national level of and preparedness/awareness to climate change impacts at the national level ; the meaning is different whether you put this at then end of the sentence or where I have placed it.

(5) To assess whether to which extend the a link between the adaptation priorities defined by each country assessed are inline with the actual SDC/NRE projects/program orientation or not; and

(6) To identify the main barriers towards constraints to the implementation of SDC/IC programs and their potential implications concerning vulnerability.

Some considerations regarding biological conservation and experiences in promoting environmental services have been taken into account but in a complementary way only. A broader analysis of these issues is therefore beyond the results presented in scope of this report.

2.3 Methods

The method used for analyzing and understanding the linkages between development cooperation in NRM and adaptation to climate change and variability followed three steps: (1) collecting primary information at the SDC/IC programs and projects levels; (2) collecting secondary information at the national level; and (3) analyzing information.

2.3.1 Collecting primary information at the program/project level

For this first step, a questionnaire (Annex 1) was prepared and distributed to the SDC/NRE projects and programs managers or to IC delegations. This questionnaire was structured around the following themes: institutional framework, legal framework, project/program description, project activities, benefits and barriers for the program/project.

Specific questions on climate change, conservation of biological diversity, and other ecosystem services (i.e. services that are different than carbon sequestration and biodiversity conservation) were also included. This report is based on a total of 13 answered questionnaires coming from nine different countries in Latin America, Asia, Africa and Eastern Europe (Table 1).

2.3.2 Collecting secondary information at the national level

This step refers to collecting information on potential impacts from climate change at the national level based on information contained in the National Communications for the UNFCCC. This information allowed the IC/CCG to identify the major vulnerabilities and adaptation priorities as defined by each country assessed, and to check if these correspond to the adaptation priorities defined by each country assessed

Table 1: SDC/IC projects assessed in this study (n = 13)

COUNTRY	PROGRAMME/PROJECT
Ecuador	IC Andes
Bolivia	ATICA
Central America	PASOLAC (Partial information)
Tunisia	PAOTIC
Madagascar	IC Madagascar / SAHA
Bangladesh	IC Bangladesh / Sustainable Land Use Program
India	Indo-Swiss Participative watershed development project - KARNATAKA
India	PCU, NRMPO: LCO & LSD Thrust, ORISSA
India	Indo Swiss project SIKKIM
India	Biodiversity Conservation, Integrated NRM and Poverty Reduction
India	Participatory Natural Resource Management and Rural Livelihood Development in drought prone areas of Andhra Pradesh
Kyrgyz Republic	KIRFOR
Bulgaria	Bulgarian-Swiss Forestry Project BSFP

2.3.3 Analyzing information

To analyze climate change and variability, the following variables were considered:

- Country positions to the UN Convention on Biological Diversity (CBD), the Biosafety Protocol, the UNFCCC and the Kyoto Protocol
- Vulnerability of the projects/programs' areas and related social-ecological systems to climate hazards
- Expected direct impacts on the social-ecological systems[3]
- Cross-cutting variables including institutional issues, land tenure, and land use rights

The questionnaire was designed considering each of these variables separately together with two additional sections on biological diversity conservation and environmental services. The assessment was done on the basis of the cluster analysis, which encompasses a number of methods for grouping objects of similar kind into respective categories. These methods allow the analyst to organize the data into meaningful structures. In other words, the cluster analysis is an exploratory data analysis tool. It aims at sorting different objects into groups so that the degree of association between two objects is maximal if they belong to the same group, and minimal otherwise. The analysis of the clusters allowed the CCG to fulfil the proposed objectives.

It must be underlined that the present study doesn't pretend to be a scientific report. This is due to the following specific limitations; firstly the sample is too small; secondly we used a very open questionnaire as a basic information source from the projects. A survey based on such a questionnaire allows one to provide answer on the basis of previous experience and current

[3] In the assessment, direct impacts of climatic hazards on social-ecological systems were seen from the perspective of development cooperation. It means that direct impacts *on natural systems* (e.g. changes in the structure of a given ecosystem or migration of species of flora or fauna) were not covered. The assessment concentrated on the impacts of climate change on livelihoods with regard to the living conditions of the local population.

challenges but makes it extremely difficult to systematically create the different clusters. As a result a relative bias is unavoidable. However, as the issue itself is relatively new, we decided to use this system to have the possibility to a) create awareness and b) make use of the specific knowledge and experience of those who answered the questionnaires.

3 Adaptation to climate change: Main Concepts

3.1 Climate change and climate variability

The UNFCCC defines **climate change** as a "*change of climate, which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods*" (UNFCCC, 1992). Because climate change implies a trend over time in the behaviour of climatic variables (especially temperature and rainfall) and constitutes a phenomenon of global nature, it is more easily observed at the hemispheric or global level. **Climate variability** refers to variations in the mean state of the climate, and all temporal and spatial scales beyond that of individual weather events (IPCC 2001). Variability does not necessarily refer to a trend. Local livelihoods are not only affected by dramatic changes in the climatic system but also by slight variations. To define climate ***change*** at the local level is extremely difficult as it is impossible to separate it from from local variability.

3.2 Impacts of change

The degree to which a given system can be impacted by climate change depends primarily on the nature of change, the type of change and the characteristics of the systems impacted. Four factors define the nature of change. The first factor is the **magnitude of change** in the behaviour of climatic variables. For example, an impact is more intense if the temperature increases by 3ºC rather than by 1.5ºC (and all other variables remaining). The second factor is the **probability** of a change occurring, as well as the probability of its intensity. The behaviour of the hurricanes in the Polynesian Tikopia Islands can illustrate this point. Hurricanes in that part of the world are frequent but unpredictable disturbances. The anthropologist Firth (1959) recorded from Tikopia elders an average of one hurricane every 30 years. With climate change, the probability of an average of one hurricane occurring every 30 years might change, as well as its intensity. The third factor influencing responses to climate change is the **rate of change**. The faster a change occurs, the greater the impact will be. For instance, although arctic hunters have always been facing changes, change is now so quick that their local knowledge does not enable them to "read" the environment and predict the weather (Berkes and Jolly 2001). The fourth factor is the **permanence of change**. For example, a heat wave, although temporary, can last weeks or months, and the longer it lasts, the greater the impacts will be.

Further, the extent to which a system is affected also depends on the type of change/events that causes an impact, that is, in this report, climate hazards. Climate hazards can be classified as : a) hazards resulting from long-term changes in temperature or rainfall patterns; or b) the hazard related to extreme events. Beside the consideration of climate hazards it is necessary to recognize that changes in the climatic system also can bring opportunities to some livelihoods. Hazards and opportunities depend upon the impact of the overall social-ecological system as well as on its adaptation capacity.

One can distinguish between three different types of impacts: direct, indirect, and incremental.

- **Direct impacts** are those primary effects biophysic assets as a result of changes in the climatic variables, especially temperature and rainfall, and changes in frequency and intensity of extreme events (e.g. impacts on ecosystems due tofloods, droughts, huricans).

- **Indirect impacts** refer to the impacts on a given sector or social group as a effect of the direct impacts (e.g. impacts on a given production changes due to reduction on a specific good; impacts on food security due to yield loss as a consequence of an extreme event).

- **Incremental impacts** refer to the increase or reduction in vulnerability over time as a result of the management practices (IPCC 2001; Robledo and Forner 2005)

For example, an extended drought, would directly affect the quality and quantity of wood produced from affected forest areas. This would have an indirect impact on employment in the wood industry. Incremental impacts of climate change on the forest will depend the long-term sustainability of the management practices. These impacts are not going to concentrate only on one sector but will affect various sectors (Robledo and Forner 2005).

Finally, the degree to which a given system can be impacted by climate change also depends on its own characteristics and their ability to tolerate or absorb impacts or to adapt to changes. All systems have the capacity to react to a stimulus but some systems might be more resilient to change than others at a specific time and place. The **resilience** of a social-ecological system refers to its buffer capacity (i.e. its ability to absorb perturbations and bounce back after a change occurs). In other words, the resilience of a social-ecological system refers to the magnitude of a disturbance that can be absorbed before the system changes its structure or behaviour (Berkes and Folke 2000)..

3.3 Vulnerability and responses to change

Vulnerability refers to the degree to which a system is susceptible to the impacts climate change. So vulnerability is a function of the impacts and the adaptation capacity of a social-ecological systems

Vulnerability = Impacts - autonomous adaptation capacity

Adaptive capacity is the potential or capability of a socio-ecological system to adjust, via changes in its characteristics or behaviour in order to better cope with existing climate variability and change. Adaptive capacity is constrained by the existing information, technology and resources of the system under consideration. **Adaptation** can be defined as a process, which combines strategies and actions to avoid, moderate, cope with and/or take advantage of the consequences of climate variability and change. The concepts of vulnerability, adaptive capacity and adaptation are interlinked because the vulnerability of a system is determined by its adaptive capacity (i.e. the greater its capacity of adaptation, the lesser its vulnerability).

Autonomous adaptation refers to the range of automatic responses of any system to a stimulus. These responses are aimed to overcome this change and do not foresee indirect or incremental impacts. For doing so an ecosystem need a minimum of environmental conditions are and its need that these conditions can be maintained over some time without new stresses.

Human beings have the capacity to foresee some of the impacts and to generate responses aimed at minimizing negative impacts or at preparing to use opportunities. The set of strategies and conscious actions to minimize those impacts or to prepare for using opportunities is called **planned adaptation.** Planned adaptation supplements the autonomous capacity of adaptation, especially in case the autonomous capacity is limited, or in case the autonomous adaptation's responses generate a cost that can be reduced. Planned adaptation determines the vulnerability of a system in the following way:

Vulnerability = Impacts - autonomous adaptation capacity - planned adaptation

3.4 The adaptation process

Article four of the United Nations Framework Convention on Climate Change (1992) defines the following three essential steps in the adaptation process: (1) vulnerability assessment, (2) capacity building, and (3) implementation of adaptation measures. The first step "vulnerability assessment" consists in the stakeholders' identification of prospective climate impacts, in the characterization the affected system (e.g. a country, a region, a watershed); and in the definition of priorities for action. Through implementation of the second step "capacity building", a given social system, and especially its institutions, create favourable conditions for implementing concrete actions aimed at adapting to climate change. Finally, the "implementation of adaptation measures" allows for implementing specific actions to improve the adaptive capacity of the system.

Ideally, these steps are part of a continuous and iterative process, where the lessons learned provide feedback to continue improving the process. However, this creates a conflict between the need to ascertain the vulnerability before establishing adaptation measures and the urgency of reducing the current negative impacts. Discussions at the international level highlight the importance of starting the implementation of preliminary adaptation measures (i.e. capacity building or pilot projects) without waiting for a detailed assessment of the national or local vulnerability, while concurrently not ignoring the importance of understanding the vulnerability of a given sector, ecosystem or community. The steps can be completed through specific projects, at several levels (regional, national and local), which must be part of the adaptation policies,. Therefore, responsibility for planning, implementing and monitoring these projects should be assigned to several stakeholders, such as national and local governments, private sector, research centres, universities and other representatives of the civil society. Overall, climate events can profoundly affect socio-ecological systems (e.g. the increments in hurricanes in Central America in 1998). Answers to climate change impacts should also address the ways and means by which a society manages its resources.

To consider climate change in development projects would add a long-term sustainability component to development assistance. There are three ways in which climate change is relevant to the bilateral cooperation as climate change:

- affects the inputs, as it affects all assets of the livelihoods
- affects the outputs, as it can devastate some of the outputs of the development cooperation (e.g. infrastructure)
- affects the outcomes of the cooperation as it affects the overall development process

Further, adaptation and development are dynamic processes focusing toward continuous improvement. In other words, both processes aim at reducing the vulnerability of a given system over time. Continuous improvement occurs primarily when social groups and institutions are able to learn from previous experiences and manage to turn change into opportunities.

4 Findings

4.1 National frameworks of SDC priority countries

In order to understand the potentials of including vulnerability and adaptation to climate change into development cooperation, the first objective of this study was to describe the level of understanding of and preparedness to climate change impacts at the national level. The national frameworks of SDC priority countries investigated reveal three major findings: (1) the importance of agriculture/water, forest and the human health sectors as being generally highlighted as the most vulnerable sectors in the National Communications; (2) the weak integration of adaptation to climate change into the national policies (3) the need for considering institutional diversification and decentralization processes around climate change issues at a national level.

4.1.1 Significant vulnerable sectors

The impacts of climate change on social-ecological systems will include various sectors (e.g. agriculture, forestry, tourism, human health), ecosystems (e.g. watersheds, lakes) and livelihood systems (e.g. rural and urban livelihoods). Any attempt at identifying the sectors most likely to be vulnerable to climate change is therefore relatively subjective. However, some aspects do emerge more than others in the National Communications of SDC priority countries depending on the specificities of each country and the related contexts (e.g. socio-cultural, geo-political, economic, environmental contexts) within which each country is embedded in. Table 2 summarises the most expected vulnerable sectors to climate change as specified in the National Communications of the nine countries assessed. The countries' data aggregation indicate that the most vulnerable sectors are expected to be, by ascendant order: (1) agriculture and water; (2) forest; (3) human health; (4) coastal zones; (5) infrastructure and energy; (6) livestock; (7) other fragile ecosystems (e.g. mangroves), biodiversity and fisheries; and (8) human settlements and land use.

Table 2: Summary of the sectors considered/expected in the National Communications to be most vulnerable to climate change

		Agriculture	Livestock	Forest	Other natural ecosystems	Water	Fisheries	Biodiversity	Land use	Coastal zones	Infrastructure & Energy	Human settlements	Tourism	Human Health
Africa	**Madagascar**													
	Mali													
	Tunisia									*				
South America	**Ecuador**													
	Bolivia													
Europe	**Bulgaria**													
Asia	**India**													
	Bangladesh													
	Kirgiz Republic					**								
	Total frequency	8	3	7	2	8	2	2	1	5	4	1	1	6
	Ranking	**1**	**6**	**2**	**7**	**1**	**7**	**7**	**8**	**4**	**5**	**8**	**8**	**3**

* including islands

** But only due to the situation in neighbouring states

4.1.2 Local institutional framework for implementing the UNFCCC and the CBD

Table 3 lists the ratification or acceptance date of biodiversity and climate change related protocols/conventions by the SDC priority countries assessed in this report. All the assessed countries have ratified or accepted the UN Convention on Biological Diversity (CBD) and its Biosafety Protocol as well as the UNFCCC and the respective Kyoto Protocol. However, according to the data collected in the SDC/IC projects, climate change issues, methods or mechanisms are rarely understood or used at the local level.

Furthermore, in many countries, the adjustment of national laws (such as laws on forestry) in line with the UNFCCC and CBD is considered to be weak or non-existent. National action plans against climate change or national strategies for the conservation of biodiversity have often been elaborated but are sometimes perceived as not very appropriate for regional or local circumstances (this is especially true for centrally planned countries). According to the data collected for this study, such action plans and strategies are not appropriately communicated to the local governments and communities and sometimes have to be adjusted or enriched by local strategies or action plans.

Table 3: Ratification of the protocols by SDC priority countries (acceptance in brackets)

	Country	CBD	Biosafety	UNFCCC	Kyoto
Africa	Madagascar	1996	2003	1999	(2003)
	Mali	1995	2002	1994	2002
	Tunisia	1993	2003	1993	(2003)
South America	Ecuador	1993	2003	1993	2000
	Bolivia	1994	2002	1994	1999
Europe	Bulgaria	1996	2000	1995	2002
Asia	India	1994	2003	1996	(2002)
	Bangladesh	1994	2004	1994	(2001)
	Kyrgyz Republic	(1996)	-	(2000)	(2003)

Sources: CDB Secretariat and UNFCCC Secretariat (October 2003)

4.1.3 Institutional considerations

The questionnaires (i.e. project managers) reveal that **institutions responsible for climate change-related issues** are generally located at the national level and, in most cases, associated with the Ministry of Environment and or the Ministry of Energy. Generally, the institutional framework with regard to climate change ranges from very elaborate (e.g. in Bangladesh) to almost non-existent (e.g. in Kyrgyzstan). Such institutional disparities not only exist between countries (national level) but also between regions (regional level) of a given country (e.g. India, where institutions responsible were reported at national, regional and local levels. **In the case of biodiversity conservation and environmental services**, institutions can be found at the national as well as at the regional and local levels. At the national level, the Ministries of Agriculture, Forestry and/or Environment or an associated institution are responsible for the implementation of the UN convention on biodiversity conservation. Further, the governmental body in charge of implementing endangered species' trade-related laws often plays an important role at the national level. At the regional and local levels, institutions include research institutes and universities, water management bodies (water use, irrigation), seed banks, etc.

The existence of different institutions related to climate change, biodiversity conservation and management of natural resources does not necessarily imply an efficient and effective implementation of strategies through programs and projects nor a promotion of cross-cutting issues among these three sectors. National institutions are generally increasingly delegating responsibilities to the local level. Local institutions responsible for tackling climate change issues include regional Forest Departments with reforestation or forest conservation programs (national parks), weather watch committees, meteorology institutes, drought monitoring cells, or institutions working against consequences of climate change such as desertification, salinisation, floods, droughts, etc. From the collected data, there is the feeling that this institutional "atomisation" can be a hindrance the implementation of concrete holistic measures at the local level, because it generally reduces the possibility to mainstream cross-cutting issues.. As a general perception, the institutional capacities in climate change mitigation and adaptation and the institutional coordination in the mainstreaming of these could improve if sufficient international support could be provided. In many countries, NGOs try to fill the lack of state institutional capacities. NGOs are reported to be active (or at least interested) in all the three issues - climate change, biodiversity conservation and resource management (including environmental services). Many multilateral and international donors as well as private foundations are active in these thematic issues in many countries (i.e. CIDA, DFID, IUCN, WWF, as well as SDC).

4.2 Project/program level

The second objective of the study was to describe the level of understanding of and preparedness to climate change impacts at the project/program level through a questionnaire send to project managers. The questionnaires' analysis reveals that: (1) none of the projects directly focus on climate change mitigation and adaptation, although climate is considered as a key variable; (2) biodiversity conservation is felt as an important issue for the majority of the programs/projects although only in two cases biodiversity indicators are included and, (3) water and watershed management are perceived as being a major issue.

4.2.1 Focus of the projects

None of the projects assessed focused directly on capacity building on mitigation or adaptation to climate change or to future climate variability. Programs and projects included in this assessment focus on three major **working domains** (see table 4**)**: (1) natural resources management, (2) governance, and (3) rural economy development. Projects and programs combine activities of these working domains according to the specific needs. More precisely, **key topics** for development intervention in the assessed projects included by order of importance: (1) capacity building and institutional development, (2) participatory mechanisms, (3) gender, and (4) technological development.

Table 4: SDC/IC project Working domains

Rural economy/technologies	***1***
Rural economy	2
Participatory mechanisms/technologies	3
Technologies	4
Governance/NRM	8
Participatory mechanisms	8
Gender	9
Governance	12
Capacity building	15
Institutional development	25

NRM	47

Capacity building is a constant throughout the projects and programs assessed. However SDC and IC staff have been experiencing a change in the content of the capacity building activities components/modules (e.g. from management practices toparticipatory).

4.2.2 Awareness about climate change and biodiversity

In general terms, IC project and program managers state that climate change is an issue in all of their countries, except in Kyrgyzstan. Three of the projects already consider that, even if not so far ? planned, their projects could account for climate change mitigation. Furthermore, over 65% of the answers show an interest in accounting for climate change mitigation effects, especially through the CDM. The remaining four projects and programs state different reasons for not being interested, among them a specific project focus not related to climate change (processing of cardamom, conservation of agro-biodiversity), lack of institutional development and of political priorities in the country (Kyrgyzstan), or the prejudice that the sustainable livelihood approach does not allow for accounting of climate change mitigation effects. The latter statement demonstrates yet again the need for understanding the real potential and limitations of i.e. the flexible mechanisms of the Kyoto Protocol.

4.2.3 Water as a major concern

From the questionnaires, change in water availability (qualitative and quantitative), partially due to climate change is a major concern at the program/project level. Sixty-five percent of the projects assessed reported that increments in floods and/or drought represented the main climatic hazard in their focus area. Only 14% of the projects reported another climatic hazard, namely landslides. In some cases, a clear relationship was expressed between increments in floods and such landslides (e.g. the ATICA project in Bolivia). The identification of water related hazards as a major concern within the projects coincides with the information given by the National Communications (Annex 2) as well as with widely accepted literature (Varis et al, 2004; Riebsame 1988; Frederick and Major, 1997). Further, reduction in productivity was reported to be the most frequent impact on livelihoods (65%), followed by house damage (61.5%) and health deterioration, lost or damaged infrastructure and lost of income source (30%).

4.3 Assessing the linkages between the national and project levels

The second objective of this study was to assess the linkages between national and project levels. For this, the study focuses on assessing whether a link existed or not between the adaptation priorities defined by each assessed country and the actual SDC/NRE projects/program orientation. The study reveals that:

Table 5 identifies the SDC/IC projects' orientation through the lens of the National Communication classification of the most vulnerable sectors. The table results are based on the questionnaires and on the projects' description in the IC website. The most expected vulnerable sectors identified in the National Communications as well as the targeted sectors for intervention in the DDC/IC programs are, by ascendant order: (1) biodiversity; (2) agriculture; (3) forest; (4) land use and soil management, (5) livestock; (6) water; (7) other fragile ecosystems; (8) infrastructure and energy; and (9) fisheries, settlement, tourism, and human health. We hypothesise that the importance of biodiversity might be a bit overstated because the theme had its own category in the questionnaire (Annex 1) and/or because it is also a theme which is transversal to various sectors (e.g. tourism, agriculture, forestry).

Table 5: Summary of key targeted sectors from the assessed DDC/IC projects (sources: IC website and questionnaires)

	Country	Project Title	Project Goals	Agriculture	Livestock	Forest	Other ecosystems	Water	Fisheries	Biodiversity	Land use & soil management	Coastal zones	Infrastructure & Energy	Human settlements	Tourism	Human Health
				Key targeted sectors												
Africa	Madagascar	SAHA	Rural Development Program													
	Mali	Jekasy	Support Program to farmers' organizations to enhance natural resources													
	Tunisia	PAOTIC														
South America	Ecuador	PROBONA	Programa de bosques nativos y agrosistemas andinos													
	Bolivia	ATICA	Agua Tierra Campesina													
Europe	Bulgaria	BSFP	Bulgarian-Swiss Forestry Project													
Asia	India/Karnataka	ISPWD - K	Indo-Swiss Participative watershed development project													
	India/Orissa	NRMPO: LCO/LSD	Indo-Swiss Natural Resources Management Programme Orissa: Livelihood and Community Organization (LCO) & Livestock Service Delivery (LSD) Thrust													
	India/Sikkim	ISPS	Indo Swiss project Sikkim													
	India		Biodiversity Conservation, Integrated NRM and Poverty Reduction													
	India/Andhra Pradesh	ISNRMPA	Participatory Natural Resource Management and Rural Livelihood Development in drought prone areas of Andhra Pradesh													
	Bangladesh	SLU	Sustainable Land Use Program													
	Kyrgyz Republic	KIRFOR	Kyrgyz-Swiss Forestry Support Program													
			Total frequency	10	6	9	3	5	1	12	7	0	2	1	1	1
			Ranking	**2**	**5**	**3**	**7**	**6**	**9**	**1**	**4**	**10**	**8**	9	9	9

Table 6 ("comparison 1 - sectors") and Table 7 ("comparison 2 – spatial") summarize whether a link exists or not between the adaptation priorities defined by each assessed country and the actual SDC/NRE projects/program orientation. Two important remarks can be made from an interpretation of the tables:

1. Overall, and for the assessed countries, agriculture and forest appear as key sectors for intervention at both national and project levels. Development projects for adaptation to climate change need to continue their focus on **agriculture and forest sectors**, but, as demonstrated earlier, need to also include the **water sector**. Although donor agencies are reducing the amount of money invested in the forestry sector, forestry appears to be key for adaptation at the national level (NC, Annex 2).
2. Although **human health** is expected to be among the most vulnerable sectors to climate change in the National Communication, this dimension is not part of the key sectors of intervention of the IC projects. One of the major reasons is that historically IC has specialized in natural resources management. However, the National Communications show that appropriate climate change adaptation projects need to include and account for the human health dimension. Partnerships need to be built between SDC/IC and other agencies working in the field of human health.

Table 6: Comparison between sectors

NC ranking compared with SDC/IC ranking

NC	Sectors	SDC/IC
1	Agriculture	2
	Water	**6**
2	Forest	3
3	**Human Health**	**9**
4	**Coastal zones**	**-**
5	Infrastructure & energy	8
6	Livestock	5
7	Other ecosystems	7
	Biodiversity	**1**
	Fisheries	9
8	Human settlement	9
	Tourism	9
	Land use and soil	**4**

Table 7: SDC/IC ranking compared with NC ranking

SDC/IC	Sectors	NC
1	**Biodiversity**	**7**
2	Agriculture	1
3	Forest	2
4	**Land use & soil**	**8**
5	Livestock	6
6	**Water**	**1**
7	Other ecosystems	7
8	Infrastructure & energy	5
9	Fisheries	7
	Human settlement	8
	Tourism	8
	Human health	**3**
-	**Coastal Zones**	**4**

These two findings of the study lead to a more general conclusion that although the orientation of donor agencies to deal with climate change focuses on "adaptation", increasing the adaptive capacity of communities to climate change *per se* is not enough. Indeed, and importantly, individuals do adapt to change but not all adaptation strategies are sustainable. In other words, communities can also adapt in unsustainable ways. Therefore, activities considering adaptation to climate change need to take a transversal approach (across sectors, across space and time). To do so these activities need to be mainstreamed into the overall development process.

A prerequisite to climate change adaptation is to understand to what extent the systems can absorb climate change impacts and how far new structures or arrangements are required to adapt(Gunderson, 2003). To answer this question, estimating the resilience of social-ecological systems will be the first necessary step. For the purpose of this assessment and based on the information provided by the questionnaires, a general resilience profile can be established distinguishing (for the purpose of simplification) between (1) the social and (2) the natural components of the system under investigation. For a more rigorous estimation/definition of the resilience profiles, each project or program should be assessed separately.

Social component: The primary goal of the projects and programs participating in this assessment has been to contribute to poverty reduction. Generally, poverty is characterized by a low level of organization (social, political, economic, legal), a lack of clarity on land tenure and land use rights, low social security networks a low access to natural resources, decision-making, state agents and officials, markets, capital, labour opportunities and low income (Ribot 1998). Thus a low social resilience profile could be expected as a rsult of poverty. This observation corroborates with the results presented in the report on Poverty and Climate Change (African Development Bank, et al. 2003).

Natural component: Two main ecosystems have been differentiated in the assessment: forest and agricultural land. After discounting the two projects that did not focus on a specific ecosystem, one third of the projects and programs focused on forestry, one third on agriculture and one third combined both. In over 85% of the cases, forest and agricultural land have been identified at the project level as being under environmental threat (see the questionnaire, Annex 1), especially due to overexploitation. Interestingly, over 20% of the cases (n = 3) identified climate change as an environmental threat. We hypothesise that ecosystems, which are exposed to unsustainable management practices have a low ecological resilience to absorb ecological surprises (e.g. unexpected discrete events or discontinuities in long-term trends) (Gunderson, 2003). Thus, such ecosystems are more vulnerable to additional stress as such caused by climate change.

4.4 Barriers and benefits

The third objective of this study was to identify the main barriers that SDC/IC projects and programs have experienced and try to analyze the potential implications of such barriers for the implementation of adaptation measures to climate change and variability.

As expressed in table 8 the following barriers were considered:

- ***Institutional barriers***, including/such as those related to the existing legal frameworks and their means of enforcement. Different issues are included in this category, such as tenure over and access rights to natural resources or implementation of an adequate decentralization process. Lack of institutional coordination was identified as the major institutional barrier. This represents an important challenge for future work in implementing climate change mitigation and particularly adaptation strategies, since institutional coordination has been identified as a key element for promoting adaptation to climate change in the framework of sustainable management of natural resources (Robledo and Forner, 2005)
- ***Technical barriers***, are those barriers which are linked to the access of know-how and technology for sustainable management practices of natural resources. The main technical barrier identified was the reduced access to techniques and technologies.. However it remains unclear why that happens. Local circumstances linked to

institutional, economic or social barriers can perhaps explain this barrier if it is required in a future analysis.

- ***Social barriers*** The major social barrier reported was the lack of access to decision-making. This confirms the understanding that long-term development process need to promote empowerment of more local groups. This will be surely an important element for any activity in climate change mitigation or adaptation.
- ***Economic barriers.*** Two major economic barriers were identified: insufficient access to markets and insufficient income. Similarly to the social barriers these economic barriers will surely be of interest in trying to promote the implementation of activities related to the climate change mitigation and adaptation strategies. The potential importance of the Clean Development Mechanism (CDM) in creating income for the rural poor needs particular consideration. Even if there are some experiences that demonstrate that CDM projects really have this potential, it is important to ensure that local circumstances allow participation of the rural poor in these projects.

Table 8: Summary of barriers encountered by SDC/IC programs and projects

	Ecuador	Bolivia	Central America	Tunisia	Madagascar	Mali	Bangladesch	India	India	India	India	India	Kyrgyz Republic	Bulgaria		
	IC Andes	ATICA	PASOLAC (Partial information)	PAOTIC	IC Madagascar / SAHA	D-IC Sahel	IC Bangladesh / Sustainable Land Use Program	Indo-Swiss Participative watershed development project - KARNATAKA	PCU, NRMPO: LCO & LSD Thrust, ORISSA	Indo Swiss project SIKKIM	Biodiversity Conservation, Integrated NRM and Poverty Reduction	Management and Rural Livelihood Development in drought prone areas of Andhra Pradesh	KIRFOR	Bulgarian-Swiss Forestry Project BSFP	Frequency	Ranking
Institutional barriers																
Insufficient legal framework		X		X		n.a		X	n.a		n.a	X	n.a		4	2
Lack of institutional development	X	X		X	X	n.a			n.a		n.a		n.a	X	4	2
Lack of institutional coordination	X	X			X	n.a	X		n.a		n.a	X	n.a	X	5	1
Lack of capacity	X	X				n.a			n.a		n.a		n.a		1	4
No legal/ reducedownership over or access to natural resources				X		n.a	X		n.a	X	n.a		n.a		3	3
Technical barriers																
Insufficient access to technology					X	n.a	X	X	n.a	X	n.a		n.a	X	5	1
Inappropriate use of techniques or technologies						n.a			n.a		n.a		n.a	X	1	3
Lack of capacity	X	X		X		n.a			n.a		n.a	X	n.a		4	2
Social barriers																
Lack of information					X	n.a			n.a	n.a	n.a		n.a		1	3
Lack of participation	X					n.a			n.a	n.a	n.a		n.a		1	3
lack of skills/capacity						n.a			n.a	n.a	n.a		n.a			

Lack of access to decision-making from local social groups						X		n.a		X		X		n.a		n.a		n.a		X		n.a		X		5	1
Local conflict			X				X		n.a					n.a		n.a		n.a				n.a				2	2
Migration			X			X			n.a					n.a		n.a		n.a				n.a				2	2
Economic barriers																											
Insufficient access to markets							X		X	n.a				n.a		n.a		X		n.a		X		n.a		X	5	1
insufficient employment										n.a				n.a		n.a				n.a		X		n.a			1	2
Insufficient income		X		X			X		X	n.a				n.a		n.a		X		n.a				n.a			5	1
Lack of investment										n.a			X	n.a		n.a				n.a				n.a			1	2

5 Conclusions

The following are the general conclusions from the study:

- All countries, which have participated in the study have ratified the UNFCCC and are Parties of the Kyoto Protocol. Therefore, all countries can be active in both mitigation and adaptation projects and programs.

The institutional framework for climate change adaptation varies considerably between countries. For future activities in climate change adaptation the framework of each country needs to be clarified in order to facilitate considering all the relevant cooperation partners in a given country. New actors for the cooperation will be key in addressing adaptation in SDC priority countries. Proper identification of these new partners for SDC need do be done in each priority country.

- 65% of the sample shows interest in mitigation and 50% report activities in (autonomous) adaptation. Nevertheless, modalities and procedures for mitigation (more specifically for the CDM in forestry) or steps and methods for adaptation as well as new financial sources for such activities are less known.

- According to the National Communication of the countries where the study was conducted following sectors are their priorities for adaptation
    4. Agriculture and water
    5. Forestry
    6. Health

- Biodiversity seems to be relevant for all projects. Nevertheless, in general, there is little quantitative or qualitative information available on changes in biodiversity.

- Interest concerning environmental services appears to be high. However there is some confusion on concepts as well as a general lack of concrete experience on quantifying and valuing environmental services or in accessing corresponding markets. A good experience in this sense is PASOLAC, where some payments for environmental services (PES) have taken place. However there is a very low level of understanding of the role that PES can play in supporting the strategies for climate change mitigation and adaptation. Carbon sequestration is perhaps an exception since some projects mentioned their intention of getting payments for it in the CDM or in the voluntary markets. Lack of knowledge and experience with the modalities and procedures for the CDM in forestry is a however a severe constraint.

- Conflict concerning land tenure and land use rights seems to be the major institutional constraint for a sustainable management of natural resources. This is not a new understanding, however it has a big role in preventing the implementation of climate change mitigation and adaptation strategies. It is particularly relevant for the mitigation strategy because projects have to thoroughly clarify ownership of the carbon certificates before the project can be registered. If poor communities have reduced or inexistent access to the carbon pools in the forest, these communities have severely reduced opportunities to obtain the benefits from CDM forestry projects.

5.1 Adaptation to climate change

Current changes in the climatic system and its variability have an important impact on the development process. Future climatic scenarios are expected to increase stress in the most regions of the world, with a resultant increase in poverty. Developing countries are in general aware about the general meaning of climate change. However these countries have lower installed capacity to understand their vulnerability and to propose and implement adaptation measures.

Bilateral cooperation projects often are inline with the adaptation priorities defined at the national level. However, due to lack of awareness the potential for synergies is not realised or, even worse, bilateral cooperation is reducing in some cases its activities in sectors that prioritary for adaptation. This is particularly the case of the forestry sector which, after water and agriculture has been identified as the second priority for adaptation in the countries covered by the survey.

Finally, we need to consider the different scale on which climate change affects regions and in which many bilateral cooperation projects are located. Climate change has impacts over mega-regions, while – in comparison – bilateral cooperation projects work over smaller geographical areas. Cooperation activities aimed at implementing climate change mitigation and particularly adaptation strategies should be aware of this difference and be planned accordingly.

6 Recommendations

Based on the results of the questionnaire, we highly recommend that activities in adaptation to climate change will be clearly mainstreamed into development cooperation, and conclude that SDC as a development agency is in a unique position to promote such integrated resource management approaches in collaboration with its partners.

Such a process of mainstreaming adaptation into development cooperation should be systematically promoted. In doing so different levels of cooperation should be considered:

1. Capacity Building

Developing countries need to improve their capacities for using opportunities for and reducing constraints to climate change adaptation. Large efforts have been made worldwide to improve capacities of national negotiators from developing countries. However, those responsible for project formulation and implementation in rural areas, including local authorities, have not been included in these initiatives yet. This shortcoming needs to be addressed for climate change adaptation activities to be implemented at field level. Since SDC supports a large number of projects and programs at the local level in rural areas, it already has contacts with those communities that would be in a position to concretely mainstream climate change mitigation and adaptation activities into ongoing programs and projects. Nevertheless, these require the information and skills that enable them to do so. Such an improvement in understanding as well as in skills for adaptation need to take place not only in developing countries but also among the practitioners of the development cooperation.

2. Institutional level

Developing countries need support for mainstreaming adaptation priorities in the national plans for development as well as into the sectoral plans. For such a mainstreaming it is necessary to promote intra-sectoral communication and coordination.

Institutional and legal matters related to land tenure and access to natural resources are highly relevant for adaptation.

Cooperation activities in adaptation should include considerations on clarification of land tenure and access to natural resources and governance at different levels

Finally we want to highlight the need to mainstream adaptation into other areas of the development cooperation as e.g. disaster risk reduction or technology transfer

3. Level of instruments for adaptation:

There is a need for designing methods and tools for adaptation that incorporate vulnerability and coping strategies at different levels (e.g. sectoral policies or the livelihood level). Such tools are needed for answering e.g. the following questions:

- How to assess impacts and vulnerability of sectors or of livelihoods?
- How to monitor adaptation?
- How to integrate adaptation measures with other activities at the field?

4. Level of implementation

As adaptation to climate change is a relatively new field in the development cooperation the implementation of concrete activities can face new challenges (e.g. how to define and quantify vulnerabilityor how to monitor adaptation). SDC can pave the way for wider mainstreaming of climate change adaptation by supporting pilot projects that integrate adaptation into sustainable management of natural resources ans sustainable livelihoods. Methods and lessons from these projects should be systematically monitored and transmitted to other stakeholders through the capacity building initiative mentioned in numeral 1.

7 References

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8 Glossary

The authors using different sources, such as those in the Adaptation Policy Framework and scientific literature, have compiled this section.

Adaptation – a process by which strategies to moderate, cope with, and/or take advantage of the consequences of climatic events are enhanced, developed, and implemented.

Adaptation baseline - an adaptation baseline includes a description of adaptations to current climate that are already in place. Also see Baseline.

Adaptation Policy Framework (APF) – a structured process to develop adaptation strategies, policies, and measures to enhance and ensure human development in the face of climate change, including climate variability. The APF is designed to link climate change adaptation to sustainable development and other global environmental issues. It consists of five basic components: project scope and design, assessing current vulnerability, characterizing future climate risks, developing an adaptation strategy and continuing the adaptation process.

Adaptive capacity – the potential or capability of a system to adjust, via changes in its characteristics or behaviour, enabling it to cope better with existing climate variability and change. It is possible to differentiate between adaptive potential, a theoretical upper boundary of responses based on global expertise and anticipated developments within the planning horizon of the assessment, and adaptive capacity that is constrained by existing information, technology and resources of the system under consideration.

Adaptive management - the act, manner, or practice of managing, handling, or controlling a specific system in a way in which its adaptive capacity is increased. Adaptive management is achieved by the implementation of adaptation actions

Baseline (also called project baseline) – a description of current conditions, including existing or required information on socioeconomic conditions, climate risks and hazards, and known system vulnerabilities and adaptations. See also vulnerability baseline and adaptation baseline.

Climate change – any change in climate over time, whether due to natural variability or because of human activity.

Climate change vulnerability - the degree to which a system is susceptible to, or unable to cope with the adverse effects of climate change, including climate variability and extremes. See also vulnerability.

Climate variability – variations in the mean state and other statistics (such as standard deviations, the occurrence of extremes etc.) of the climate on all temporal and spatial scales beyond that of individual weather events. Variability may result from natural internal processes within the climate system (internal variability) or to variations in natural or anthropogenic external forces ? (external variability). Climate variability is the result of the interaction between climate variables over the short term and does not necessarily represent a trend. (IPCC, 2001)

Coping range – the range of climate within which the outcomes are beneficial or negative but tolerable; beyond the coping range, the damages or loss are no longer tolerable and a society and/or a natural system is said to be vulnerable.

Cost-benefit analysis - a quantitative method that makes a detailed comparison of the costs and benefits of a particular measure, or set of measures. A decision to fund the project depends on the ratio of benefits to costs – the higher the ratio, the more attractive the investment. Its major advantages are its verifiable bottom line and its familiarity within ministries and planning agencies. Disadvantages include limitations regarding the ability to directly address equity considerations and represent non-quantifiable benefits.

Evaluation – a process for systematically and objectively determining the relevance, efficiency, effectiveness and impact of the adaptation strategies in the light of their objectives.

Food insecurity – a situation that exists when people lack secure access to sufficient amounts of safe and nutritious food for normal growth and development and an active and healthy life. It may be caused by the unavailability of food, insufficient purchasing power, inappropriate distribution, or inadequate use of food at the household level. Food insecurity may be chronic, seasonal, or transitory. More recent literature focuses on livelihood security—an expansion beyond food security to include multiple stresses and sectors to which livelihoods might be exposed.

Hazard – a physically defined climate event with the potential to cause harm, such as heavy rainfall events, droughts, floods, storms, long-term changes in mean climatic variables such as temperature.

Hybrid - "Hybrid" approaches apply both uniform and site-specific methods in tandem and within an iterative process to develop and assess the range of adaptation strategies.

Indicator – an item that can be clearly characterized and possibly quantified that represents an abstract concept, such as human well-being.

Institution - humanly devisedthat structure human interaction. They are made up of formalconstructs (rules, laws, constitutions), informal constructs (norms of behaviour, conventions and self-imposed codes of conduct) and their enforcement characteristics.

Logical Framework Analysis Approach/Logframe – a project planning tool that includes project goals, objectives and activities, with specific outputs and measurable indicators of achievements.

Measure – see "Policies and measures."

Monitoring – a mechanism or mechanisms to track progress in implementation of an adaptation strategy and its various components in relation to targets.

Policies and measures – usually addressed together, policies and measures address the need for climate adaptation in distinct, but sometimes overlapping ways. Policies typically refer to instruments that government can use to change economic and other behaviours. Policies are usually composed of taxes, command-and-control regulations (e.g. performance specifications for technologies), market mechanisms such as trading schemes, incentives such as subsidies for new management techniques, and information gathering (e.g. on the likely impacts of climate change) or dissemination (e.g. the merits of new technologies or behaviour changes). Measures are usually specific actions amenable to implementation, such as re-structuring irrigation systems, planting different crops, or initiating a new industry. Many "projects" could be also termed "measures".

Priority system – priority system is the focus of the APF process. It is a system that is characterized as highly vulnerable to different climate hazards, as well as being strategically important at local and/or national levels. It has been identified as a priority system through a stakeholder-driven process.

Probability - defines the likelihood of an event or outcome occurring. Probability can range from being qualitative, using word descriptions such as likely or highly confident, to quantified ranges and single estimates, depending on the level of understanding of the causes of events, historical time series and future conditions.

Reference scenario – an internally coherent description of a possible future without consideration of climate change; the reference scenario is used for comparison with alternative scenarios that include consideration of climate change and options for adaptation policies and measures.

Resilience - the buffer capacity or the ability of a system to absorb perturbations; the magnitude of disturbance that can be absorbed before a system changes its structure by changing the variables and processes that control behaviour.

Risk (climate-related) –The result of the interaction of physically defined hazards with the properties of the exposed systems - i.e. their sensitivity or [social] vulnerability. Risk can also

considered as the combination of an event, its likelihood, and its consequences - i.e. risk equals the probability of climate hazard multiplied by a given system's vulnerability.

Scenario – a plausible and often simplified description of how the future may develop, based on a coherent and internally consistent set of assumptions on driving forces and key relationships. Scenarios may be derived from projections, but are often based on additional information from other sources, sometimes combined with a narrative storyline.

Sector – a part or division, as of the economy (e.g. the manufacturing sector, the services sector) or the environment (e.g. agriculture, forestry).

Site-specific approaches – these seek to develop and assess detailed adaptation strategies on the basis of specific perceptions of vulnerability that have emerged from the full range of stakeholders at the site level (e.g. local communities, local project).

Socioeconomic vulnerability - an aggregate measure of human welfare that integrates environmental, social, economic and political exposure to a range of harmful perturbations . See also vulnerability.

Stakeholders – those who have interests in a particular decision and/or process, either as individuals or as representatives of a group. This includes people who influence a decision, or can influence it, as well as those affected by it.

Strategy – a broad plan of action that is implemented through policies and measures. Strategies can be comprehensive (i.e. focusing on national, cross sectoral scales) or targeted (i.e. focusing on specific sectors, regions, or measures).

System - a system may be a region, a community, a household, an economic sector, a business, a population group, or other systems, such as an agricultural system, that are exposed to varying degrees to different climate hazards..

Uncertainty – an expression of the degree to which a value (e.g. the future state of the climate system) is unknown.

Uniform approaches – these seek to develop and assess broad adaptation strategies on the basis of a comprehensive perception of vulnerability that may exist – for example across sectors, across regions, across development challenges.

Vulnerability – the degree to which an exposed unit is susceptible to harm due to a perturbation or stress, and the ability (or lack thereof) of the exposed unit to cope, recover, or fundamentally adapt (become a new system or become extinct). It can also be considered as the underlying exposure to damaging shocks, perturbations or stresses, rather than the probability or projected incidence impacts of those shocks themselves. See also socioeconomic vulnerability and climate change vulnerability.

Vulnerability baseline - vulnerability baseline includes a description of current vulnerabilities to climate variability and events. Also see Baseline.

9 Appendixes

9.1 Appendix 1: Questionnaire

9.2 Appendix 2: Summary of the National Communications by country and region

inter cooperation
Natural Resource Management
Rural Economy
Local Governance and Civil Society

IC-Forest-Environment Team
FOREN
Climate Change Group

Understanding the effects of SDC/IC programs and projects on vulnerability and adaptation to Climate Change and Climate Variability
Questionnaire

Country: ☐

Designation: the present questionnaire has been filled out on the level of

- ☐ IC Delegation
- ☐ IC Program
- ☐ A specific Project
- ☐ A project within an IC program implemented by a local partner

Name of the Delegation/program/project:

Name and e-mail address of the person responsible for filling out the questionnaire:

A. PART A: General Questions to all projects

I. Climate Change:

		YES	NO
1	Is Climate Change an issue in your country?	☐	☐
2	If not; do you think that it will become an issue in near future?	☐	☐
3	Does your project takes into account/consider mitigation of greenhouse gases?	☐	☐
4	Is your project interested/accounting in CDM (Clean Devolopment Mechanism) activities?	☐	☐
5	Does your project takes into account/consider possible measures for adaptation to climate change?	☐	☐

If climate change is not an issue for your project, explain why:

II. Conservation of Biological Diversity:

		YES	NO
1	Is biodiversity an issue in your country?	☐	☐
2	If not; do you think that it will become an issue in near future?	☐	☐
3	Does your project consider biodiversity conservation in its work?	☐	☐

If biodiversity conservation is not an issue for your project, explain why:

III. Other Environmental Services:

		YES	NO
1	Do you think that payment for environmental services is or will become an issue in your country?	☐	☐
2	Is your project interested in the valuation/payment of environmental services (water and soil conservation, water regulation, Eco-tourism etc)?	☐	☐

IV. Observations:

Further Procedure:

• If climate change and conservation of biodiversity are not relevant in your project or are not interesting issues in the region you are working, you might or might not consider the remaining part of this questionnaire.

• If your answer to one or more questions of section I or II is "yes", please fill out the specific part of the questionnaire with particular reference to the level of your project/programme activities (national, regional or local). FOREN is aware that you might not have all information available or you might be unable to go into depth in many of the questions. Try however to make some active research to get necessary information if needed.

PLEASE RETURN THE QUESTIONNAIRE (Part A and Part B) TO FOREN LATEST BY END OF JUNE 2003, either by e-mail (crobledo@intercooperation.ch) or regular mail (IC-attention Carmenza Robledo, B..P. 6724, CH-3001 Bern, Switzerland.

Thank you for your collaboration.
Juergen Blaser

PART B: Specific Questions to Interested Projects/Programs

1. Institutional framework

Please describe the institutions in charged of climate change, biodiversity conservation and other environmental services in your country of affectation.

Note: These institutions are the potential future partners to integrate climate change/environmental service issues in projects and programmes in the field of natural resource management.

1.1 Did the country signed, respectively ratified the UN Convention on Climate Change and/or the Kyoto Protocol (date); if not, what is the countries specific policy in regard to climate change?

1.2 Did the country signed, respectively ratified the UN the Convention on Biological Diversity (date); if not, what is the countries specific policy in regard to biodiversity?

Please describe the institutional framework in charged of Climate Change and/or Conservation of Biological Diversity, considering the key actors at the national, regional (sub-national) and local levels (the following matrix can be used as support)

	National Level	**Regional Level** (Department, Province, Prefecture/Rayon, etc,	**Local level** (Municipality, Town, Commune, etc)
1.3 Institution(s) responsible for Mitigation of Climate Change (name; contact addresses)			
1.4 Institution(s) responsible for Adaptation to Climate Change			
1.5 Institution(s) responsible for Biodiversity Conservation			
1.6 Institution(s) responsible for other environmental services (e.g. water management, soil conservation)			
1.7 NGOs interested or working in projects considering climate changes			
1.8 NGOs interested or working in projects considering conservation of biodiversity			
1.9 NGOs interested or working in projects considering other environmental services			
1.10 Other donors working in the field of Climate Change and generally on Environ. Services			

1.11 Do you consider that this framework is well articulated? Please explain your answer

2. Legal framework

2.1. Please describe the legal framework covering climate change and/other conservation of biological diversity in your region, considering as well the relevant the national legal framework.

Do you consider that this framework is well articulated? Please explain your answer

2.2 Who are the landowners in the area of your project/program?

2.3 Do local people have legal access to natural resources? Is it ruled who owns the environmental services provided by natural resources? Please explain.

2.4 Is there informal and/or illegal use of natural resources, including forest and forest land in the specific area of your project/program? Please shortly describe this illegal or informal use.

3. Project/programme description

Please describe your specific IC programme/project considering following elements

- Goal
- Project/Programme components
- Synergies (if some) between projects (if analytical level is an IC-country program)

4. Project activities

4.1 General aspects:

4.1.1 What was the specific (environmental, social, economic) situation before the project started?	Describe the problem the project is aim to solve
4.1.2 Specific project objectives	
4.1.3 Project partners at the national, regional or local levels (governmental and non-governmental)	
4.1.4 Communities involved (Number of communities, number of people to be reached)	
4.1.5 Size of the project/program area (ha)	
4.1.6 Duration of the project (divided in phases, if needed)	
4.1.7 Please summarize the main achievements and outputs of the programme/project until now (general level)	

4.2 Specific aspects:

4.2.1 Which social groups form your local community (indigenous, farmers) and how are their organization/participation mechanisms?	
4.2.2 How do you inform the local community about the project's activities?	
4.2.3 Is the local community aware about the problematic the project intends to solve?	
4.2.4 What kind of the technical measures do you use in the project (planting of trees, agricultural, forest management practices, building of infrastructure, etc.)	
4.2.5 Who is responsible for planning and implementation of technical measures? (Institutions, organizations, communities, etc.; describe their responsibility)	
4.2.6 Does the project offer capacity building in specific areas?	If yes please describe how it works
4.2.7 Which instruments/methods did the project use to promote participation of local communities?	
4.2.8 Please summarize the main social achievements and outputs of the	

programme/project until now	

5. Benefits and barriers of the project/program

Please describe the main benefits and mayor barriers

BENEFITS	National	Regional	Local
Institutional (inc. legal framework)			
Technical			
Social			
Economic			

BARRIERS	National	Regional	Local
Institutional (inc. legal framework)			
Technical			
Social			
Economic			

6. Climate Change

6.1 Climatic-physical characteristics of the project area	Nam and locality of central weather station(s) : Altitude of the observation side (m above sealevel): Mean annual temperature (°C): Mean annual rainfall (mm): Average number of months with less than 30 mm of rainfall: Extreme rainfalls (indicate observation period):
6.2 Climate Hazard (Floods, droughts, hurricanes, etc...) Type, Frequency and severity over the past 20 years in the project/program area. Has there been changes noted/documented?	
6.3 List any relevant studies in the project/program areas that you are aware of in relation to climate hazards	
6.4 Number of people/households possibly affected by climate hazard in your project/program area (total and in % of total people living in the area).	
6.5 How are people affected? (housing damages, lower agricultural production, health, reduction in income, ...)	
6.6 How did the project deals this climate hazard? (Technical measures, capacity building, information to local social groups...)	
6.7 Is there an observed/quantified reduction regarding the mentioned climate hazard? If yes, describe it	

6.8 Vulnerability assessment	National Communications for developing countries can be downloaded from http://unfccc.int/resource/natcom/nctable.html#nonannex1 Has a vulnerability assessment been conducted? YES / NO If yes by whom? If YES, please summarise main findings for your project's region:
6.9 Determine (in ha and if possible on map) in your project area in the land that was in the year 1990 forested and the land that was in 1990 already deforested? (see definition of forest given [I1]). Specify if this is a rough estimate, or based on an assessment.	If partial, please note how many hectares were non-forests at January 1st, 1990
6.10 Area that has been successfully reforested until today (through the project or generally in the project area)	
6.11 What are the future plans for reforestation/regreening, agroforestry development, etc.?	
6.12 Has there been observed any changes in agricultural production in your project/program area during the past 20 years? If yes, what kind of changes?	
6.13 Has there been observed any changes in soil fertility in your project/program during the past 20 years? If yes, what kind of changes?	

7. Conservation of Biological Diversity

7.1 Ecosystems

7.1.1 In what kind of ecosystems is your program/projects working ? (inland waters, marine and costal areas, climatic and vegetation type, altitude range)	
7.1.2 What are the most important threats of the concerned ecosystems?	
7.1.3 Landscape situation: primary, secondary forests, degraded (forest) landscape, cultivated landscape, etc?	
7.1.4 Do you know any planning activities concerning regional ecosystem conservation (for example ecoregional planning, "corridor" consideration, etc.	
7.1.5 Do the administrative borders represent a component to deal with for conservation?	
7.1.6 To which extent can your program/projects contribute to the conservation of these ecosystems? (sustainable management/conservation	

of forests or other ecosystem, fauna, forest and landscape restoration, etc.)	
7.1.7 If yes, do you use biodiversity indicators? What kind of indicators?	
7.1.8 Are public consultative talks, environmental studies or Impact Assessment common for new projects? Do you know examples?	

7.2 Species

7.2.1 What do you know about species in danger (animal, over-exploited plants, etc.) in your project area ?	
7.2.2 If yes, do you take it into account in your program/projects? Do you know "in-situ conservation program" related to a specific species?	
7.2.3 Do you see any risk of extinction for a specific species (for example NTFP, hunted species, etc.)?	
7.2.4 Do you know problems related to exotic invasive species in your program/projects area? What do you do?	
7.2.5 If there is an increase of the use of a specific natural resource, can you preview some forthcoming difficulties (for reproduction, survival)?	
7.2.6 Do you know the origin of what were planted in your program/projects? (seeds, plantulas,…)	
7.2.7 Is there a strategy in species choices? In seed supplies? Which one?	

7.3 Genetics/biotechnology

7.3.1 Do you know or do anything in relation with biotechnology in your program (Meristem culture and micropropagation? Marker assisted breeding? Vaccine development for livestock? Genetic modification of crop plants?)?, same question for the region?	
7.3.2 Are you aware of any intellectual property rights existing in your project area in relation to local knowledge and use of natural resources, including NTFP and medicinal plants?	

8. Other Environmental Services

8.1 Does the project consider management and/or valuation of other environmental services? If yes, which services are included?	If yes, please describe which.
8.2 Do some payment mechanisms exist for environmental services in the country or the region/ project area?	If yes, please describe which.

9. Personal Comments

Please include in this section your personal comments and other information that, based on your project experience, can be relevant for the analysis.

Place, Date:

Thank you

The climate change team of IC/FOREN wants to express our deep gratitude to those who answer this questionnaire. It is just through your answers that the assessment can be done.

Many thanks!!

Carmenza Robledo, Annette Kolff,
Jean-Laurent Pfund, Thomas Stadtmueller, Juergen Blaser

Page: 8
[I1]JLP We have to include the definitions of forest, reforestation, aforestation and deforestation by UNFCCC and CDB

Annex X: Summary of vulnerabilities to climate change in Africa

Vulnerable Sectors	Key barriers identified	Policy recommendations for adaptation
Agriculture	Grain yields are projected to decrease for many scenarios, diminishing food security, particularly in small food-importing countries (medium to high confidence)	
Livestock		
Water resources	change in water supply for household use, agriculture and industry; political gap (e.g., regional cooperation protocols for shared river basins minimize adverse impacts and potential for conflicts) major rivers of Africa are highly sensitive to climate variation; average runoff and water availability would decrease in Mediterranean and southern countries of Africa (medium confidence)	
Coastal zones	Sea-level rise, coastal erosion, saltwater intrusion and flooding will have significant impacts for African communities and economies.	
Forestry		
Human Health	Extension of ranges of infectious disease vectors would adversely affect human health (medium confidence)	
Biodiversity	Significant extinctions of plant and animal species are projected and would impact rural livelihoods, tourism, and genetic resources (medium confidence)	
Infrastructure	although the basic infrastructure for development (i.e., transport, housing and services) is inadequate in many instances, it nevertheless represents substantial investments for governments. It could result into a critical situation due to extreme events related damages.	
Desertification	desertification would be exacerbated by reductions in average annual rainfall, runoff, and soil moisture, especially in southern, North, and West Africa (medium confidence)	
Extreme events	Increases of droughts, floods, and other extreme events would add to stresses on water resources, food security, human health, and infrastructures, and would constrain development in Africa (High confidence)	
Coastal zones	Coastal settlements in, for example, the Gulf of Guinea, Senegal, Gambia, Egypt, and along the East-Southern African coast would be adversely impacted by sea-level rise through inundation and coastal erosion (high confidence)	
General	Ø Major difficulties and limitations in predicting climate change's impacts: § Regional diversity of African climates § High rainfall variability Very sparse observational network	

Source: Desanker P. and Magadza C. (Eds.) 2001. Chapter 10: Africa in McCarthy et al. (Eds.) 2001. Climate Change in 2001: Impacts, Adaptation, and Vulnerability, IPCC Third Assessment Report (TAR), Cambridge University Press, p. 487-532.

Source: IPCC. 2001. Climate Change 2001: Synthesis Report. A contribution of Working Groups I, II, and III to the Third Assessment Report of the Intergovernmental Panel on Climate Change [Watson, R.T. and the Core Writing Team (Eds.). Cambridge University Press, Cambridge, United Kingdom, p. 14.

Annex X: Summary of vulnerabilities to climate change in Madagascar

Vulnerable Sectors	Key barriers identified	Policy recommendations for adaptation
General	Logistics: Incertainties related to simulated climate trends	need to improve data quality (report include 4 major recommendation for improving data quality for next report)
Agriculture	* **Rice cultivation:** Possible change in agroclimate leading to change in farming activities, including possible changes in livelihood activities. Rice culture highly vulnerable in the Aloatra region, the main region of rice production	(1) To increase the productivity or the production of the rice culture including intensification, modernization, rehabilitation/extension of irrigation networks (2) To improve the social working conditions of farmers. Priorities include: training, technical assistance, diversification of the plantations and access to markets.
Livestock	* Threats to the livestock sector due to changes in the repartition of vegetation, disturbance in the trophic chain of the ecosystem requiring additional tasks in the sector * Additional threat to the limited pastures areas in combination with the pressure of population growth and bush fire practice	(1) Intensive farming, including rational use of green fodder during the rainy season and conserving and storing fodder practices during the dry season. (2) Current policy: (a) Redefinition of the roles and creation of synergies among the different actors of the livestock sector; (b) Focus on the “filiere approach” and regional specialization
Water resources	* risk of change in hydrological regimes of various watersheds * **Central high lands case study:** the increase of temperature will modify the hydrological bilan of the watershed including a new temporal and spatial distribution of precipitations and water flow. The plain of Antanarivo where population density is the highest will be the most vulnerable zone within this watershed due to unplanned urban development. By 2025, resource need might not be fullfilled by the water resources of the watershed itself due to overpopulation. This trends will reinforce the already existing water crisis and will affect all the sectors of production with terrible socio-economic impacts. * **Coastal zones case study:** climate change might lead to high seasonal irregularity and a slight increase of annual water flow average in 2025 followed by a decreased around 2050-2100. High vulnerability of the Mandrare watershed due to an already permanent water crisis. This crisis is increasing due to: population growth, rarety of water points, high irregularity of hydro-pluviometrique regime and arid climate.	(1) To introduce organisational mechanisms and sustainable management of infrastructures (2) To improve drinking water access
Coastal zones	* Disparition of some coastal zones due to the increase of temperature leading to an increase of the watersee level e.g., site at risk: the Morondava coastal zone	To adopte a coherent protection policy allowing: (a) landownership of the coastal zone by the locality ("collectivity territorial") (b) the upgrading of the degradated sectors (c) windbreaks, reforestation des "filaos" (d) improvement of the infrastructures (digue, etc) as the water level goes up
Forestry	* Climate change will increase the already dramatic situation. E.g., an increase of the world temperature of 2.5 (optimistic hypothesis) will lead to the total stranding of the Tampoketsa valley within 95 years. The same scenario will increase the stranding of 212% of the actual stranding values of villages, pastures and of the xerophytique bush of the South within 2100. * Problem of fluvial erosion due to deforestation	To take pro-active anti-erosion measures through land-use management projects, including: (a) increase of perenial vegetal cover (b) adoption of soil protection and restauration (c) stabilization of the dunes.
Human Health	* the possible increase of temperature due to climate change will break thermal barriers of diseases or at least of its vectors. * **Paludisme** will be among many others a major issue. In 2025, the treatment of paludisme will constitute 5% of familial budget while the productivity per capita will decrease significantly.	To reinforce the current anti-paludism governmental strategy by including possible impacts of climate change on the evolution of paludisme. Especially: (1) To inform and sensibilize the population on the causes of the disesase, and the measures to take during the transmission period (2) To cut the contact human-vector (3) To reinforce the basic human health services capacity.

Source: Initial National Communication (submitted in 2004) - translated from French

Annex X: Summary of vulnerabilities to climate change in Mali

Vulnerable Sectors	Key impacts identified	Policy recommendations for adaptation in this case: current adaptation strategies
General	Logistics and institutional: insufficient local expertise for the formulation of project in the domain of climate change, inexistence of a specific institutional framework related to climate change etc.	
Agriculture	* Facts: 95% of the population depend on the primary sector, which provides the basic raw material required by the industrial sector and which thus contributes an important part of the country's gross national product. * Importance of the cotton industry: Mali is the first producer of cotton in West Africa and the 2nd in Africa after Egypte. * Increase of the frequency and severity of droughts since the 70s. study zone: the upper valley of the Niger River one of the main agricultural areas of the country	(1) **Assistance of the international community** to reenforce the meteorological and hydrological services to improve droughts forecasting (2) **Data management:** Creation of an agrometeorological division within the National Meteorological Service, formation of specialist, acquisition of equipments to reinforce the observation network and the transmission, stockage and analysis of data. (3) **Information:** Provision of technical information and advices to farmers to enable them to plan and manage their agricultural activities more efficiently
Water resources	* Previous experiences of drought demonstrated the vulnerability of water access for population and the livestock with socio-economic and environmental impacts (land conflicts, rural exode leading to an increase of unemployment and insecurity)	To improve the efficiency of water resource management, including: (a) Knowledge on water resources (b) Creation of water points to satisfy the water needs of rural populations (c) Creation of urban water supply (d) Creation of infrastructures to regulate river flow regimes (e) Knowledge improvement: use of regional circulation models, creation of an observatory of climate change, creation of a managing body of the main watersheds
Forest	n/a	n/a
Human Health and well being	n/a	n/a
Fisheries	n/a	n/a
Land use	n/a	n/a
Biodiversity	n/a	n/a

Source: Initial National Communication (submitted in 2000) - Translated from French

Annex X: Summary of vulnerabilities to climate change in Tunisia

Main Vulnerable Sectors	Key impacts identified	Policy recommendations for adaptation
Coastal water resources	* Facts: Tunisia has already the lowest level of water resources in the Maghreb region. According to the international usual standards, Tunisia is in a hydrous stress situation close to a shortage, sharpened by a high anthropic pressure. * The coastal resources in water will get direct effects due to climate change and indirect effects following the sea level rise. The resources in water of the coastal regions will so have the maximum of risk	n/a
Coastal natural ecosystems	* In general, ASLR (Accelerated Sea Level Rise) has no significant impact on the humid places in continental zone with the single exception of the Lac d'Ichekeul. The most vulnerable humid places will be the lagoons, the sebkhas, the lowest coastal marshes, which will be in majority annexed to the sea domain. * Littoral forests seem relatively less vulnerable to ASLR except for coastal oasis where ASLR could result in a retreat of coastal line and an increased salinization of the littoral ground water, detrimental to the palms good growth	n/a
Littoral agriculture	* The agricultural sector would be among the sectors most affected by ASLR, especially due to the existence of many littoral agricultural speculations (citrus fruit, irrigated cultures, etc.) with important covered surfaces. * ASLR can lead to important losses of these grounds by erosion or salinization. ASLR would also affect the agricultural infrastructure (drainage and irrigation pipes).	n/a
Coastal tourism	* Facts: Tourism is among the main strategic lines of the development of Tunisia * Aesthetics and extent of the beaches which are among the main appeal of the 3 major tourist poles of the country could be highly affected by ASLR. * Threat to tourism infrastructures	n/a
Coastal settlement and infrastructures	* Facts: The coast line represents: 2/3 of the total population live on the tunisian coast line, 70% of the economic activities, 90% of the tourists accommodation total capacity, a great part of irrigated agriculture * Vulnerability of coastal zones to ASLR can lead to important socio-economic costs * Major ASLR sensitive zones/risky coastal segments: the city of Bizerte and its lakeside system, the northern and central parts of the Gulf of Tunis, the oriental coast of the Cap Bonn peninsula, different segments of the Gulf of Gabes, the low island of the country oriental coast * Less sensitive areas to ASLR: northern coast but problems exists especially with important agglomerations zones	n/a
Island and small island	* Island with acused relief will be less affected by sea elevation than others	n/a

Source: Initial National Communication of Tunisia to the UNFCCC (submitted in 2001) - translated from French

Annex X: Summary of vulnerabilities to climate change in Asia

Main Vulnerable Sectors	Key impacts identified	Policy recommendations for adaptation
Agriculture and food security	Decreases in agricultural productivity and aquaculture due to thermal and water stress, sea-level rise, floods, and droughts, and tropcial cyclones would diminish food security in many countries of arid, tropical, and temperate Asia; agriculture would expand and increase in productivity in northern areas (medium confidence)	
Biodiversity	Climate change would exacerbate threats to biodiversity due to land-use and land-cover change and population pressure in Asia (medium confidence). Sea-level rise would put ecological security at risk, including mangrove and coral reefs (high confidence)	
Ecosystems	The frequency of forest fires is expected to increase in boreal Asia (medium confidence).	
Water resources	Runoff and water availability may decrease in arid and semi-arid Asia but increase in northern Asia (medium confidence)	
Extreme weather events	Extrem events have increased in temperate and tropical Asia, including floods, droughts, forest fires, and tropical cyclones (high confidence)	
Coastal zones	Sea-level rise and an increase in the intensity of tropical cyclones would displace tens of millions of people in low-lying coastal areas of temperate and tropical Asia	
Human health	Human health would be threatened by possible increased exposure to vector-borne infectious diseases, and heat stress in parts of Asia (medium confidence)	
Infrastructure	Polewards movement of the southern boundary of the permafrost zones of Asia would result in a change of thermokarst and thermal erosion with negative impacts on social infrastructure and industries (medium confidence)	
General	Adaptive capacity of human systems is low and vulnerability is high in the developing countries of Asia; the developed countries of Asia are more able to adapt and less vunerable	* Adaptation to climate change in Asian countries depends on: (1) Affordability of adaptive measures (2) Access to technology (3) Biophysical constrains (e.g., land and water resource availability, soil characteristics, genetic diversity for crop breading, topography) * Coping strategies have to be developed for the following crucial sectors: (1) Land resources (2) Water resources (3) Food productivity

Source: p. 14

Source: Lal M. et al. (Eds.). 2001. Chapter 11: Asia in McCarthy et al. (Eds.) 2001. Climate Change in 2001: Impacts, Adaptation, and Vulnerability, IPCC Third Assessment Report (TAR), Cambridge University Press, p. 533 - 590.

Annex X: Summary of vulnerability to climate change in Bangladesh

Main Vulnerable Sectors	Key impacts identified	Policy recommendations for adaptation
General	* Bangladesh would be one of the most adversely affected country to climate change (low economic strenght, inadequate infrastructure, low level of social development, lack of institutional capacity, higher dependency on the natural resources base) * Much of the future vulnerability due to climate change will not necessarily add any new climate related hazards to the already existing well known ones of floods, droughts, and cyclones but will enhance both the frequency as well as intensity of such climatic events in future.	(1) To promote knowledge and experiences sharing of existing coping strategies and practices in other are that would come under similar climate change related problems (2) To develop techniques for transfering knowledge and experiences from one area/ecosystem (3) To use an integrated approach: due to the complexity of the issues, integrated approach (sectors and technologies) need to be analyzed along with acceptibility by the communities for whom the technologies would be suggested (4) To address adverse effects of climate change including variability and extreme events based on existing coping mechanisms and practices (5) To disseminate climate change and adaptation information to vulnerable community to raise awareness (6) To mainstream adaptation to climate change into policies and programmes in different sectors (focusing on disaster management, water, agriculture, health, industry) (7) To include climate change issues in curriculum at secondary and tertiary educational institution (8) To develop eco-specific adaptive knowledge (including indigenous knowledge) on adaptation to climate variability to enhance adaptive capacity for future climate change (9) To explore options for insurance and other emergency preparedness measures to
Water resources	* The effects of increased flooding resulting from climate change will be the greatest problem faced by Bangladesh as both coastal (from sea and river water), and inland flooding (river/rain water) are expected to increase. * **Sedimentation and river bed rise:** Changes of the riverbed level due to sedimentation and changes in morphological processes due to seasonal variation of water level and flow are also critical for Bangladesh. * **Change of land type**	(1) To build capacity for integrating climate change in planning, designing of infrastructure, conflict management, land water zoning for water management institutions (2) To contruct flood shelter (3) To create information and assistence center to cope with enhanced recurrent floods in major floodplains
Coastal zone	* The population living in the coastal area are more vulnerable than the population in other areas. * Vulnerability of coastal zones due to the combined effects of climate change, sea level rise, subsidence, change of upstream river discharge, cyclone and coastal embankments * Physical effects: saline water intrusion, drainage congestion, extreme events, change in coastal morphology	(1) To reduce climate change hazards through coastal afforestation with community focus (2) To provide drinking water to coastal communities to combat enhanced salinity due to sea-level rise (3) To promote adaptation to coastal crop agriculture to combat desertification through maize production under Wet Bed no-tillage method and Sorjan systems of cropping in tidally flooded agro-ecosystems (4) To promote adaptation to coastal fisheries through culture of salt tolerant fish special in costal areas of Bangladesh
Crop agriculture and food security	* The agricultural sector will face significant yield reduction. Food grain self sufficiency will be at risk in future. * Possible problem of reduction of rice yield due to increase temperature * Effects on the incidence of insect pests, diseases and microoganisms	(1) To promote research on drought, flood, and saline tolerant varities of crops to faciliate adaptation in future (2) To adapt agriculture systems in areas prone to enhanced flash flooding North East and Central Region through No-tillage potato cultivation under water hyacinth mulch in wet sown conditions, and vegetable cultivation on floating bed
Forestry and biodiversity	* Biodiversity is undergoing threats due to human interventions and fragmenting of habitats etc. Climate chance impacts will add an extra dimension to these ongoing stresses including erosion problem…	
Human health	* The combination of higher temperatures and potential increases in summer precipitation could create favorable conditions for greater intensity or spread of many infectious disease. The perceived risks to human health is low relative to those in other sectors (such as water resources) mainly because of the higher uncertainty about many of the possible health outcomes	
Infrastructures	n/a	To enhance the resilience of urban infrastructure and industries to impacts of climate change including floods and cyclone
fisheries	n/a	To adapt fisheries to areas prone to enhanced flooding in North East and Central region through adaptive and diversified fish culture practices

Source: National Adaptation Programme of Action (submitted in 2005)

Annex X: Summary of vulnerability to climate change in India

Main Vulnerable Sectors	Key impacts identified	Policy recommendations for adaptation
Water resources	* Impacts on the water balance in different parts of India: preliminary assessments have revealed that under the IS92a scenario, the severity of droughts and intensity of floods in various parts of India is likely to increase. Problems of acute water scarcity and shortage in some water basins. Increased rainfall intensity may lead to higher runoff and possibly reduced recharge. * Impacts on the quality of ground water along the coastal plains: rising sea levels may lead to increased saline intrusion into coastal and island aquifers, increased frequency and severity of floods may affect groundwater quality in alluvial aquifers.	To intensively development ground water resources, exploiting both dynamic and in-storage potential in addition to current efforts to promote improve water management practices (e.g., water conservation, artificial recharge and watershed management, and integrated water development)
Agriculture	* **Food production:** despite an increased of the food grain production in the last 50 years, food production still dependent on the rainfall quantity and its distribution, which is highly variable spatially as well as temporally. * **Small and marginal farmers:** threat to livelihood security of small and marginal farmers in the rainfed agriculture region. Food security might be at risk in the future due to the threat of climate change leading to increase the frequency and intensity of droughts and floods, thereby affecting the production on small and marginal farms. * **Diversity:** according to the models used, the magnitude of crops' response to an increase of temperature and CO2 varies with the crop, the region and climate change.	
Forest ecosystemss	* The models used show shifts in forest boundary, change in species-assemblage or forest types, change in net primary productivity, possible forest die-back in the transient phase, and potential loss or change in biodiversity. * Even in a relatively short span of about 50 years, most of the forest biomes in India seem to be highly vulnerable to the projected change in climate. About 70% of the vegetation in India is likely to find itself less than optimally adapted to its existing location, making it more vulnerable to the adverse climatic conditions as well as the increase of biotic stresses. * Impacts on biodiversity, socio-economic implications for forest-dependent communities and national economy	(1) To develop and implement adaptive strategies to minimize possible adverse impacts (2) To study and identify the forest policies, programmes and silvicultural practices that contribute to vulnerability of forest ecosystems to climate change
Natural ecosystems (e.g., grasslands, mangroves, coral reefs)	* Climate change will be region specific and involve a complex interaction of factors. * **Mangroves:** Sea level rise would submerge mangroves as well as increase the salinity of wetlands. Increased snowmelt in the western himalayas could bring larger quantities of fresh water into the Gangetic delta with consequences on the Sundarbans mangroves ecosystem. Change in local temperature and precipitation would influence the salinity of the mangrove wetlands and have a bearing on plant composition. * **Coral reefs:** An increase in sea-surface temperature would lead to the bleaching of corals. impacts of sea-level rise. already degrated reefs may not be able to adapt.	

Main Vulnerable Sectors	Key impacts identified	Policy recommendations for adaptation
Coastal zone	* Densily populated * Under the present climate, it has been observed that the sea-level rise along the Gulf of Kutchh and the coast of West Bengal is the highest. Along the Karnataka coast, however, there is a relative decrease in the sea level. * Future climate change in the coastal zones in likely to be manifested through worsening of some of the existing coastal zone problems. Main climate-related concerns are : erosion, flooding, submergence and deterioration of coastal ecosystems and salinization. * Key climate-related risks in coastal zones are: tropical cyclones, sea-level rise, change in temperature and precipitation. * Impacts of sea-level rise include: land loss, population displacement, increased flooding of low-lying coastal areas, loss of yield and employment resulting from inondation and salinization, damage to coastal infrastructure, aquaculture, coastal tourism...	
Human health	* The extent of access to and utlization of health care varies substantially between states, districts, and different segments of society. * It is projected that **malaria** will move to higher latitudes and altitudes in India, with 10% more area offering climatic opportunities for the malaria vector to breed throughout the year during the 2080s with the respect to the year 2000.	
Infrastructure and energy	* Huge monetary losses due to infrastructure degradation if not taken into consideration while planning * Possible increase of the electricity demand and added costs to the consumers for maintaining their lifestyles as well as to the electricity production systems * Possible increase of the electricity demand in agriculture sector due to projected variability in precipitation * Accentuation of inequities: currently income disparities and high population growth constrain the opportunities and equitable access to the existing social infrastructure. the projected climate change could accentuate these conditions.	The implementation of energy conservation measures would require substantial investments
general		to identify opportunities that facilitate the sustainable use of existing resources faster economic development with more equitable income distributions, improved disaster management efforts, sustainable sectoral policies, careful planning of capital intensive and climate intensive long-life infrastructure assets

Source: Initial National Communication of India to the UNFCCC (submitted in 2004)

Annex X: Summary of vulnerabilities to climate change in the Kirgyz Republic

Key sector considered for the vulnerability assessment	Key impacts identified	Policy recommendations for adaptation
Water resources	* The expected change in water resources as a result of climate change is going to be favourable	Adaptation measures should be worked out taking into account the interests of the neighbouring states (Water supply problems already exist in a regional perspective).
Energy	* The total energy potential is fairly high, which does not exclude certain problems: existing oil and gaz reserves do not satisfy the country needs for oil products, coal deposits are located far from the major consumers, use of unconventional and renewable power sources absent	(1) To harmonize conditions of usage of rivers that are important for irrigation and hydropower, taking into account the interests of all states of the regions (2) To create prerequisites for a fuller use of hydro-power potential (3) To reduce electric and thermal energy losses and introducing energy-saving technologies (4) To increase the share of renewable energy sources in the energy balance (5) To increase the share of ecologically clearner fuels (6) To work out a development strategy for motorised transport
Human Health	* A substantial relationship between sickness rates and climate change has been determined. A significant increase in the urolithiasis rate may be expected. * Expected climate change may cause an increase in common sicknesses, cardiovascular and broncho-pulmonary pathology, skin diseases, trauma rates. etc.	(1) To increase the population's socio-economic living standards (2) To improve the health care system
Biodiversity	* Desert and steppe belts will significantly expand. However it is not expected that belt shifts will lead to substantial loss in flora and fauna (esp. invertebrates and vertebrates posses a natural adaptation to temperature increase or will migrate)	
Forest	* Increase of the spruce forest density * As a result of an increase in the sum of above-zero temperatures, by 2100, thre may be a boundary shift of the habitat zones for every type of archa-tree.	(1) To do an inventory of species and intra-species diversity on the basis of a single methodological approach and a well-developed method of forest genetic resources assessment (2) To alleviate poverty among the population (3) For local communities to participate in decision-making as far as their access to forest resources is concerned, based on community forest use
Agriculture	* An increase in areas under crops is not expected. Output is likely to grow through an increase in crop yield per hectare.	
Livestock	* Pasture fooder is likely to be sufficient for required growth in heads of cattle. But majority of experts assume an excessive pasture overload in 1990	

Source: Initial National Communication of the Kirgyz Republic (submitted in 2003)

Annex X: Summary of vulnerabilities to climate change in Europe

Main Vulnerable Sectors	Key impacts identified	Policy recommendations for adaptation
General	* Adaptive capacity is generally high in Europe for human systems * Southern Europe and the European Arctic are more vulnerable than other parts of Europe	
Water resources	* Summer runoff, water availability, and soil moisture are likely to decrease in soutern Europe, and would widen the difference between the north and drought-prone south; increases are likely in winter in the north and south (high confidence) * Half of alpine glaciers and large permafrost areas could disappear by end of the 21st century (medium confidence) * River flood hazard will increase accross much of Europe (medium to high confidence)	
Coastal zones	* The risks of flooding, erosion, and wetland loss will increase substantially with implications for human settlement, industry, tourism, agriculture, and coastal natural habitats	
Agriculture	* Some broadly positive effects on agriculture in northern Europe (medium confidence): productivity will decrease in southern and eastern Europe (medium confidence)	
Ecosystems	* Upwards and northward shift of biotic zones will take place. * Loss of important habitats (wetlands, tundra, isolated habitats) would threaten some species (high confidence)	
Tourism	* Higher temperatures and heat waves may change traditional summer tourist destinations, and less reliable snow conditions may impact adverserly on winter tourism (medium confidence)	

Source: p. 15.

Source: Kundzewicz Z.W. and Parry M.L. (Eds.) 2001. "Chapter 13: Europe" in McCarthy et al. (Eds.) 2001. Climate Change in 2001: Impacts, Adaptation, and Vulnerability, IPCC Third Assessment Report (TAR), Cambridge University Press, p. 641-692.

Annex X: Summary of vulnerabilities to climate change in Bulgaria

Main Vulnerable Sectors	Expected key impacts of climate change/vulnerability assessment	Policy recommendations for adaptation
Agriculture	* Warming will lead to an increased crop growing season and will move upper limits for agricultural productions to 1000m a.s.l. at suitable areas.	(1) New zoning of the agro-climatic resources and agricultural crops (2) New cultivars and hybrids to be adapted to climate change (3) Optimization of soil treatment (4) Measures for increase of the irrigation effectiveness (5) Phyto-sanitary adaptation measure
Forestry	* Current state: forest desintegration * Causes: the current coniferous forest vegetation has been widely indroduced during the last decades out of its natural habitats. It forms a hardly stable forest ecosystems due to the discrepancy between he ecological conditions and the requirements of the coniferous tree species. * Consequences: the vulnerability of forest vegetation to dry climate increases If the projections about the CO2 doubling during the next century come true the ecological conditions in Bulgaria will drastically get worse	(1) Helping the forest adaptation to the unfavorable climatic conditions (2) Preserving the biodiversity and genetic resources to ensure forest reproduction (3) Change in the selection of the species for afforestation

Source: Third National Communication on climate change of Bulgaria to the UNFCCC (submitted in 2002)

Annex X: Summary of vulnerabilties to climate change in Latin America

Main Vulnerable Sectors	Key impacts identified	Policy recommendations for adaptation
Water resources	Loss and retreat of glaciers would adverserly impact runoff and water supply in areas where glacier melt is an important water source (high confidence) Floods and droughts would become more frequent with floods increasing sediment loads and degrade water quality in some areas (high confidence)	
Biodiversity	the rate of biodiversity loss would increase (high confidence)	
Extreme events	Increases in intensity of tropical cyclones would alter the risks to life, property, and ecosystems from heavy rain, flooding, storm surges, and wind damages (high confidence)	
Agriculture	Yields of important crops are projected to decrease in many location of South America, even when the effects of CO2 are taken into account; subsistence farming in some regions of Latin America could be threatened (high confidence)	
Human health	The geographical distribution of vector-borne infectious diseases would expand poleward and to higher elevations, and exposures to diseases such as malaria, dengue fever, and cholera will increase (medium confidence)	
Sea-level rise	Coastal human settlements, productive activities, infrastructures, and mangrove ecosystems would be negatively affected by sea level rise (medium confidence)	
General	Adaptive capacity of human systems in LA is a low, particularly with respect to extreme climate events, and vulnerability is high	

Source: p. 15

Source: Mata L.J. and Campos M. (Eds.). 2001. Chapter 14: Latin America in McCarthy et al. (Eds.) 2001. Climate Change in 2001: Impacts, Adaptation, and Vulnerability, IPCC Third Assessment Report (TAR), Cambridge University Press p. 693 - 734.

Annex X: Summary of vulnerabilities to climate change in Bolivia

Main Vulnerable Sectors	Key impacts identified	Policy recommendations for adaptation
Forest	* Climate change will cause varied impacts to forest ecosystems depending on the scenario used	(1) To manage and use forest in a sustainable way (2) To enhance the efficiency of industrialization processes (3) To identify forest tree species that are resistant to climate change (4) To reduce habitat fragmentation
Agriculture	* Agricultural regions would be affected by probable climate change. Some zone would be more affected than others. It might become critical if economically important basic crops are negatively affected. * The national food security could run the risk of being affected * Agricultural ecosystems: a probable 2C temperature increase would not seriously damage cultivated areas if this increase goes together with precipitation increase. In the high plains, these conditions would be favorable for growing crops if provided with adaptations measures (irrigation systems, improved cultural practices). However if precipitation decreases occur, even under no temperature increase conditions, negative effects would be critical.	(1) To improve soil and water resources management (2) To carry on agriculture research (3) To allow for interactive technology transfer
Water resources	* Important runoff levels depending on the considered global and national climate scenario and studied basins and their location impacting on water resources by affecting forestry, agricuture, and consumption systems	(1) To plan and coordinate the use of water resources by basin (2) To construct works to arrange water regulation, irrigation, and storage (3) To adopt water conservation policies (4) To control water quality (5) To implement systems for a controlled and paid water supply (6) To adopt contingency plans (7) To construct work for inter-basin water transferts (8) To forecast systems for flood and droughts (8) To educate and train people on water resource management and use
Human heatlh	* Direct impacts of climate change increasing population mortality: floods, landslides, forest fires, storms * Indirect impacts: Malaria and leishmaniasis are sensitive to climate variations and changes	To focus on: (1) Environmental Care (2) Sanitary Education (3) Reservoir control (4) Decreasing vector/human contact (5) Epidemic and climate vigilance (6) Biological and chemical control
Livestock		(1) To identify pastures resistant to climate change (2) To introduce improved pastures (3) To introduce improved livestock species (4) To make changes in the livestock grazing seasons (5) To introduce supplementary diets for livestock

Source: Initial National Communication of Bolivia to the UNFCCC (submitted in 2000)

Annex X: Summary of vulnerability to climate change in Ecuador

Vulnerable Sectors	Key impacts identified	Policy recommendations for adaptation
Agriculture	* Agriculture was considered under the framework of **food security** in the years 2010 - 2030.	(1) Agro-ecological zoning and appropriate seasons for sowing and harvesting (2) Introduction of higher-yield varieties (3) Installation of approriate irrigation systems (4) Appropriate use of fertilizers (5) Implementation of a system for controlling pests and disease
Forest	* The Holdridge methodology was used as basis for the analysis in the forestry sector. It showed increases in dry areas and a clear trend to desertification. The analysis defined three major impact zones.	(1) Buffer forest plantations (2) Sustainable management of production plantations (3) Integral rural developments of watersheds (4) Agroforestry (5) Wood/land grazing systems (6) Forest protection against pest (7) Disease and parks fires (8) Sustainable management of native parks (9) Sustainable management of fragile ecosystems (10) Comprehensive anti-desertification program
Seacoast	* The assessment was concentrated on the Guayas river basin, one of the principal areas for agriculture, industry and trade. This area is vulnerable to rising water levels (floods and overflowing), higher frequency of excedence and salinity.	(1) Establishment of a climate change biophysical and surveillance program (2) Adjustment of sewage and clearer water for Guayaquil (3) Mangrove preservation (4) Reforestation (5) Re-organization of shrimp-farming activities (6) Establishment of withdrawal lines, buffer zones and urban protection borders (7) Adjustment of road drainage and hydraulic fill of some urban areas
water resources	* Water resources can experience increase in shortages and more severe runoff periods especially in the basins of Ecuador, Pastaza and Napo. This could have a serious impact on hydropower generation.	

Source: Initial Communication on Climate Change of Ecuador to the UNFCCC (submitted in 2000)

Annex X: Summary of the most expected vulnerable sectors to climate change as considered in the National Communications

		Agriculture	Livestock	Forest	Other natural ecosystems	Water	Fisheries	Biodiversity	Land use	Coastal zones	s & Energy	Human settlements	Tourism	Human Health
Africa	Madagascar													
	Mali													
	Tunisia									*				
South America	Ecuador													
	Bolivia													
Europe	Bulgaria													
Asia	India													
	Bangladesh													
	Kirgiz Republic					**								
	Total frequency	8	3	7	2	8	2	2	1	5	4	1	1	6
	Ranking	1	6	2	7	1	7	7	8	4	5	8	8	3

* including islands

** But only due to situation in neighboring states