Indigenous and Traditional Peoples and Climate Change

Issues Paper

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Map Sources

Sources for ethnolinguistic groups: map *Indigenous and Traditional Peoples in the Global 200 Ecoregions* (WWF International and Terralingua, Gland, November 2000), and report *Indigenous and Traditional Peoples of the World and Ecoregion Conservation: An Integrated Approach to Conserving the World's Biological and Cultural Diversity* (WWF International and Terralingua. Gland, November 2000).

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Executive Summary

The Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report published in early 2007 confirmed that global climate change is already happening. The report found that communities who live in marginal lands and whose livelihoods are highly dependent on natural resources are among the most vulnerable to climate change. Many indigenous and traditional peoples who have been pushed to the least fertile and most fragile lands as a consequence of historical, social, political and economic exclusion are among those who are at greatest risk.

On the other hand, people living in marginal lands have long been exposed to many kinds of environmental changes and have developed strategies for coping with these phenomena. They have valuable knowledge about adapting to climate change, but the magnitude of future hazards may exceed their adaptive capacity, especially given their current conditions of marginalization.

The potential impacts of climate change on the livelihoods and cultures of indigenous and traditional communities remain poorly known. The goals of the IUCN report on **Indigenous Peoples and Climate Change** are:

- to improve understanding of the potential impacts of climate change on vulnerable communities and cultures and their associated ecosystems;
- to identify further research required to reduce the risks of climate change; and
- to develop appropriate adaptation and mitigation measures, particularly in areas with high risk of socio-cultural impacts.

Through this report, IUCN offers some elements that will facilitate integration of socio-cultural considerations in programmes and actions to address climate change impacts.

The first chapter critically analyses the treatment of traditional and indigenous people in climate change policy documents, including the United Nations Framework Convention on Climate Change (UNFCCC) (1992), the Kyoto Protocol and the Clean Development Mechanism (1998), the Stern Review (2006) and the Fourth IPCC Report (2007). Even though these documents agree that the costs of climate change are going to fall inequitably on the world's poorest and most disadvantaged communities including traditional and indigenous peoples, the communities discussed almost exclusively live in developed countries, i.e. in North America, Europe, Australia and New Zealand and the Polar Regions. The majority of traditional and indigenous peoples who live in the tropical developing world get very little or no consideration. Furthermore, while all the analysed documents put their emphasis on monetary, knowledge and technology transfer from developed to developing countries, traditional and indigenous peoples' own coping and adaptive strategies are hardly recognized.

Chapter two identifies the determining factors of social and biophysical vulnerability of indigenous and traditional peoples. Even though no single conceptual framework of vulnerability has been agreed, many recent publications agree that vulnerability is a multidimensional concept which involves exposure, sensitivity and resilience. Assessing vulnerability of a system to climate change is based on the exposure of a system to a potential biophysical hazard level at a global, regional or local scale, the sensitivity of vulnerable groups and ecosystems to climate change impacts, and their adaptive capacity. The capacity of a social group to adapt to environmental hazards depends on their physical location, entitlements of the use of certain resources and land, and access to knowledge, technology, power, decision making, education, health care and food.

Chapter three provides maps that superimpose the location of indigenous and traditional peoples (ethno-linguistic groups) over climate change projections on temperature, precipitation and sea level change from the IPCC (2007). The resulting maps show areas of high concentration of indigenous and traditional peoples and areas of greatest predicted climatic change. Predicting changes at a regional or local level to pinpoint specific groups that are at risk remains challenging, because of the limited resolution of regional climate change models. Still, it is possible to identify broad regions which are likely to experience certain types of climate change. These include the Arctic region, the Caribbean and the Mediterranean region, the south of Latin America and the Amazon, southern Africa, the Arabian Peninsula and large parts of Australia. Concerning sea level rise, areas at greatest risk include islands in general but especially small islands, the Arctic region, and low-lying Asian coastal areas.

Chapter four describes the projected impacts of climate change on coastal areas; islands; tropical forests; and drylands. It provides case studies showing that climate change is already having serious implications on traditional and indigenous peoples' livelihoods. These communities have adapted to a wide variety of hazards and these adaptation practices have the potential to alleviate adverse impacts and to capitalize on new opportunities brought about by climate change. Examples of such traditional and innovative adaptation practices include:

- shoreline reinforcement,
- improved building technologies,
- rainwater harvesting,
- supplementary irrigation,
- traditional farming techniques to protect watersheds,
- changing hunting and gathering periods and habits,
- crop and livelihood diversification,
- use of new materials, and
- community-based disaster risk reduction.

However, the adaptability and the degree of vulnerability can be unevenly distributed between different tribes and can even be asymmetrically distributed within a community. Women are particularly affected by climate change as a result of their disproportionate involvement in reproduction work, insecure property rights, limited access to resources, and reduced mobility.

In conclusion, climate change is already having serious implications on the livelihoods and cultures of traditional and indigenous peoples. Even though these peoples have developed important strategies to adapt to these changes, the magnitude of future hazards may limit their capacity to adapt. IUCN and its member and partner organizations therefore will further explore culturally appropriate ways to enhance the resilience of traditional and indigenous peoples and to reduce factors which are hindering adaptation. Recommendations include:

- formulating policies which actively involve indigenous and traditional communities in the international, regional and local climate change discourse and which secure their entitlements to self-determination, land, natural resources, information, education, health services, and food;
- recognizing and actively promoting indigenous adaptation strategies;

- building awareness of traditional adaptation and mitigation strategies;
- promoting technology transfer which is culturally appropriate;
- improving the social and physical infrastructure;
- supporting or enhancing livelihood diversification;
- ensuring the conservation of natural resources and biological diversity;
- supporting further research on impacts of climate change on vulnerable cultures and their associated ecosystems;
- collecting and analyzing information on past and current practical adaptation actions and measures;
- combining scientific and indigenous knowledge;
- promoting collaborative research and action between indigenous peoples and scientists; and
- monitoring the implications of mitigation efforts including the Clean Development Mechanism (CDM) and Reduced Emissions from Deforestation in Developing countries (REDD) on indigenous and traditional peoples.

Introduction

The purpose of the current report is to help bridge the knowledge gap in understanding the present and future impacts of climate change on traditional and indigenous peoples. The report identifies options of adaptation to and mitigation of climate change based on the traditional knowledge of communities at risk, in order to reduce their vulnerability and to enhance their cultural resilience and adaptation capacity. Through this report, the authors aim to offer IUCN and its member and partner organizations some elements that will facilitate integration of socio-cultural considerations in programmes and actions to address climate change impacts through mitigation and adaptation measures.

It is widely accepted that poor, natural-resource dependent communities in the developing world are especially vulnerable to climate change, especially those living in high-risk areas such as small islands or low lying coastal areas (Adger, 2006; IPCC 2007). Human groups located in areas exposed to severe impacts of climate change are often diverse in terms of cultural backgrounds. Such groups speak many different languages and have very diverse origins and cultures. Many of them have preserved traditional knowledge about agriculture, hunting, fishing, foraging and the use of medicinal plants. In the past many of these communities have been exposed to different kinds of environmental changes and have developed coping strategies to face these phenomena. These peoples may therefore have to offer valuable knowledge to learn from for future adaptation to and mitigation of climate change.

However, while there is a growing knowledge about the impacts of climate change on species and ecosystems, the understanding about the potential impacts of climate change on livelihoods and cultures of indigenous and traditional communities is fragmented. Furthermore, there is a lack of recognition of the importance which traditional people may play in their own future adaptation to climate change. For example, in the recent Fourth Assessment Report of the IPCC Working Group II (IPCC, 2007) on impacts, adaptation and vulnerability there is little mention of the role and situation of indigenous and traditional peoples in the context of adaptation to and mitigation of climate change.

Given these issues, the **general objective** of this report is to:

improve understanding of the potential impacts of climate change on traditional, vulnerable communities and cultures of the world and their associated ecosystems, and to identify further research and knowledge required to contribute to risk reduction and appropriate adaptation and mitigation strategies that take into account traditional knowledge and involve indigenous communities. The report particularly focuses on areas with high risk and potentially high socio-cultural impacts.

The **specific objectives** of this report are to:

1. ***identify most vulnerable areas***
2. ***analyse potential impacts of climate change on the livelihoods and cultures of vulnerable communities***
3. ***identify past and current coping strategies developed by traditional communities to adapt to and mitigate environmental change based on their own specific cultural background***

In order to achieve these objectives a systematic review of existing literature on the topic using case studies from past successful or unsuccessful adaptations to environmental change by traditional communities has been conducted. To identify areas of "high cultural risk", i.e. areas of elevated socio-cultural vulnerability due to the effects of climate change, a cartographic representation of these areas was made. For this purpose, maps representing physical high risk areas including areas affected by sea level rise, changes in temperature and precipitation as predicted by the IPCC Fourth Assessment Report were overlaid with maps of the distribution of ethnolinguistic groups and high social vulnerability, to identify the most vulnerable communities in the most volatile regions.

1 Traditional and indigenous peoples in global climate change policy

Traditional societies in many cases have built up knowledge over long periods about changes in the environment and have developed elaborated strategies to cope with these changes. However, traditional knowledge systems in mitigation and adaptation have for a long time been neglected in climate change policy formulation and implementation and have only recently been taken up into the climate change discourse. Traditional and indigenous peoples, who have survived over long periods to many kinds of environmental changes, including climate change, may have valuable lessons to offer about successful and unsuccessful adaptations which could be vital in the context of climate change.

The scope of the following chapter is to reveal how issues of traditional and indigenous peoples and their traditional knowledge systems are approached by global climate change policies and mechanisms including the UNFCCC; the Kyoto Protocol and the Clean Development Mechanism (CDM); the assessment reports of the Intergovernmental Panel on Climate Change (IPCC); and others.

1.1 United Nations Framework Convention on Climate Change

In the text of the **United Nations Framework Convention on Climate Change** (UNFCCC) indigenous and traditional peoples in relation to climate change are not explicitly discussed. However, Article 4 calls on developed country Parties of the Convention to consider the needs and challenges that developing country Parties are facing with regard to adverse effects arising from climate change. Paragraph 8 of Article 4 describes the urgencies which different social groups may face, including those living in areas threatened by sea level rise, areas liable to drought and desertification, areas prone to natural disasters or with fragile ecosystems, including mountainous ecosystems. Developed country Parties are therefore urged to support social groups living in these countries with the transfer of knowledge and technology in order to strengthen their resilience to adverse effects of climate change on their livelihoods (UN, 1992).

Indigenous and traditional peoples representatives who since 1998 have been participating at UNFCCC Conferences of the Parties (COP) have released a number of statements and declarations in which they express their concerns and discontentedness related to the implications of climate change policies on their livelihoods and cultures. Since 2001, indigenous peoples' organizations (IPOs) have been acknowledged as a constituency in climate change negotiations within the UNFCCC (2004). However, indigenous peoples' organizations are still waiting for the approval of an ad hoc Working Group on Indigenous Peoples and Climate Change by the UNFCCC, allowing them to actively participate in the COP. At the 11th COP and the first session of the Meeting of the Parties to the Kyoto Protocol (MOP 1) of the UNFCCC in Canada in 2005 the *International Alliance of Indigenous and Tribal Peoples of Tropical Forests* called upon the COP to

> *provide the necessary support to Indigenous Peoples from developing and developed countries for our full and effective participation in all levels of discussion, decision-making and implementation, and ensure that the necessary funding be provided to guarantee such participation and strengthen our capacities (International Alliance of Indigenous and Tribal Peoples of Tropical Forests, 2005).*

At the 12th COP in Nairobi in 2006, more emphasis was given to indigenous peoples and their traditional knowledge. Two side events on indigenous peoples and climate change were held, one on implications of carbon trading on indigenous peoples and the other on their experiences and concerns. At the same conference**, *"The Nairobi work programme on impacts, vulnerability and adaptation to climate change"*** was adopted. The aim of this five-year programme of work on the one hand is

> *to assist countries, in particular developing countries, including the least developed countries and small island developing states, to improve their understanding and assessment of impacts, vulnerability and adaptation;*

and on the other hand

> *to assist countries to make informed decisions on practical adaptation actions and measures to respond to climate change on a sound, scientific, technical and socio-economic basis, taking into account current and future climate change and variability (UNFCCC, 2006).*

This work programme does consider indigenous peoples and their traditional knowledge on climate change impacts and adaptation. In the context of adaptation planning and practices it recommends to collect, analyse and disseminate information on past and current practical adaptation actions and measures, including projects, short- and long-term strategies and local and indigenous knowledge.

Additionally, the UNFCCC website features a database on local coping strategies with the intention to facilitate the transfer of long-standing coping strategies/mechanisms, knowledge and experience from communities that have had to adapt to specific hazards or climatic conditions to communities that may just be starting to experience such conditions, as a result of climate change. This database features some adaptation strategies developed by indigenous and traditional peoples (see example below).

Qhuthañas in Bolivia

Aymaran indigenous peoples of Bolivia have been coping with water insecurity and scarcity over centuries. In order to collect rainwater in the mountains and pampas they have developed a sophisticated system of rainwater harvesting by way of constructing small dams (qhuthañas). This traditional technique of rainwater harvesting has proved to be vital not only to people but also to livestock in times of droughts. Additionally, it has been found that these water reservoirs serve as thermo-regulators of humidity and help reducing the risk of skin cancer as they diffuse harmful sun-rays (UNFCCC, 2007).

1.2 The Kyoto Protocol

As with the UNFCCC the Kyoto Protocol does not mention indigenous communities. However, similar to Article 4 of the UNFCCC, Article 10 of the Kyoto Protocol stresses the importance of the

> *transfer of, or access to, environmentally sound technologies, know-how, practices and processes pertinent to climate change, in particular to developing countries, including the formulation of policies and programmes for the effective transfer of environmentally sound technologies that are publicly owned or in the public domain and the creation of an enabling environment for the private sector, to promote and enhance the transfer of, and access to, environmentally sound technologies (United Nations, 1998).*

Clean Development Mechanism

The purpose of the Clean Development Mechanism (CDM), as defined in Article 12 of the Kyoto Protocol, is to support developing countries in their efforts to achieve sustainable development and in contributing to the overall objective of the UNFCCC. Specifically, the Kyoto Protocol, in Article 12, calls on developed countries to implement project activities in developing countries, in order to reduce their emissions and to enhance their carbon storage capacities. These certified emission reductions (CER) generated by such project activities can be used by developed country Parties to meet their own emission reduction commitments agreed to under the Kyoto Protocol.

These mitigation efforts have driven indigenous and traditional peoples' spokespeople to adopt a defensive position as they fear expropriation of their lands, displacement or loss of biological diversity and self-determination through project activities for emission reduction, e.g. afforestation and reforestation or plantations for the production of biofuels. In the Declaration of the *International Alliance of Indigenous and Tribal Peoples of Tropical Forests* (2005) to the COP 11 and MOP 1 of the UNFCCC in Canada in 2005, they criticised that:

> *The modalities and procedures for activities under the Clean Development Mechanisms (CDM) do not respect and guarantee our right to lands, territories, and self-determination. CDM and Sinks projects do not contribute to climate change mitigation and sustainable development*

and in the *Declaration of the Sixth International Indigenous Peoples Forum on Climate Change* prepared by indigenous peoples' representatives for the 9th COP meeting held in Milan in 2003 they requested that

> *The Clean Development Mechanism (CDM) and Joint Implementation (JI) must incorporate principles which address transparency, free, prior and informed consent and equitable benefit sharing with Indigenous Peoples in order to accomplish the objectives of lowering greenhouse gas emissions and achieving sustainable development in developed and developing countries (Klimabuendnis, 2003).*

1.3 IPCC 2007 Fourth Assessment Report on Climate Change Impacts, Adaptations and Vulnerability

The IPCC 2007 Fourth Assessment Report (IPCC, 2007) is structured into three main parts. Part I of the report gives an overview about observed impacts of climate change on the natural and human environment and about new assessment methods and the characterisation of future conditions; Part II features current knowledge about future impacts of climate change on a global scale and across the regions, and Part III of the report provides information about current knowledge about responding to climate change.

Compared to the IPCC Third Assessment Report (2001), which included very scarce mention of indigenous and traditional peoples and the importance of their own capacity to adapt to climate change, the fourth Assessment Report puts a lot more emphasis on indigenous and traditional peoples, especially those living in Polar Regions, North America and Australia and New Zealand.

Part I of the report reveals that indigenous peoples' livelihoods, especially of those living in the Arctic, have already been altered. For example, changes in the cryosphere led to

> *changes in the migration patterns, health, and range of animals and plants on which they depend for their livelihood and cultural identity.*

Given the fact that adaptation to climate change already is happening, the authors urge the climate change research community to further study indigenous knowledge systems which could prove to be valuable sources of information for Climate Change Impact, Adaptation and Vulnerability (CCIAV) assessments.

Part II points out that on a global scale indigenous peoples with limited adaptive capacity as a result of their dependency on natural resources and their limited information access should be specifically considered in climate change research and policy making processes as they are expected to be disproportionately affected by climate change impacts including health risks, sea level rise, environmental hazards, etc. Furthermore, the authors emphasise that indigenous practices such as sustainable water use systems, traditional coastal management or erosion control should be promoted.

On a regional scale, the report specifically focuses on the fate of indigenous peoples living in North America, Australia and New Zealand and the Polar Regions. In the chapter on Africa, the use of indigenous knowledge in mitigation and adaptation is described in several case studies. Very little mention is given to indigenous peoples living in small island states and to Andean communities, and no specific mention is made of indigenous peoples living in the Amazon or Asia, which are also areas highly vulnerable to climate change and of high cultural diversity (see maps in chapter four). As far as small islands states are concerned, indigenous and traditional knowledge systems are only mentioned in relation to the conservation of the bumphead parrotfish in the waters surrounding the Solomon Islands, while no reference is given to the importance of traditional coastal management systems as an important strategy to cope with sea level rise. In Latin America, indigenous and traditional peoples are only mentioned in the context of traditional, pre-Columbian coping strategies with scarce and unpredictable water resources in the Andes.

In **Part III** it is again pointed out that vulnerability to climate change differs considerably across socio-economic groups and that indigenous communities who are already affected by other stresses are considered as being specifically vulnerable. In the closing chapter of the report the authors advocate for the promotion of innovative technology in response to climate change impacts, while at the same time, they warn that improved technology may also have negative implications, and could, in the worst case, lead to a loss of indigenous cultures, as it did occur in the past, e.g. through the green revolution. They therefore recommend including local and indigenous knowledge in adaptation and sustainability research and in the process of public policy making to respond to climate change.

1.4 Stern Review on the economics of climate change - 2006

The Stern Review, led by Prof. Sir Nicholas Stern, and released in autumn 2006, was commissioned by the UK Treasury to assess the economic impacts of climate change as well as the cost of mitigating climate change. In the review, Stern demonstrates that the costs of climate change are inequitably born by developing countries as a result of their geographic exposure, low incomes, and greater reliance on climate sensitive sectors such as agriculture. The review also reflects in several chapters on the implications of climate change for traditional and indigenous communities:

In Part II of the review on *The Impacts of Climate Change on Growth and Development*' it is stated that countries in Latin America and the Caribbean are already today *significantly affected by climate variability and extremes, particularly the ENSO events* (Stern Ed., 2006: 105). Stern further predicts that living conditions and livelihood opportunities of millions of people living in these regions may be affected by climate change and that the overall production of maize in the Andean Countries and Central America could drop by 15 per cent

by 2055 putting the traditional indigenous communities living in the Andes at risk of hunger. The Stern report further highlights the vulnerability of about one million people of 400 different indigenous groups living in the Amazon to potentially dramatic impacts with some models predicting a widespread die-back or even collapse of the Amazon rain forest. Stern also forecasts that sea level rise could cause major displacement of people from coastal areas or, in some cases, even abandonment of entire atolls and small islands - places of high cultural diversity. In the Arctic, the review anticipates challenging times for indigenous peoples:

> *"warmer summers and smaller ice packs will make life difficult for the polar bear, seal and other Arctic mammals and fish on which indigenous people depend" (Stern Ed., 2006: 128).*

In Part III on *Economics of Stabilization*, Stern calls for an ending of deforestation to benefit, among others, indigenous groups, especially those living in the Amazon. He further advises caution with climate change mitigation measures as these might be accompanied by social problems. If, for example, in certain areas biomass for the production of biofuels will be grown at very large scales, increased amounts of pesticides might be used, which may result in a depletion of ecosystems linked to a loss of biodiversity and natural habitats as well as displacement of indigenous communities.

In Part VI on *International Collective Action*, Stern urges the international community to support developing nations in adapting to climate change in order to increase their resilience. However, whereas the review mainly stresses the importance of monetary funds and the provision of global public goods for adaptation, it largely omits already existing indigenous or traditional coping strategies.

1.5 Conclusion

All the documents mentioned above consent that the costs of climate change are going to be inequitably born by developing countries and specifically poor, natural resource dependent communities, and therefore stress the importance of monetary, knowledge and technology transfer from developed to developing countries for adaptation to and mitigation of climate change. However, only a few of these policy documents acknowledge or even mention the potential of local communities' own coping strategies and adaptive capacity latent in their traditional knowledge. So far, the discourse on indigenous and traditional peoples and climate change has been predominantly limited to climate change mitigation efforts such as those associated with the Clean Development Mechanism.

It is striking that in the IPCC reports (2001 and 2007) the main emphasis has predominantly been laid on indigenous communities living in developed countries, i.e. in North America, Europe, Australia and New Zealand and the Polar Regions where they can count on at least some support from their governments, whereas the majority of traditional and indigenous peoples who are living in developing countries did get very little or no such consideration.

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2 Vulnerability of traditional and indigenous peoples to global climate change

2.1 The conceptual framework of vulnerability

Vulnerability to climate change is a socially and spatially variable phenomenon which may change over the course of time. It is conceptualised in many different ways in climate change literature and is determined by a wide range of factors. Many scholars in recent climate change literature suggest separating vulnerability into social and biophysical vulnerability (Cutter, 1996, Füssel, *forthcoming*; Brooks, 2003). This integrated approach is adopted in the present report and is largely compatible with the concept of vulnerability proposed by the Intergovernmental Panel on Climate Change (IPCC) on which this report is principally based. The IPCC (2007b) defines the concept of vulnerability as

> *the degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and extremes. Vulnerability is a function of the character, magnitude, and rate of climate change and variation to which a system is exposed, its sensitivity, and its adaptive capacity.*

This definition implies that in order to assess future vulnerability of a system to climate change not only the exposure of a system to a potential future biophysical hazard level at a global, regional or local scale needs to be considered, but also the sensitivity of vulnerable groups and the ecosystems they live in to climate change impacts and their adaptive capacity (Füssel, *in press*). According to the IPCC (2007b), the concept of adaptability is defined as

> *the ability of a system to adjust to climate change (including climate variability and extremes) to moderate potential damages, to take advantage of opportunities, or to cope with the consequences.*

In this sense, the adaptive capacity of a human-environmental system is therefore the potential of this system to reduce its vulnerability and consequently to moderate the potential impacts of climate change. Concrete examples of successful and unsuccessful adaptations of indigenous and traditional peoples to climate variability and change are described in Chapter four of this report.

2.2 Determining vulnerability factors

The vulnerability factors which are thought to have a direct influence on the social and biophysical vulnerability of traditional and indigenous communities to global climate change are described below. The identification of vulnerability factors should not be considered comprehensive.

2.2.1 Social vulnerability factors

According to Brooks (2003) social vulnerability exists within a system independently from external hazards and is therefore not a function of the frequency and severity of a given type of hazard but of factors which are incorporated within a human system, for example poverty and inequality, marginalisation, literacy, food entitlement, health and so forth. The factors which specifically determine the social vulnerability of traditional and indigenous communities are described in the following section.

Poverty and inequality

Insufficiency of income, assets or wealth is one of the most important determining factors of socioeconomic vulnerability of indigenous and traditional peoples. For many of them subsistence agriculture as well as hunting and gathering remains the core of the household economy, and food consumption is therefore both the driving force as well as the outcome of indigenous livelihood systems. They often have very limited additional income from cash crops or other activities, and are highly dependent on natural resources. Climate change induced hazards could have devastating impacts on indigenous and traditional peoples' lives and livelihoods.

A recent study of the World Bank (Hall & Patrinos, 2004) has shown that indigenous peoples in Latin America remain among the poorest of the region with very little alleviation of poverty over the past decade, while in some places their overall situation even worsened. Climate change is likely to further aggravate the situation of indigenous and traditional peoples, especially those living in places that are susceptible to natural disasters, and will consequently further limit their ability to cope with or recover from shocks (DFID, 2004). Furthermore, climate change is expected to have negative impacts on efforts for poverty eradication and to challenge the attempts made to reach the Millennium Development Goals (MDGs).

Health and nutrition

Communities which are already suffering from bad health conditions and malnutrition are suggested to be more vulnerable to climate change impacts and to have a lower adaptive capacity compared to healthy communities. Many indigenous peoples live within natural ecosystems and are therefore exposed to numerous health hazards mostly as a consequence of their difficult environment. Furthermore, as a result of their prevalent poverty and marginalisation, they often have very limited access to mainstream health services, health prevention and promotion programmes and, in case they do have access to such services, they are often culturally inappropriate (Montenegro, Stephens, 2006). In many cases, indigenous and traditional communities still maintain their isolation and their traditional indigenous health systems, which largely depend on the health of the environment. If environmental destruction takes place, e.g. as a consequence of climate change induced hazards, the communities' ability to obtain medicinal plants and food may collapse, which consequently again increases their vulnerability.

The IPCC report (2007b) predicts that climate change will further weaken the health status of millions of people particularly those with low adaptive capacity. The expected health risks related to climate change are significant including increased exposure to Ultra Violet Radiation (UVR) causing chronic sun damage of skin and eyes; malnutrition in response to increased competition for crop and water resources; deaths caused by heat waves, droughts, floods and storms; spatial distribution of infectious vector-borne diseases causing for example malaria and dengue fever, and of water-born diseases as a result of reduced water quality causing increased incidences of diarrhoea and respiratory diseases (DFID, 2004). The World Health Organization (WHO, 2003) estimated that in the year 2000 climate change was responsible for approximately 2.4 per cent of worldwide diarrhoea, and six per cent of malaria in some middle-income countries.

WHO (2003) further suggests that of the vector borne diseases, malaria is the one which is most sensitive to long-term climate change. Assuming a global temperature increase of 2-3 ºC the number of people at risk of malaria in climatic terms would rise by about 3-5%, or several hundred million. The following figure shows the expected spread of the primary malaria agent, the *falciparum malaria* parasite, into new regions by 2050 (using the Headly CM2 scenario).

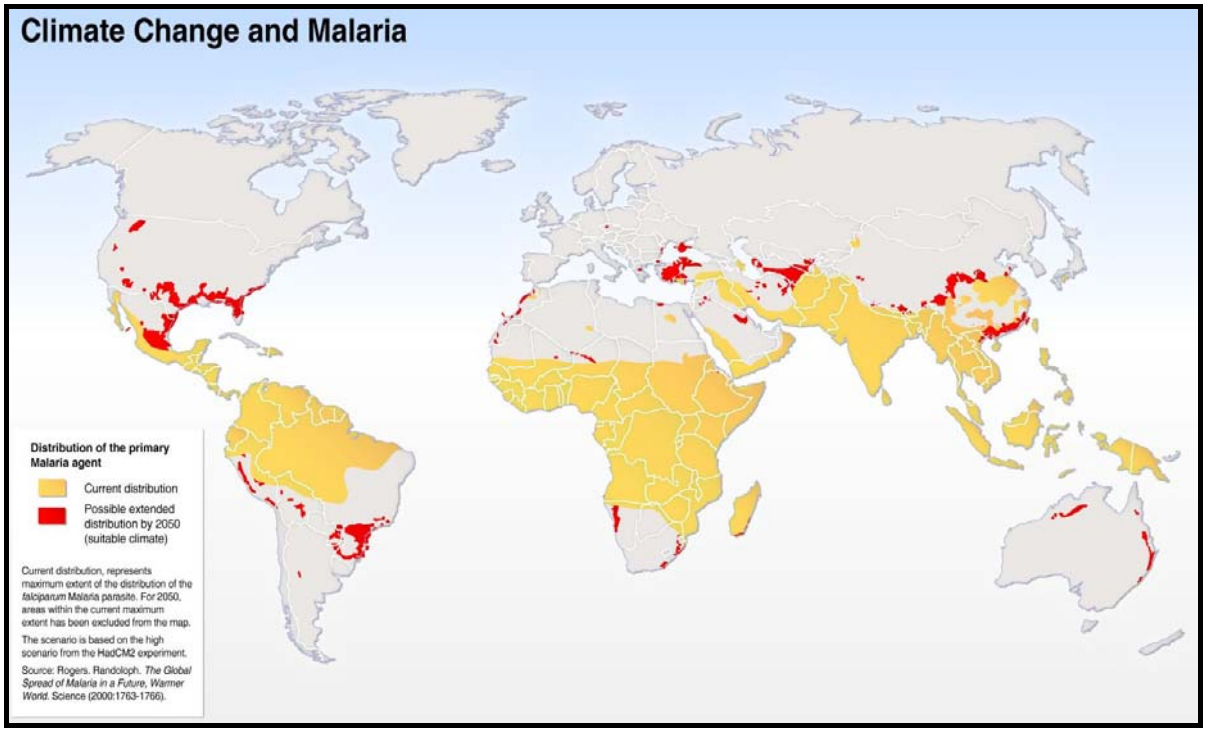

Figure 1 Climate Change and Malaria, scenario for 2050 (Ahlenius, H., UNEP/GRID-Arendal, 2005)

Today, an estimated 790 million people suffer from nutritional deficiency (DFID, 2004). This situation is expected to aggravate with climate change, especially in low-latitude countries where the overall crop productivity is expected to decrease (IPCC, 2007). Food insecurity and malnutrition will affect the overall health status of millions of people, with implications for infant mortality and child growth and development. Groups which are most at risk from malnutrition or even famines include rural dwellers especially those living in marginalised areas, pastoralists, urban poor people, refugees and displaced people (DFID, 2004). Indigenous and traditional peoples who often live in remote places are expected to be particularly at risk.

Social networks

Indigenous and traditional peoples highly rely on social networks. They often maintain social and economic ties between different groups of peoples and in many places they still support systems of food and labour sharing including exchange, reciprocity, barter or local markets. Such exchange practices have a role to play as adaptation strategies to environmental variability and stress. In the future, these practices could gain importance when these peoples, as a result of adverse impacts of climate change, might become increasingly dependent on non-locally available resources. However, in the future some of these reciprocal systems may also disappear, as certain groups may become more disadvantaged than others (Salick, Byg eds., 2007).

In addition to the rather local or regional exchange practices described above, indigenous and traditional peoples might also become more reliant on aid provided by the state, NGOs or international organisations, especially in times of crisis. Moreover, extension of their social network across the country they live in or even beyond could become more common in the future as an additional adaptation strategy to reduce socioeconomic vulnerability. For example, families that can count on members who seasonally migrate or temporarily or permanently work abroad may be more resilient to adverse climatic impacts than families whose members are exclusively dwelling within the community itself.

Marginalization: Deprivation from power, information and technology

Indigenous peoples belong to the word's most vulnerable and marginalized communities. Many of them - as a consequence of historical social, political and economic rejection and exclusion - have been pushed to the least fertile and most fragile lands where living conditions are harsh and challenging and where they struggle to survive. As a result of their marginalization and exclusion, indigenous and traditional peoples often do have very limited access to education, health care, information, technologies, power, resources and national or international aid. With exceptions, they have very limited access to power and decision making.

Indigenous and traditional peoples base their adaptatioin measures on their traditional knowledge, which largely develops based on their own observations and interpretation of climate variability and change. Nevertheless, their own observations and weather forecasting systems in the future may become less meaningful or even mislead them in their decisions, due to more rapid and complex global climate change. Facilitated access to scientific information and technology such as early warning systems, evacuation strategies or improved building techniques may help decrease indigenous and traditional peoples' vulnerability to hazards.

Diversified livelihoods

Another important factor which influences socioeconomic vulnerability is the maintenance of a diversified resource base which is a prerequisite for adaptation to climate variability and change. Diversified livelihood systems allow indigenous and traditional communities to draw on various sources of food and income and in doing so, spreading the risks of vulnerability to climate change.

Diverse crops and varieties reduce the risk of crop failure. For instance, the Peru based International Potato Centre (CIP) has identified about 3800 traditional Andean cultivated potato varieties. This enormous variety of potatoes developed by Andean farmers over centuries allows them to adapt their crops to different biophysical parameters including soil's quality, temperature, inclination, orientation and exposure. However, even though it is widely accepted that livelihood diversification in general is increasing the resilience of poor communities, it should be considered that diversification of livelihoods exclusively within natural-resource use might reinforce vulnerability to climate change (Thomas, Twyman, 2005). That is, if the climate for agriculture is becoming more and more variable and unpredictable, it may become necessary for indigenous and traditional peoples to supplement their subsistence livelihoods with income gathering activities beyond agriculture in order to minimize their susceptibility to hazards.

In summary, communities who already dispose over diversified livelihood systems are less vulnerable to climate change or other factors which adversely influence their livelihoods and will have higher chances to successfully cope with future climate change than others.

Land tenure and access rights

Traditional or ancestral land that indigenous and traditional peoples inhabit represents the fundament of their cultures. It is estimated that traditional and indigenous peoples, who only constitute to about five per cent of the world's total population, occupy about 20 per cent of the world's land surface (Oviedo, Maffi & Larson, 2000). These peoples have managed and shaped their surroundings over centuries, adapting their livelihoods to very specific local natural, physical and climatic conditions. Many of the ancestral territories that indigenous and

traditional peoples dwell in comprise sacred natural sites[1] represented in the form of mountains, rivers, lakes, caves, single trees or forest groves, coastal waters and entire islands. Traditional and indigenous peoples are tightly connected to their land, not only through their livelihoods but also through spiritual bonds.

However, in many cases, land tenure and access rights of indigenous communities are not legally recognised (IFAD, 2003). As a consequence, their land and resources are often exploited and encroached by outsiders. With the implementation of projects related to the Clean Development Mechanism (CDM) or the Reduced Emissions from Deforestation in Developing countries (REDD), and as a result of the increasing demand for biofuels, there are fears that the land rights of traditional and indigenous peoples will be increasingly contested or violated. This insecure situation further acuminates the already challenging situation many of these peoples live in, and may result in severe implications to their vulnerability and capacity to adapt. For instance, in times of acute climatic crises, people often shift their agricultural activities to more favourable areas. The Makushi of Guyana, for example, move their savannah homes to forest areas in times of droughts (Salick, Byg eds., 2007). If this traditional way of adaptation to environmental variability is restricted or denied these people might not be able to cope with environmental stresses and be at acute risk. Consequently, it is crucial to protect land tenure and access rights of traditional and indigenous peoples and to reward them for the goods and services their lands provide.

2.2.2 Biophysical vulnerability factors

Biophysical vulnerability is interpreted as the amount of damage experienced by a system caused by the impacts of a specific type of hazard and is therefore, in contrast to social vulnerability, a function of the frequency and severity of given types of hazards (Brooks, 2003). The following factors are believed to determine biophysical vulnerability of indigenous and traditional peoples.

Exposure to extreme events

Biophysical vulnerability highly depends on the intensity and frequency of hazards. According to the IPCC Working Group I report (2007a) the type, frequency and intensity of extreme events including heat waves, floods or droughts are going to change. Increase in the frequency of some of these events including heat waves and heavy precipitation events have already been registered.

As far as temperature is concerned, it is expected that the global mean temperature is going to rise with an increase of warming from the tropics to the poles on the Northern Hemisphere. It is furthermore expected that the amount of warming will be higher in the interiors of continents. On a global scale the amount and duration of heat waves is predicted to increase whereas the amount of low temperature extremes is expected to decrease.

Changes in precipitation are more difficult to model and there is still a large degree of uncertainty. However, it has been projected that there will be more rain around polar areas and less rain in areas adjacent to the tropics. More intense flooding is expected in the Asian monsoon region and other tropical areas. In general it is expected that precipitation events are going to be more intense as a result of higher air temperature and its consequential higher capacity to hold water. Impacts on mountain hydrology could lead to droughts or floods in the adjacent lowlands.

[1] Sacred natural sites are “natural areas of special spiritual significance to peoples and communities. (…)” (Oviedo, Jeanrenaud, Otegui, 2005).

Furthermore, according to the IPCC (2007a), there is evidence that future tropical cyclones may become more severe, with greater wind speeds and more intense precipitation. However, as a result of limited resolution of global climate change models (GCMs) and even regional climate change models (RCMs) it remains still challenging to make accurate predictions at a regional or even local scale and there is still a great deal of uncertainty among the predictions.

Availability of natural resources

Traditional and indigenous communities are highly reliant on natural resources which they use in many different ways - as food, wood for timber or fuel, fibre for clothing, medicinal plants for health care, materials for income generating activities – and depend on for spiritual purposes. Due to the effects of climate change the availability and distribution of these resources are expected to be directly affected. This could increase the socioeconomic and biophysical vulnerability of these peoples, possibly putting them at severe risk. For example, increased frequencies of hazards such as droughts and floods are projected to affect local production negatively, possibly leading to crop failure, especially in subsistence sectors at low latitudes (IPCC, 2007b). In addition, it has been projected that the availability and quality of water will decrease and that there will be a loss of biodiversity which is expected to have fundamental impacts on indigenous peoples' environmental management and livelihoods.

Access to safe water and fuelwood

The IPCC report (2007a) projects that it is likely that areas affected by droughts will increase during the 21st century and that it is very likely that the frequency of heavy rainfalls will increase over most areas during the 21st century. Floods and droughts can lead to serious health impacts especially in vulnerable regions. Floods facilitate the proliferation and spread of infectious diseases as well as respiratory and diarrhoeal diseases. Droughts can boost concentration of pathogens in water sources as pathogens multiply at increased rates in less available water (DFID, 2004). In many places, because of a lack of alternatives, people are forced to use contaminated water for drinking and household as well as for livestock and agriculture putting not only themselves but also their agricultural production at risk.

Persistent droughts may also lead to an increase in forest fires and desertification and as a consequence contribute to a lack of fuelwood which plays an important role in indigenous and traditional peoples livelihoods. A lack of fuel for cooking may force communities to reduce their intake of warm meals . This again may have implications on their health since especially in warm climates, germs proliferate at high rates. What is more, a decrease in the availability of water and fuelwood may have particularly serious implications on women and children. In many traditional communities, women, apart from being involved in the care of children and the elderly, are also in charge of household food production and water and firewood gathering. Climate change may further increase the time necessary for completing these errands as the availability of water, vegetation and fuelwood may decrease. A lack of firewood and safe water could prompt these communities to take their children, especially girls, out of school, in order to help their mothers to complete these tasks.

Availability of biological diversity

Traditional and indigenous communities mostly depend on subsistence farming and derive a substantial part of their diet from wild plants and animals. These communities also play an important role in the conservation and management of species and ecosystems and avail on the plants and animal medical and pharmaceutical products provided by nature. Biodiversity loss as a result of potential adverse impacts of climate change will affect indigenous peoples in many different ways, such as depriving them of important food sources, and reducing their

ability to cope with pests and diseases with the help of medicinal plants (Salick & Byg eds., 2007).

Location of residence

Exposure to climate change impacts depends on where people choose or are forced to live (Brooks, 2003). Indigenous and traditional peoples often live in physically isolated, fragile and harsh environments. Frequently, these environments are especially vulnerable to environmental change due to their latitude, topography, distance from the sea, soil's quality et cetera.

Mountain areas

Mountains, for example, are areas of high cultural as well as biological diversity but are also considered among the regions which are expected to be most affected by adverse impacts of climate change. Mountain glaciers and snow packs feeding lakes and creeks have already declined significantly especially in the northern hemisphere and permafrost has degraded, leading to changes in land surface characteristics and drainage systems. (IPCC, 2007a). Additionally, high alpine flora, used for food, medicine, clothing and craftwork is projected to get lost due to global warming (Salick, Byg eds., 2007).

Though, not all indigenous peoples live in isolated rural areas. Experts have estimated that in certain countries the portion of indigenous peoples living in urban areas constitutes up to more than half of their total population. This rate is on the increase for a variety of reasons leading to forced or involuntary migration from rural to urban areas (UN Habitat, 2007). These peoples often live on the fringes of cities, they contend with very bad living conditions and many of them are subject to discrimination, exclusion and violence.

Indigenous and traditional peoples in Lima

In Lima the most disadvantaged and poorest members of the Peruvian population were forced to occupy the worst territories of the city which are susceptible to inundations, erosion and land- and mudslides. A recent study by the Metropolitan Institute for Planning of the city of Lima has found that there is a clear correlation between the social status of people and their exposure to risk (Villacorta et al., 2005).

Housing quality

The building techniques and quality of housing are linked to the location of residence, the availability of local resources and the local culture. The way houses are built is often based on traditional knowledge. As access to non-local building materials is regularly limited because of logistical or economical constraints, houses are usually built out of locally available materials such as adobe, timber, bamboo, fibre, leaves or tree bark. Such houses are usually well adapted to local conditions, but may be less resistant to new hazards than houses built purposefully with more resistant materials, and may not endure the force of expected future hazards. In urban areas, houses of marginal people are often of very poor quality exposing their occupants to hazards.

Consequently, the future biophysical vulnerability of indigenous and traditional peoples highly depends on the environment they dwell in, the quality of their houses and infrastructure and on the gravity that projected hazards will have on their built and non-built environment.

Land use and land cover change

Finally, changes in land use and land cover are additional factors which have implications on the vulnerability of indigenous and traditional peoples. Land cover is defined as

> *the observed physical cover including the vegetation (natural or planted) and human constructions which cover the earth's surface. Water, ice, bare rock or sand surfaces count as land cover (GTOS, 2007).*

Changes in land cover and land use on the one hand drive climate change and on the other hand are directly or indirectly affected by climate change.

Conversion of forest into agricultural land, for example, drives climate change. It leads to alteration of surface properties of an ecosystem (e.g. albedo, roughness length) and changes the efficiency of ecosystem exchange of water, energy and CO2 with the atmosphere. It is expected that the land use shift from forest to agricultural land will continue in the future, especially in parts of western North America, tropical areas of South and Central America and arable regions in Africa and south and central Asia (IPCC, 2007a). Urbanisation too, is another alternation in land cover that drives climate change. Urban areas form heat islands which contribute to global warming.

However, as stated above, land cover change not only drives climate change but is also driven by climate change. Global warming may lead to dramatic changes in land cover. In the Arctic, for example, ice sheets are melting which seriously affects the Earth's surface properties. Satellite data have demonstrated that since 1978 the annual average arctic sea ice extent has decreased by 2.7%, importantly contributing to sea level rise (IPCC, 2007).

Indigenous and traditional peoples' degree of vulnerability is expected to be seriously influenced by land use and land cover change. Land cover change caused by climate change could force them to adapt to new circumstances and alter their traditional ecosystem management systems. In many places, for instance in the Arctic (See Chapter 5.1) such adaptation processes are already taking place. Sadly, in some places climate change impacts may overstrain indigenous and traditional peoples' capacity to adapt and eventually lead to a loss of their traditional habitats and along with it their cultural heritage.

2.3 Conclusion

In summary, vulnerability of traditional and indigenous peoples to global environmental change is mainly determined by the low degree of social and biophysical security driving from poverty and marginalization, the lack of entitlements to resources, power and decision making, the exposure to future hazards as well as other external stressors such as violent conflicts or epidemics.

Hence institutions and policy makers play a key role in empowering indigenous and traditional peoples by securing and enhancing their entitlement to resources including land, water, biodiversity as well as health care, technology, education, information and power in order to improve their capacity to adapt to climate change and decrease their social and biophysical vulnerability. Where institutions fail to secure these entitlements, the resilience of indigenous and traditional peoples may decrease and the threshold, beyond which a system may not be able to adapt to environmental change may be exceeded (Adger, 2006).

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3 Areas of 'high cultural risk'

Identifying the most vulnerable areas and groups living in these areas to global climate change with reasonable accuracy remains challenging since global as well as regional climate change models still lack detailed resolution to predict the types and magnitudes of changes to be expected at a regional or local level. Especially when it comes to direction of change in precipitation for some regions there is not sufficient knowledge available to make reliable predictions. Nevertheless, even though it is not possible today to isolate specific groups and local places of highest risk it is possible to identify broad regions which are likely to experience certain types of climate change and extreme events (Dow, Kasperson & Bohn, 2007).

The following maps superimpose the location of indigenous and traditional peoples (ethno-linguistic groups) on climate change prediction data from the IPCC (2007)[2]. The resulting maps show the coincidence of some areas of high concentration of indigenous and traditional peoples and areas of greatest predicted climatic change. Regions where these two conditions occur simultaneously may represent areas of particular interest or vulnerability. The particular interests and needs of indigenous and traditional peoples where change, even change which may be considered beneficial at a national or regional level (for example, increased precipitation in currently arid areas such as the Sahel) may give rise to potentially threatening changes in traditional livelihood systems, settlement patterns, land prices, etc.

3.1 Projected Global Changes in Precipitation

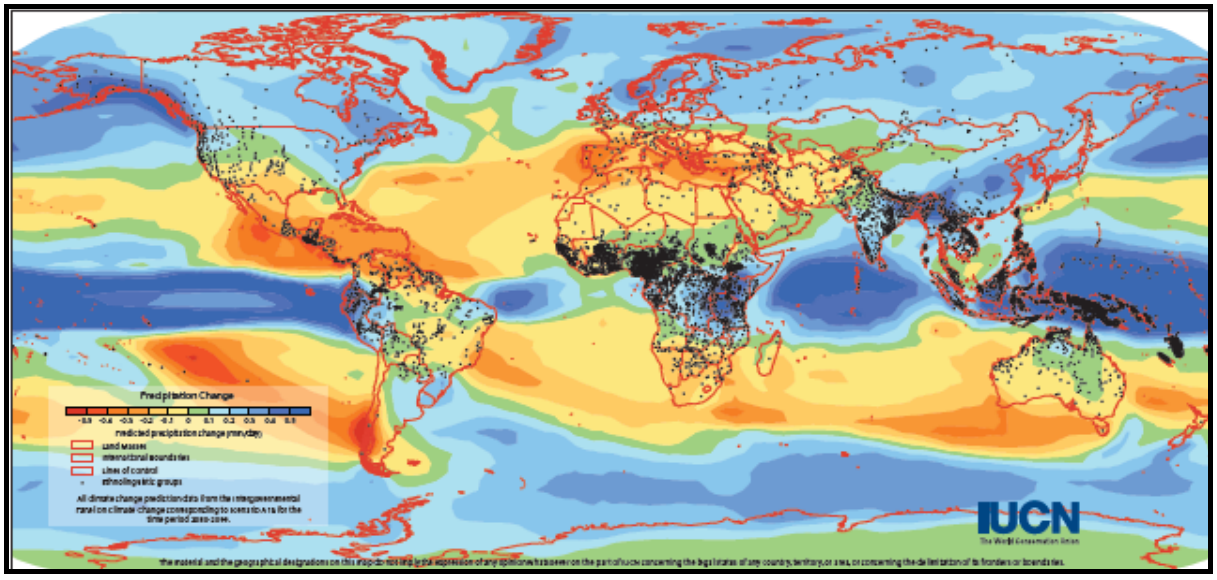

Figure 2 Multi model mean changes in precipitation (mm day–1) for the time period 2080 to 2099

Changes in precipitation remain hard to predict and there are still large uncertainties. As precipitation is a function of inherently small scale processes, such as cloud formation, moisture availability and so forth predictions for future precipitation represent an on-going, important challenge for climate modellers (Frame, 2007). However, as the map above indicates, it is possible to locate broad areas which are expected to experience the biggest

[2] All climate and sea level change data were taken from the IPCC Forth Assessment Report of Working Group One (2007) and represent an average prediction of several climate models for the A1B emissions scenario during the period 2080-2099 (see Annex II). Maps with the location of ethnolinguistic groups are from Oviedo, Maffi and Larsen, 2000.

changes in precipitations (increase or decrease). Based on data from the IPCC (2007), a majority of models indicate an increase in precipitation across the seasons in high latitudes and in some of the monsoon regimes (including South Asian monsoon in June, July, August and Australian monsoon in December, January, February). In mid latitudes a widespread decrease of summer precipitation has been predicted except for increases in eastern Asia. The models further converge in their predictions of major decreases in precipitation across the subtropics. A particularly pronounced decrease in precipitation has been predicted for the Caribbean and Mediterranean regions. Thus, traditional and indigenous peoples living across the Caribbean and Mediterranean regions, parts of Brazil, southern Chile and Argentina, southern Africa and large parts of Australia are expected to face increasing freshwater stress over the course of this century, putting them at severe risk. Increases in precipitation over 20% have been projected for most high latitudes, as well as in eastern Africa, central Asia and the equatorial Pacific Ocean. Since not only decreases but also increases in precipitation - especially extreme events including droughts or floods - have implications on traditional and indigenous peoples' livelihoods, groups living in the mentioned 'risk areas' will have to adapt their livelihoods to new environmental conditions.

3.2 Projected Global Changes in Temperature

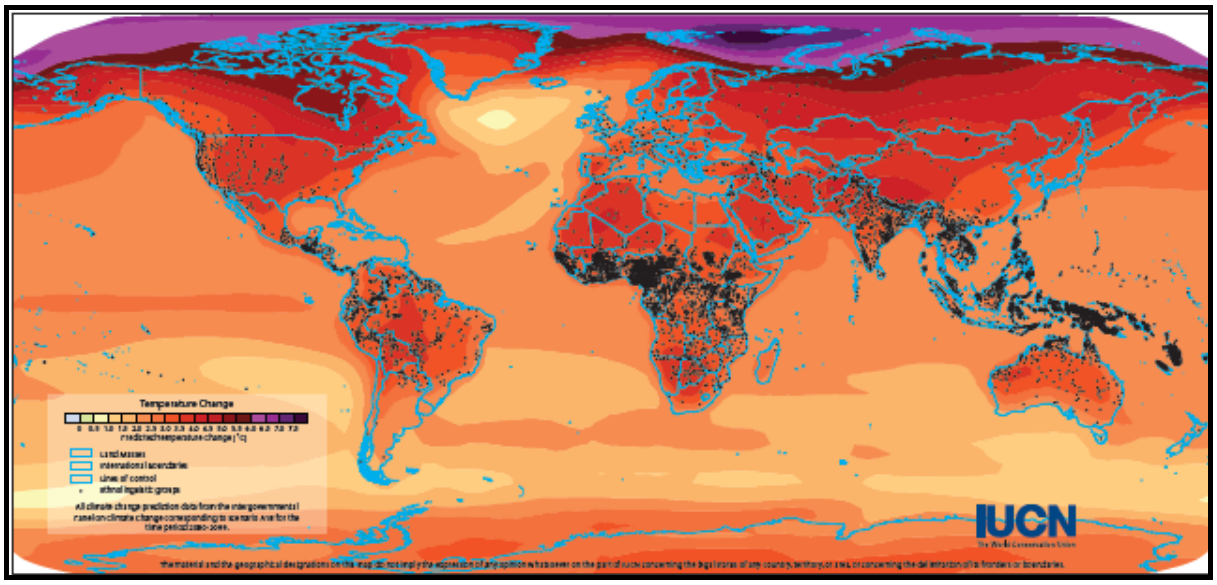

Figure 3 Multi-model mean of annual mean surface warming for the time period 2080 to 2099

Changes in temperature are easier to project because temperature in contrast to precipitation is a large-scale continuous variable (Frame, 2007). However, a certain degree of uncertainty still persists. Nevertheless, according to the data published by the IPCC (2007), very likely global climate change will cause higher maximum temperatures and more hot days over nearly all land areas. Furthermore there will be higher minimum temperatures and fewer cold and frosty days. The biggest changes in surface temperature are expected to happen in high latitudes as well as in the interior of the continents. That is, throughout the USA and Canada, across Bolivia and Brazil, in the Mediterranean region (especially in the north-western African states), in southern Africa (around the Kalahari Desert), across the Arabian Peninsula, the Tibetan plateau as well as north-west Australia.

It is noticeable that many of the regions of greatest change in surface temperature coincide with the regions of greatest decrease in precipitation as shown in Figure 2. Hence, indigenous and traditional groups living in these areas, namely the Caribbean region, the Mediterranean

region and the Middle East, southern Africa and great parts of Australia will not only have to cope with increasing water stress but also with rising surface temperatures.

3.3 Projected global changes in sea level

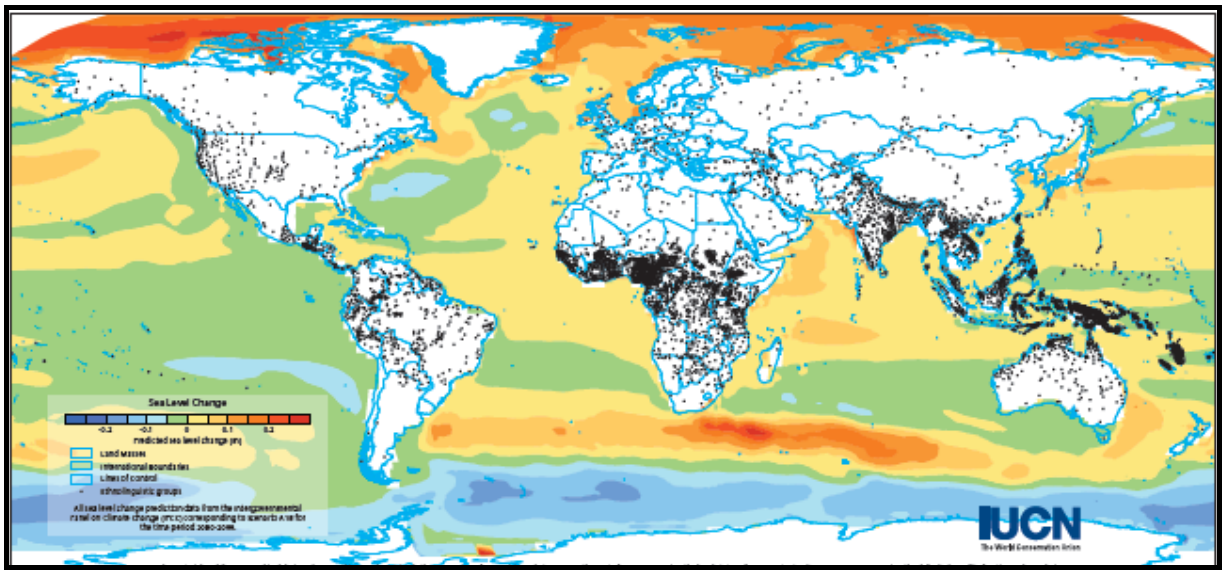

Figure 4. Local sea level change (m) during the 21st century

As with precipitation, models predicting sea level change vary and there is currently no consensus on the magnitude of the dynamical processes which are influencing sea level rise. Therefore, it would not be meaningful to pinpoint individual groups which are going to be affected or at risk by sea level rise. However, again it is possible to identify the areas of projected greatest change. Most pronounced change in sea level is projected to take place in the Arctic. Other areas of interest where sea level is expected to rise within a range of 0 -0.2m are situated along the Asian and African coastlines as well as parts of the South and North American Atlantic coastline. Sea level rise is expected to have especially serious impacts along the low lying coastline of the Indian states Gujarat and Kerala, the Bay of Bengal as well as around the Korean peninsula and Japan. Furthermore, island states across the world are expected to be at risk, namely low lying parts of Madagascar, Sri Lanka and the Pacific Island states. Among these, especially small island states, which contain a high proportion of the world's linguistic and cultural diversity, are at risk.

3.4 Conclusion

Even though it is not possible to make accurate projections for future global change in local places or for specific groups with the data currently available, it is nevertheless possible to locate broad regions which are likely to experience certain types of environmental change.

To summarise the findings drawn from the maps above, areas of high risk with regard to changes in precipitation and surface temperature include: the Arctic region, the Caribbean and the Mediterranean region, the very south of Latin America and the Amazon, southern Africa, the Arabian Peninsula and large parts of Australia. Concerning sea level rise, areas at greatest risk include island states in general but especially small islands states, the Arctic region as well as low lying Asian coastal areas. If all the maps above were overlaid it could be concluded that ethnolinguistic groups dwelling in the Arctic, in the Caribbean and Mediterranean region, in the Amazon and southern Chile and Argentina, in Southern Africa, on the islands in the Pacific and other island states, along the Asian coastline and across

Australia are going to be the ones who will be at greatest risk. However, it should be borne in mind that exposure to extreme events including droughts or floods, is not the only factor which determines the vulnerability of indigenous and traditional peoples. As described in chapter two, social and biophysical vulnerability is influenced by a wide range of factors of which exposure to extreme events, availability of water, location of housing etc. are only a few. Hence, in order to draw a comprehensive and integrated conclusion on the vulnerability of a specific cultural group, a wide range of the social and biophysical variables described in chapter two should be considered.

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4 Overview and analysis of the potential impacts of climate change on livelihoods and cultures and evidence of adaptation strategies

The aim of this chapter is to describe the projected impacts of climate change on different selected key biomes and to compile and describe case studies of successful and unsuccessful adaptation of natural-resource-dependent communities to environmental change. The chapter is structured in four sections, each focusing on a specific biome, namely oceans, coastal areas and islands; tropical forests; drylands; and watershed areas. Each of these sections features a general part describing the projected impacts of climate change on the mentioned biome and the people living in these environments and case studies describing adaptation practices of indigenous and traditional peoples to specific impacts of global environmental change such as sea level rise, forest fires, droughts and changes in the cryosphere.

Livelihood adaptations to environmental change are not novel or "special", but have taken place throughout history. Natural-resource-dependent communities have been continuously adapting their livelihoods to a wide variety of external disturbances and stresses in order to survive. However, climate change creates additional risks to which these communities are exposed, and the intensity of future climate change impacts may be outside the range of risks that they have experienced and adapted to in the past. According to the IPCC report (2007), the intensity of impacts such as droughts, heat-waves, hurricanes and accelerated glacier retreat is likely to increase (see 3.2.2).

4.1 Oceans, Coastal Areas and Islands and Climate Change

4.1.1 Introduction

The potential impacts of climate change on oceans, coastal areas and islands are quite well known and get more and more documented. Their repercussions on people in terms of socio-economic impacts is also part of a growing body of literature, as are vulnerability assessments of regions or countries. However, when it comes to cultural consequences of climate change and adaptation strategies, especially with regards to indigenous communities, researchers are faced with a notable void.

In order to give elements and priorities for further research, this section will look at the known impacts of climate change on oceans and their repercussions on coastal and island communities. It will then briefly summarise the regional projected impacts of climate change. Finally, two case studies on indigenous peoples in the Arctic and in Bangladesh will illustrate how ocean-related changes can impact on traditional ways of life, and possibly jeopardise the very existence of some communities.

4.1.2 The oceans and climate change

The oceans, which cover over 70% of Earth's surface, play a very important role in regulating climate and weather, through exchanges of water, gases and heat between the atmosphere and the oceans. They are a key part of the carbon cycle of our planet, and are believed to have absorbed about one-third of total anthropogenic CO_2 emissions until now. They contain more than 90% of the planet's living biomass and provide a living space 168 times larger than

terrestrial habitats. The great wealth of marine biodiversity provides livelihoods and important animal protein intakes to millions around the world.

Today, this vitally important ecosystem is at risk. The latest scientific findings show that marine and coastal ecosystems will be significantly altered and damaged by global climate change, which will in turn have severe consequences for humankind: "Human activities are unleashing processes of change in the oceans that are without precedent in the past several million years" (German Advisory Council on Global Change, 2006). While projections of the impacts of climate change are marked by uncertainty, impacts are predicted to be particularly high for poor countries. Similarly, people among the most vulnerable will be those who live at or near sea level, often crowded into cities along the coasts (Hopkin, 2007).

Rising water temperature

We now have irrefutable evidence that oceans are warming, and that this change will significantly impact marine ecosystems (Bindoff *et al.*, 2007). Although the oceans warm more slowly than terrestrial systems, due to their vastness, they react more sensitively and quickly to changes in climatic conditions. Of particular concern are the unpredictable consequences on marine animal and plant species, as they are greatly influenced by water temperature. Increasing water temperature can lead to shifts of populations, the invasion of alien species, and even the disappearance of species (German Advisory Council on Global Change, 2006). The increase in temperature will particularly affect the most productive areas in the oceans, which are the shallow continental shelves (<200m water depth). While these areas represent less than 7% of the oceans, they account for more than 90% of the global fish catch (German Advisory Council on Global Change, 2006).

Tropical coral reefs

Tropical coral reefs are recognised as among the richest and most complex ecosystems in the world. They support a diversity of organisms that live on and from coral reefs, representing an estimated 0.5-2 million species (German Advisory Council on Global Change, 2006). Most of the coral reefs of the world are situated around developing countries, where the majority of the people live along the coastline and are heavily dependent on coastal resources for their livelihood. Fisheries provide a major income source for coastal communities and a significant source of animal protein in their diet. It is estimated that more than 100 million people are economically dependent on coral reefs (German Advisory Council on Global Change, 2006), and as much as 70% to 90% of fish catch in South-East Asia is, for instance, dependent on coral reefs. Island communities that depend on coral reef fisheries are even more vulnerable as they have limited livelihood alternatives and few choices of major food sources. Coral reefs also play a significant protection role, as they serve as natural barriers to wave action and protect from tsunamis and coastal erosion.

Coral reefs are also among the most fragile ecosystems, and can be easily damaged by light or temperature changes, pollution or chemical changes in the water. The exceptionally strong El Niño events of 1997/98 in the Indian Ocean, characterized by higher ocean temperature, led to mass coral bleaching. While these El Niño events are a natural part of the Earth's climate, global warming could increase the intensity or frequency of such events, which would have major consequences in terms of marine biodiversity as well as socio-economic impact.

Increased extreme weather events

Ocean-related results of climate change also threaten humankind and natural ecosystems through extreme weather events such as tropical cyclones. While the number of them is not expected to rise due to climate change, several studies suggest that the strength of these events is very likely to increase. The many people living on coasts will be affected by these, and

people who will be possibly hardest hit live in developing countries. The IPCC (2001) estimated that the number of people potentially affected by storm-surge flooding will double, maybe even triple, in the next century.

Ocean acidification

The oceans are a major carbon reservoir and sink. They presently store about 50 times more CO_2 than the atmosphere and 20 times more than the terrestrial biosphere and soils (German Advisory Council on Global Change, 2006). They take up annually the equivalent of about 30% of anthropogenic CO_2 emissions (IPCC, 2001). Increase in CO_2 concentrations in the upper layer of the sea, attributed to the proportional rise of CO_2 concentrations in the atmosphere, has now been demonstrated. This results in a reduction of water pH, meaning an acidification of seawater. Water acidification impacts on all marine calcifying species, such as certain plankton groups, clams, snails and corals, by hampering their calcification process (growth) and could even lead to dissolution of their skeleton. The effects of acidification on these calcifying species will have important repercussions on all associated species and the whole food chain. Changes in tropical coral reefs, and possible large-scale loss of coral habitats, will affect millions of people dependent on coral reefs fishery for their livelihood.

Rising sea-level

Approximately 20% of the world's human population lives within 30km of the sea, and nearly double that number lives within a 100km of the coast (IPCC, 2001). The rate of population growth in coastal areas is further accelerating, and coastlines and cities by coastlines are drawing in more people than ever before (United Nations, 2007).

Sea-level rise is one of the unavoidable physical consequences of global warming, and is considered as the biggest challenge posed by global climate change for inhabitants of coastal regions (German Advisory Council on Global Change, 2006). Also, socio-economic impacts of sea-level rise have been much more studied than other climate change variables; and these studies emphasise on the economic aspect of sea-level rise rather than its impact on social and cultural systems (IPCC, 2001).

The IPCC report mentions the following main impacts of sea-level rise:

- Direct loss of economic, ecological, cultural and subsistence values through loss of land, infrastructure, and coastal habitats
- Increased flood risk of people, land, and infrastructure and the aforementioned values
- Other impacts related to changes in water management, salinity, and biological activities

The IPCC also mentions that adaptation to sea-level rise and climate change will involve important tradeoffs, which may include environmental, economic, social and cultural values. The tradeoffs will become particularly crucial decisions in low-lying island states and nations with large deltaic areas, which will be the most affected by sea-level rise.

4.1.3 Regional impacts of climate change

Below is a brief summary of the expected regional impacts of climate change and sea-level rise projected by the IPCC (2001).

Africa

A significant number of people in Africa are vulnerable to rises in sea level as a result of climate change, as more than one-quarter of the population of Africa resides within 100 km of a sea coast. It was estimated that as many as 70 million people could be affected by flooding

in 2080, compared to 1 million in 1990. The capital of The Gambia, Banjul, could disappear in 50-60 years because of coastal erosion and sea-level rise.

Asia

The number of coastal residents in Asia amounts to 1.7 billion people, the equivalent of more than half of the region's population. Due to accelerated and unsustainable development, Asian coasts are under increasing pressures which threaten the resilience of coastal ecosystems. The vulnerability of these ecosystems will be further exacerbated by climate change. The main impacts of climate change on coastal zones of Asia will consist of sea-level rise and more frequent and severe storm events. Bangladesh and India are particularly vulnerable to tropical cyclones and storm surges: approximately 76% of the total loss of human lives from cyclonic storms has occurred in India and Bangladesh.

In terms of sea-level rise, the consequences will be most dramatic in Bangladesh and Vietnam, where 15 million and 17 million people, respectively, could be exposed given a relative change in sea level of 1 m.

Southeast Asia has almost one-third of the world's mapped coral reefs, many of which are already undergoing rapid habitat destruction. The impacts of climate change will further exacerbate that trend, and impact on millions of people dependent on those reefs.

Latin America

Sea-level rise in Latin America could be greater than the estimated global average. Approximately 1600 km of coral reefs and 870km of mangroves are located in the region of Central America. Also, the second largest coral reef system in the world dominates the offshore area of the western Caribbean. Impacts of climate change on these fragile ecosystems could put at risk thousands of species and resources for rural communities living in coastal areas. Coastal zones with economies that are based on fishing and tourism will be most affected by sea-level rise.

Arctic

The Arctic and the Antarctic are the places on Earth where the impacts of climate change are the most obvious. The Arctic has experienced a warming trend in air temperature of as much as 5°C during the 20^{th} century, and sees a continuous decrease in sea-ice extent. Further warming and increases in precipitation are projected for the 21^{st} century. Predicted impacts of warming include: increased melting on Arctic glaciers and the Greenland ice sheet, which will retreat and thin close to their margins; substantial loss of sea ice and the opening of new sea routes; increased biological production; changes in species compositions on land and in the sea, poleward shifts in species assemblages and loss of some polar species. Changes in sea ice will alter the seasonal distributions, geographic ranges, patterns of migration, nutritional status, reproductive success, and ultimately the abundance and balance of species.

As mentioned in the IPCC report, these changes will have major impacts on human communities in the Arctic, and in particular indigenous peoples, whose longstanding traditions and ways of life could be threatened.

Small island states

Although small island states are a heterogeneous group, they share some common features that make them particularly vulnerable to impacts of climate change: they have limited space and resources, live in relative isolation and have often poorly developed infrastructure. Their capacity to adapt to climate change is thus considered as more limited. Small island states are particularly vulnerable to sea-level rise given the reduced possibility for retreat. The lowest

lying islands, such as the Maldives, are faced with the risk of disappearing from the maps and giving birth to the first "sea-level refugees". While it is not estimated that world fisheries output will be significantly impacted by climate change, island abundance and distribution of reef fish populations are expected to be severely impacted by altered water temperatures.

The IPCC report also recognises that island assets, such as know-how and traditional skills, are under threat from climate change and sea-level rise.

Case study 1: Indigenous people in the Arctic

The risks posed by climate change to traditional communities are probably best documented for the indigenous peoples of the Arctic. They are also the only indigenous communities mentioned in the summary of IPCC's Fourth Assessment Report.

A few reasons can explain this: firstly, the extreme and unique climate of the Arctic makes it special enough to attract attention and trigger research on human adaptation capacities. The Arctic is also particularly sensitive to climate changes, which are more pronounced there than in any other region of the world. Finally, indigenous peoples have a recognized political power in the region, as they are for instance represented in the Arctic Council – "a high-level forum for cooperation, coordination and interaction between Arctic States (USA, Canada, Denmark/Greenland, Iceland, Norway, Sweden, Finland and Russia) and indigenous communities" (Arctic Council, 2006).

It is recognized that the Arctic is now experiencing some of the most rapid and severe climate change on earth (ACIA, 2004), and that changes will continue at an accelerated pace. This will have major physical, ecological, social, cultural and economic impacts, and might even jeopardize the survival of some traditional cultures.

Shifts of vegetation zones, changes in animal species diversity, range and distribution, reduction of the extent and thickness of sea-ice, sea-level rise or increasing exposure to storm are some of the challenges that Arctic communities will have to face. While it is believed that most of the changes will have negative consequences for indigenous communities (Nuttall, 2001), these changes will open up new opportunities as well. They include expansion of marine shipping, increase in tourism and access to offshore oil and gas (though these so-called opportunities have their own environmental and social risks), enhanced marine fisheries, agriculture and forestry.

Arctic communities have a long history of adaptation to extreme environments, to environmental changes as well as to other type of changes such as colonization, forced resettlement and rapid cultural change (Nuttall, 2001). While they have so far proved to be able to cope with those changes, it is recognized that climate change poses unprecedented challenges, and the question whether some indigenous peoples will be able to adapt is raised.

While it is difficult to find any systematic study of Arctic indigenous communities' modern adaptation strategies to changing climates, some examples include (Indian and Northern Affairs, 2007):

Housing

- Shorelines reinforcement and moving buildings from the shoreline, due to soil erosion caused by decreasing permafrost
- Use of innovative building material to support structures, due to ground instability caused by changing permafrost patterns

Subsistence

- Increased water quality testing and consumption of bottled water due decreasing water quality and accessibility
- Changing hunting habits, by either hunting with boats or switching to fishing as well as hunting quotas
- Increased consumption of store-bought foods due to scarcer local foods

Emergency preparedness

- Extension of danger zones in avalanche prone areas and expansion of research and rescue teams due to increased snow slides and avalanches
- Development of better emergency preparedness plans by having more supplies during travel or avoiding travel during periods of bad weather.
- Increasing use of Global Positioning Systems (GPS), cellular phones and CB radio.

As was mentioned by the IPCC report (2001), adaptations come in a huge variety of forms. They include spontaneous and planned (both reactive or anticipatory) adaptations, short or long term, localized or widespread, etc. The few examples above represent indeed a mixture of responses, from increased preparedness against natural hazards, accommodation of traditional ways of life (housing or hunting, for instance) to actual shifts towards less traditional ways of life, which could indicate the beginning of a possible loss of traditional cultures.

The value of traditional knowledge and observations made by indigenous people on climate change has been clearly recognized in the Arctic. The Arctic Climate Impact Assessment (ACIA) report, a four-year study of Arctic climate released in November 2004, benefited from the input of traditional people. It further recognizes that traditional knowledge provides a good supplement to and enrichment of scientific data. One of the authors of the report cited by *Science* said that "The [ACIA] report was very instrumental in awakening people to the value of traditional knowledge as 'very solid science'" (Couzin, 2007). The partnership between traditional peoples and scientists is also meant to make science useful to local peoples, and give them another perspective on the changes that are taking place in the Arctic.

This type of collaboration with indigenous communities seems however more focused on improving understanding of physical and ecological impacts of climate change in the Arctic than social and cultural impacts. It will be equally important to include indigenous peoples at the decision-making level, so that their experience and successful adaptation strategies can help shape new forms of governance and livelihoods to meet the challenge of climate change.

Case Study 2: Indigenous people in Bangladesh

Bangladesh is noted for the ethnic homogeneity of its population, of which about 897,828 people are indigenous according to the census of 1981 (slightly more than 1% of the population) (SDNP, 2004).

Bangladesh is also one of the most highly disaster-prone countries of the world (Srinivasan, 2004) and is expected to be one of the most heavily impacted by sea-level rise caused by climate change, as it is a flat deltaic land vulnerable to inundation and has a long coast. As shown in figure five, it was estimated that a 1.5 meter rise would affect 17 million people (about 15% of the population) and 22,000km^2 of land (about 16% of total land surface) (UNEP/GRID, 2007). Coastal peoples, whose livelihoods mainly depend on resources such as fisheries and mangroves, are expected to be severely affected by the effects of climate change and natural hazards.

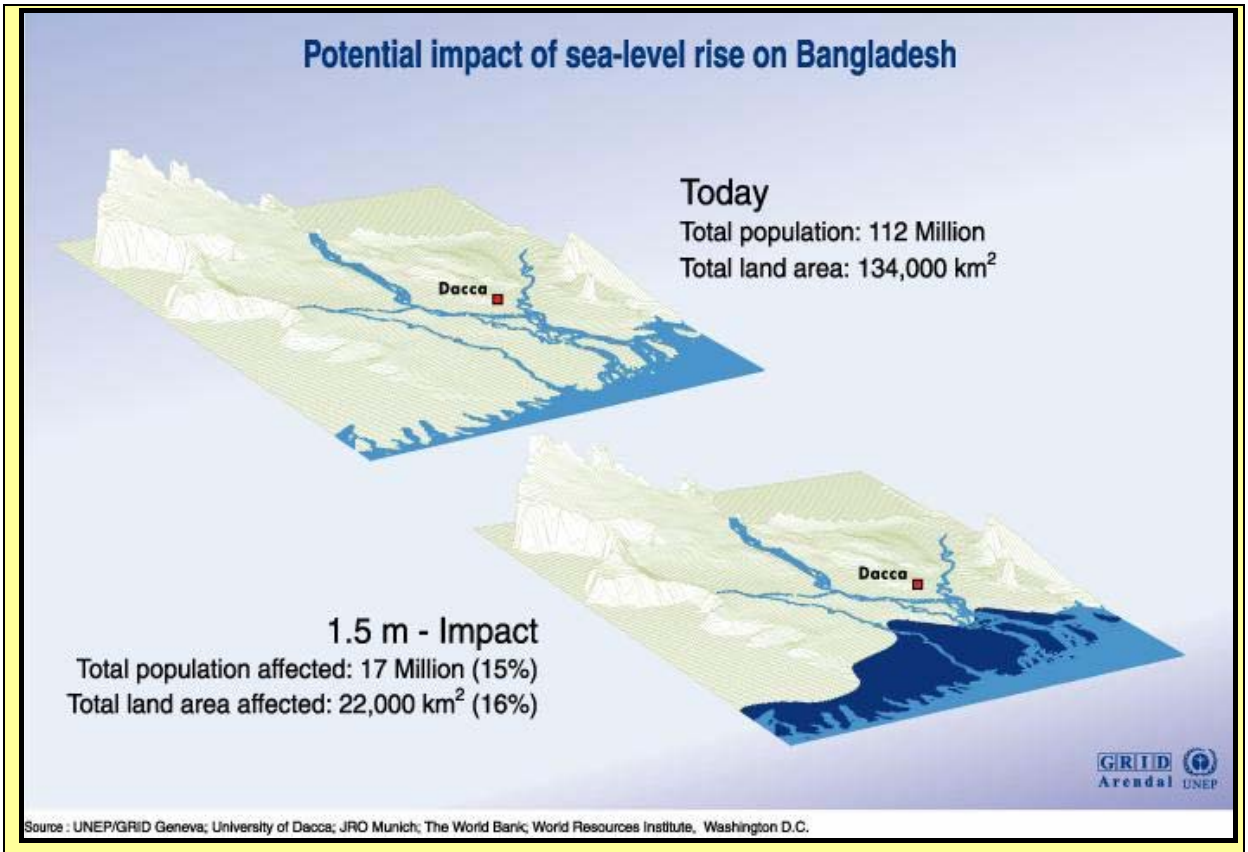

Figure 5 Potential impact of sea-level rise on Bangladesh (*Rekacewicz, UNEP/GRID-Arendal, 2000)*

Impacts of climate change are already being felt in the country. But again, it is difficult to find a systematic study of adaptation strategies adopted by local people. One paper mentions that indigenous strategies remain the dominant form of response to climate disaster (Srinivasan, 2004). That same paper gives a short description of coping strategies utilized by indigenous people in Bangladesh in times of flood, and compares their utilization over a few years. The strategies include improvement of housing conditions, taking shelter in elevated grounds, selling land, fuel and dry food storage, or diet change. The author of the paper then calls on the importance and value of integrating indigenous knowledge and adaptation strategies into climate change adaptation policies.

In January 2005, an "International workshop on community level adaptation to climate change" was organized jointly by the Bangladesh Centre for Advanced Studies (BCAS), the International Institute for Environment and Development (IIED), IUCN Bangladesh and the Regional and International Networking Group (RING). While the only documents available are the PowerPoint presentations given during the workshop, one of them focused on consultative meetings with local people, where adaptations strategies were looked at (Mahfuz, 2005).

4.1.4 Way forward

As has been mentioned throughout this report, studies on indigenous communities adaptation to climate change and their inclusion in policy processes are rather scarce. The two case studies above present a few strategies put into place by indigenous communities to cope with changing environments. It is however also recognised that climate change will have unprecedented impacts that might jeopardise the very survival of some peoples, whether located in the Arctic, on small islands or in other highly vulnerable areas. Further research into these two cases would nevertheless certainly prove useful in order to gain further

understanding of how to combine traditional and scientific knowledge, and how to translate this in decision-making processes. Additionally, mapping out indigenous communities and the most vulnerable island and coastal zones would give a sense of the priority areas to deal with.

As mentioned in the IPCC report, sea-level rise and climate change will significantly impact on communities and their social and cultural values. It is crucial that those affected, and especially the most vulnerable peoples, are integrated as active shapers of their future.

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4.2 The Tropical Forest Belt and Climate Change

4.2.1 Introduction

Significant populations of ethnically distinct indigenous peoples live in the major humid forest areas of the Amazon and Congo Basins, the islands of Borneo and New Guinea, the Guyana shield and Central America and in other humid forest areas in Asia, Africa and Latin America. Climate change creates special risks for these peoples and their interests are rarely taken into account in climate change negotiations on mitigation or adaptation options.

This section will give an overview about the impacts of climate change on the tropical forest belt and demonstrate in two different case studies from Borneo and the Congo Basin how traditional and indigenous peoples are adapting to environmental change.

4.2.2 Tropical forests and climate change

Tropical forest ecosystems around the globe, particularly the ones on which the livelihoods of people from several regions of the world depend, belong to the most vulnerable ecosystems to climate change variability and long term changes in temperature and rainfall (CIFOR, 2007). Many of these humid forest ecosystems which are occupied by indigenous peoples have seasonal climates. In many cases climate change may result in longer dry seasons. This combined with the disturbance to forest systems from industrial forestry etc will make these areas particularly prone to major forest fires. Evidence of this can already be seen in Indonesian Borneo (especially in 1983 and 1997), the northern fringe of the Congo Basin (1983) and vast areas in the Southern part of the Amazon Basin in several recent years. The intensity and extent of these fires will almost certainly increase in future years and will require major adjustments in the lives of indigenous forest dwelling peoples.

In addition to climate change variability, deforestation continues at an alarming rate across the world. From 1990 to 2005 the world lost 3% of its total forest area, an average decrease of 0.2% per year, with an estimated of around 20.000 ha per day or 7.3 million hectares per year of forest loss. From 1990 to 2005 there was a 32% increase in areas designated for conservation, meaning a total increase of 96 million hectares. Globally, more than 11% of total forest areas had been designated primarily for conservation of biological diversity (FAO, 2007).

> *Nine of the ten countries that account for more than 80% of the world's primary forest area lost at least 1% of this area from 2000 to 2005, led by Indonesia (13% of loss in just five years), Mexico (6%), Papua New Guinea (5%), and Brazil (4%) (FAO, 2007).*

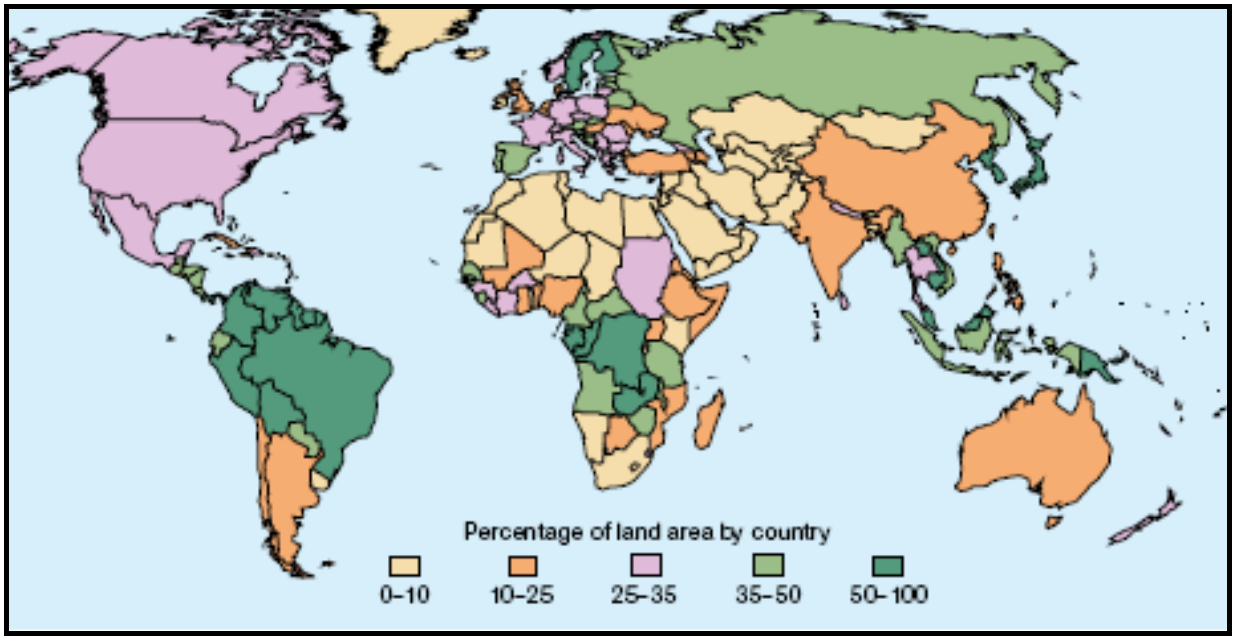

Figure 6 Forest Area, 2005 (Source: FAO, 2007)

4.2.3 Indigenous Peoples in the tropical rainforest belt

Tropical forests are the richest habitat type of the world in terms of the diversity of inhabiting peoples. Tropical forest ecosystems harbour at least 1,400 distinct indigenous and traditional peoples (Commission Européenne 1994, cited in Oviedo, Maffi & Larson, 2000), if areas under current forest cover are considered, and about 2,500 if historical coverage of tropical and subtropical moist forest ecoregions is included (Ibid.).

Indigenous peoples of the tropical rainforest belt are very dependent on the forest. Many of them are already today affected by the impacts of environmental and climate change and are struggling to adapt to the changes in the environment they live in. Most of these peoples are hunters-gatherers. (e.g. the Dayak of Borneo, the Papuans of New Guinea, Amerindians in South America, Pygmies of the Congo Basin etc). However, while it is widely assumed that hunters-gatherers still exist in a symbiotic relationship with agriculturalist groups with whom they barter and trade -for example the Punan and Kenyah in Borneo and the Baka Pygmies and Bantu in the Congo Basin, etc - today their situation is changing. Most of these hunting and gathering communities are gradually adapting their lives to an agricultural economy and are becoming increasingly semi-sedentary. It appears likely that many of them will eventually transform their way of life into agriculture and that they will become more integrated into the market economy.

The following table gives an overview over the current situation and regional distribution of present day hunter-gatherer communities across the world.

Region	Status
Africa	Almost all confined to eastern and southern Africa and the west central African rainforest. Two groups exist in client relationships with adjacent farmers. There are several groups of Pygmees in the Congo Basin.
Australia	Historically >250 distinct ethno-linguistic groups, but these are rapidly disappearing and hardly any individuals still practice classic foraging. Land rights movements have been extremely successful.

Region	Status
India	Numerous groups, poorly known due to research restrictions, but severely oppressed in many areas and traditional lands continue to be eroded by pioneer agriculture. Andaman and Nicobar island populations of gatherers have almost disappeared.
SE Asia	Poorly known, but scattered groups of inland foragers throughout the Malaysian peninsula, in the Philippines and perhaps in Laos. Nomadic fishing-peoples exist in an arc between Burma and Sulawesi (such as the Sea Nomads : Bajau people). Several Dayak groups in Borneo. The Mentawai people in Siberut island. Baduy of West Java and Kajang of South Sulawesi.
Oceania	Sago and fishing-based cultures remain largely intact in Papua, Indonesia and Papua New Guinea.
Siberia	Relatively few groups, well-studied. Some reverting to foraging in the post-Soviet era.
North America	Numerous groups in catastrophic decline from the nineteenth century and still disappearing. Larger groups now with well-established land rights advocacy. Hunting practiced within regulated frameworks.
South America	Numerous groups, not in decline and some so remote that they are still being recorded for the first time. National policies or failure to enforce regulations make their situation very precarious in some countries. Active resistance to new settlers in some areas.

Table 1 Present day hunter-gatherers (Adapted from Blench, ODI, 1999.)

4.2.4 Adaptation practices to climate change

Long before the advent of complex numerical climate models, many indigenous communities have used changes in their environments to predict fluctuations in the weather and climate. Social and communal activities such as feasting, fishing and hunting patterns were planned in response to changes in weather and climate and revolved around the different seasons. While weather and climate patterns have been documented for many years using Western scientific techniques, little attention has been paid to documenting the traditional environmental observations made by indigenous peoples (Penehuro Lefale, 2003).

In the case of indigenous peoples of the tropical forest belt, their responses to environmental change are linked with the evolution of earlier subsistence activities, with external pressures on their habitats, with cultural contact or with market and other economic pressures that prompt a desire to lead more “modern” lives. As environmental change has already affected their livelihoods in the past, in many cases indigenous peoples have developed specific coping strategies to extreme variations of weather.

Some examples of such adaptation strategies include:

a. Crop diversification in order to minimize the risk of harvest failure (many varieties of crops with differing susceptibilities to droughts, floods, pest etc. are grown). Some of these varieties are adapted to different environment/field locations (near rivers, high on mountains, close to a primary forest etc).
b. Changes of living area and a variety of movement patterns are used to deal with climatic variability.
c. Change of hunting and gathering periods to adapt to changing animal migration and fruiting periods.
d. Change of varieties and species. Livestock varieties may be changed to take account of new disease challenges.
e. Changes in food storage methods, such as drying or smoking foods according to climate variability and corresponding availability of food.

f. Changes in food habits, for example when the crops or cultivated plants are not producing good harvests, people will revert to gathering food in the forests. Or people who are close to a town might trade or barter with neighboring villages or traders/markets. Some may even become dependent on international agencies (the World Food Programme, UN agencies etc).
g. Forests as source of famine food in case of emergency.
h. Changes in environment (the habits/customs of planting crops trees may no longer be related to the phases of the moon, low/high tides etc)
i. New materials (e.g. asbestos and zinc roofing which may not be as resistant as traditional materials to changed climates, but are readily available in the market).

Climate change has critically changed the relevance of the traditional knowledge of indigenous groups. Natural signals that were used to trigger activities in the past are now less reliable. As the weather becomes hotter in the tropics, migratory birds come at a different period of the year and the rainy season comes earlier or later than usual, which can lead to a disorientation of people in their daily lives. Additionally, the need for more land to cultivate could also arise in the future due to climate change. For instance when droughts or declining soil fertility diminish crop yields, there may be a need to clear more forest areas and move to other places. Pressures on land from commercial agriculture, including biofuels, and carbon sequestration projects could also cause major land cover changes.

4.2.5 Case Study 1: Indigenous peoples in Borneo, Indonesia

Indonesia has the highest loss of forest area in SE Asia: 1.9 million hectares per year followed by Cambodia, the Philippines, Malaysia, and the Democratic People's Republic of Korea (see figure seven. Loss of forest cover is mostly caused by clearance for agriculture, mining, big plantation projects and grazing. There is an additional need for new land to compensate for loss of soil fertility, fires and drought caused by climate change. Indigenous people will need to readapt their way of life to all these changes in their environment, and possibly also to the impacts of biofuels and carbon sequestration projects.

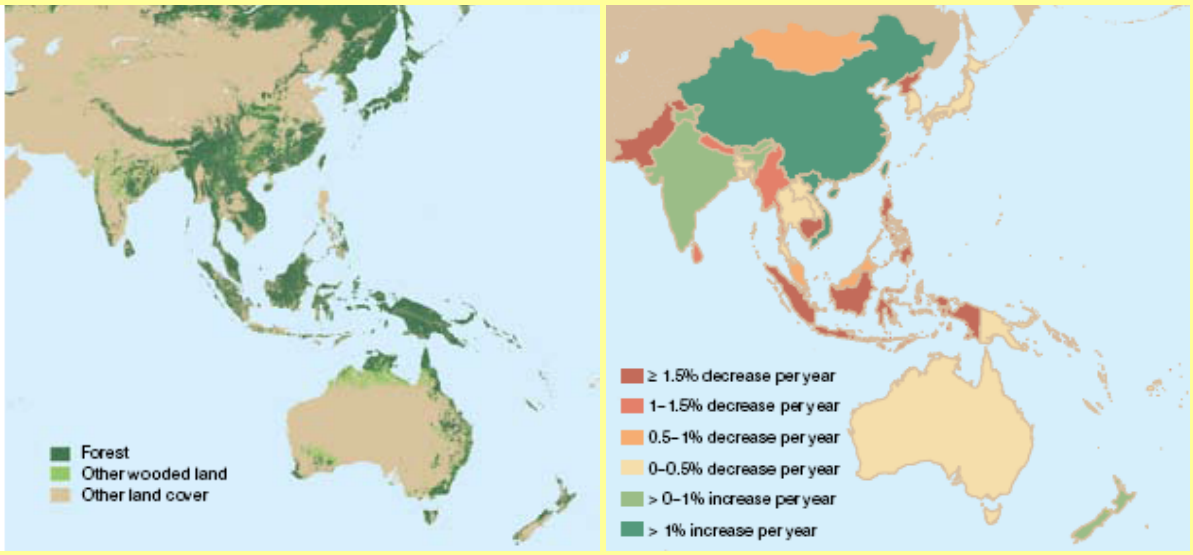

Figure 7 Extent of forest resources and forest change rate by country or area 2000 – 2005 (FAO, 2001)

The Dayak of Borneo

Changes in climate have been sensed by the Dayaks because of various indicators. They observed bird species that they had never seen before, they became aware that the level of water in the rivers is higher/lower than usual for the season and that the traditional plants used

as medicinal remedies can not be found anymore. Behaviour and migration patterns of birds have traditionally been used to guide hunting and cultivation activities but they no longer provide reliable guidance.

One of the remaining hunter-gatherer communities in East Kalimantan is the Punan people. The table below shows an example of their lunar calendar. According to the phases of the moon, they decide upon activities such as planting agricultural and tree crops, clearing cultivation areas, hunting etc. But with the changes of climate these lunar signals may no longer coincide with the favourable times for these activities and the Punan may be misled in taking their decisions (Boedhihartono, 2004).

Shape of the moon	Moon phase name	Punan interpretation
	Lihit (2 nights) : - lihit icit (small) - lihit ayo (large)	Very bad period for planting fruit trees and rice seeds (*bulan muda* : the moon is in the first phase)
	Tebengang (2 nights) : - icit - ayo	Favourable for diverse plants
	Turong (2 nights) : - icit - ayo	Very good period for hunting
	Liting (2 nights) : - icit - ayo	Good period for planting rice seeds
	Alap (2 nights) : - icit - ayo	Very good period for planting the *tuba* (the roots are used to poison fishs). Good period for planting the *pow* (the leaves are used for roofs of houses)
** 	Kuung piang (1 night)	Manioc planted on this day will be bitter
	Kuung buang (1 night)	Very good period for planting fruit trees and for hunting (animals often drink at sources of salty water)
	Kibi (1 night)	Mediocre period for planting
	Tutu beliling (1 night)	Very good period for planting fruit trees (their fruits will be large)

Shape of the moon	Moon phase name	Punan interpretation
	Alilow (1 night)	It is possible to plant
	Belong kalauw (1 night)	Very good period for planting everything
	Belat (1 night)	The best moment to plant rice seeds and banana trees
	Kibi uli (1 night)	Not a good period for planting
	Kuung buang uli (1 night)	Very good period for planting fruit trees and for hunting (animals often drink at sources of salty water)
	Kuung piang uli (1 night)	Bad for manioc (it will be bitter if planted on this day)
	Alap uli (2 nights)	Very good period for planting the tuba and the pow
	Liting uli (2 nights)	Good period for planting rice seeds
	Turong uli (2 nights)	Very good period for hunting
	Tebengang uli (2 nights)	Possibility of planting
	Lihit uli (2 nights)	Very bad period to cultivate the fruit trees and rice
	Kaun (1 night)	One extra night every two months

Table 2: Punan lunar calendar (Boedhihartono, 2004)

4.2.6 Case Study 2: Indigenous peoples in South-East Cameroon and North Congo

The area covered by forest in Africa, according to the FAO State of the World's Forest Report 2007, was estimated to cover 635 million hectares, making up about 16 percent of the world's forest area. The net annual loss in the period between 2000 and 2005 was four million hectares per year which accounts to 55 per cent of the world's total loss in forest area during that period. However, the distribution of forest cover is very uneven across the different

regions in Africa as it can be seen in the figures below. Whereas most northern African states including Morocco, Algeria, Tunisia and Egypt are gaining in area covered by forest, East and West Africa as well as central African states are loosing significant amounts of forest area. In West and Central Africa, Cameroon, the Democratic Republic of the Congo and Nigeria together account for most of the loss. The main reason for this rapid loss of forest cover can be found in wildfires which have been especially severe in Angola and in the southern Democratic Republic of Congo as well as in southern Sudan and the Central African Republic. During El Niño years these fires are particularly devastating (FAO, 2007).

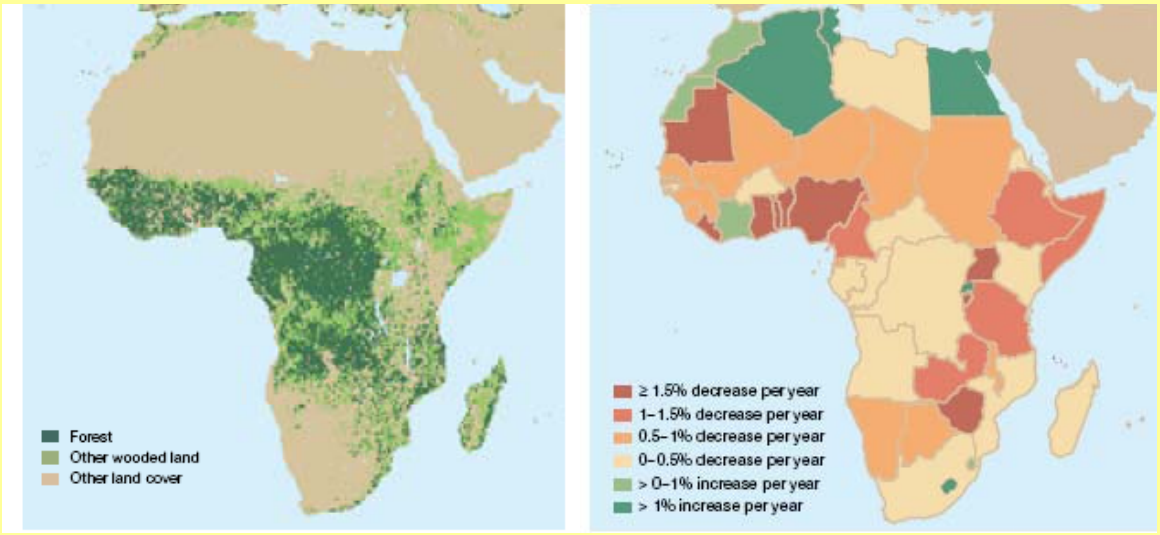

Figure 8 Extent of forest resources and forest change rate by country or area 2000 – 2005 (FAO, 2001)

The Baka Pygmies of South East Cameroon and the Bambendzele of Congo

In the forests surrounding the village of Mambele in SE Cameroon and Bomassa in N. Congo, the Baka and the Bambendzele people have had to adapt their way of life to development programmes, especially industrial logging but in addition to this now have to deal with changes in their environment. Rainfall has become less regular and harder to predict. Women who normally catch fish in barriers built in small streams in the dry season are often unable to achieve traditional fish catches as flood patterns of the rivers are changing. Fire has occurred in forest areas where it has not been observed in the past. The el Niño years of 1983, 1987 and 1997 all coincided with droughts in the forest zone and fires occurred in forests that had not previously burned in the living memory of these peoples. Crop failures occur when early or dry season rains provoke the germination of seeds, but dry periods in the traditionally wet months cause the seedlings to die.

In West Africa deforestation linked at least in part to climate change has led to outbreaks of diseases in areas where they had not earlier caused problems. In parts of the Upper Guinea savannas of Ghana and neighbouring countries meningitis outbreaks amongst rural people have been linked to climate change.

4.2.7 Current pressing issues in relation to climate change mitigation measures

Carbon trading and carbon sequestration plantations are likely to create demand for land in the humid tropics. In many cases the benefits from carbon payments may accrue to industry and bigger, richer landowners. Those who are less integrated into the market economy, whose

land rights are less clear or less easily defended in courts will rarely benefit from payments and in the worst situations they may lose their land to outsiders. In addition, avoided deforestation payments will probably flow to central or regional governments and not to forest dwelling peoples. These payments may be linked to restrictions on forest use that deny development options to indigenous peoples. Furthermore, biofuel plantations are likely to be developed on a very large scale in the humid tropics and again they will be mainly in the hands of large industrial interests still depriving indigenous peoples of their lands or pushing up the price of land. This will impact on indigenous peoples development options.

4.2.8 Way forward

There is an urgent need to help indigenous peoples living in tropical forests to prepare for different climate change scenarios. A number of specific steps are proposed:

1. Help inform and empower indigenous peoples to address climate change issues. This could be achieved by helping these groups to explore climate change scenarios, assisting them in engaging with national level climate change strategizing and planning, and in general connecting to the international and national level policy discourses on climate change.
2. Identify indigenous forest dwelling groups who are particularly susceptible to climate change threats. Provide assistance to these groups in planning and preparing to deal with climate change related risks.
3. Take measures to ensure that the interests of indigenous forest peoples are properly addressed in any negotiations on large scale carbon sequestration projects, biofuel projects or avoided deforestation projects. Ensure that any financial transfers linked to these measures flow to all legitimate beneficiaries including indigenous forest dwelling peoples.

In the short term IUCN programmes could convene workshops in each of the main humid forest regions to engage indigenous peoples' interest groups in exploring climate change scenarios and identifying risks. Such workshops could be associated with existing IUCN Forest Conservation Programme activities that already address forest peoples' issues and needs, for example in the following places:

- East Kalimantan, Indonesia with the Dayak peoples.
- West Papua, Indonesia with indigenous peoples in the areas where IUCN's Livelihoods and Landscapes programme is operating.
- SE Cameroon where IUCN is already engaged with the Baka people in its LLS programme.
- Central America where IUCN is working with a number of indigenous peoples' groups
- The SW Amazon, Acre and Rondonia where IUCN has ongoing forest conservation activities.
- The Mekong countries where IUCN is operating in a number of landscapes where indigenous populations may be at risk from climate change.

IUCN has a number of member and partner organizations who work in support of indigenous forest peoples' interestsat global, regional, national and local levels, and who have shown interest in working with IUCN on these issues.

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4.3 Drylands, climate change and indigenous and local communities

4.3.1 Introduction

The IPCC reports (IPCC 2007 a & b), the Millennium Ecosystem Assessment (e.g. MA 2006a) or the German Advisory Council on Climate Change (GACCC 2007) all state the likelihood that climate change will increase the risks of food and water stress, malnutrition, droughts and floods and generally an increase of the vulnerability of especially poor communities (IPCC 2007a, WBGU, MA 2006a). However, these reports only rarely make the link to drylands as the ecosystem that will be probably the most severely affected given the vulnerability of the people inhabiting drylands. The majority of the most vulnerable people live in drylands (MA 2006 drylands synthesis) and it is in drylands that climate change is expected to increase water shortages and malnutrition. The achievement of the Millennium Development Goals will very much depend on the sustainable management of dryland resources while promoting the adaptive capacity of the people, building on their traditional coping strategies. This chapter gives a brief overview over the projected impacts of climate change in drylands. It further discusses some of the challenges traditional communities are facing, as well as traditional coping strategies of climate variability as part of the solution. It closes with a case study on adaptation strategies.

4.3.2 The world's drylands

Drylands cover 40% of the earth's terrestrial surface and are home to over 2 billion people, the majority of whom belong to the poorest people in the world (MA 2005b). Most of the 'poorest' people living in drylands are pastoralists, hunter-gatherers and other traditional communities that can be considered as indigenous peoples according to international standards (ILO Convention No.169 Article 1).

Dryland ecosystems are characterized by the limited availability of water and consequently a relatively low primary productivity. However, it is as much the uncertainty of precipitation as the total volume that determines many features of dryland ecosystems, as well as the livelihood strategies of the people. Based on the climatic conditions drylands are divided into dry subhumid, semiarid, arid and hyperarid areas. Drylands host a unique array of biodiversity. About 32% of the global ''biodiversity hotspots'' are in drylands. At least 30% of the world's cultivated plants originate in drylands and over 40% of all cultivated lands worldwide are within drylands.

According to the Millennium Ecosystem Assessment there is medium certainty that some 10–20% of the drylands are degraded and affecting the livelihoods of millions of people. Desertification thus ranks among the greatest environmental challenges. However, at the same time it is important not to forget that drylands are very resilient ecosystems. Plant and animal species and microorganism have developed numerous coping strategies to survive the high variability of rainfall – very short life cycles to make use of periods of water availability as well as numerous strategies to escape drought (Bonkoungou and Niamir-Fuller 2001). Drylands that look deserted after a period of drought are not necessarily degraded (MA 2005b; Bonkoungou and Niami-Fuller 2001).

Similarly, people living in drylands have developed complex pastoral and cropping systems to cope with the erratic and harsh climate (Bonkoungou and Niamir-Fuller 2001).

4.3.3 The projected impact of climate change on drylands

Scientific studies on the current and projected impact of climate change in drylands are notoriously few. Although climate change will affect different regions in different ways, for drylands in general it is projected that climate change will lead to a decrease in water availability and quality while extreme weather events such as droughts and floods are projected to increase (IPCC 2007a; MA 2005a). In addition, although agricultural productivity is expected to rise in some regions, it will likely decrease overall in drylands (IPCC 2007a; MA 2005a).

> *"Agricultural production, including access to food, in many African countries and regions is projected to be severely compromised by climate variability and change. The area suitable for agriculture, the length of growing seasons and yield potential, particularly along the margins of semi-arid and arid areas, are expected to decrease. This would further adversely affect food security and exacerbate malnutrition in the continent. In some countries, yields from rain-fed agriculture could be reduced by up to 50% by 2020." (IPCC 2007a)*

Water availability in drylands is expected to decrease in the next 40 years by 10-30% while drought-affected areas will likely increase in extent and floods are expected to be more frequent (IPCC 2007a). Overall this is expected to have severe impacts on food security in drylands especially in subsistence sectors (IPCC 2007a) and will be worsened by the expected warming of lakes and rivers with effects on fish productivity.

In addition, climate change is projected to overall severely affect the health of especially vulnerable people through malnutrition, decrease in water quality, heat waves, floods, storms, fires and droughts (IPCC 2007a).

Impacts of climate change are already felt in drylands. For instance in the Sahelian region crop productivity has dropped due to warmer and drier conditions and thus a shorter growing season (IPCC 2007a). Hence, drylands and the people living in drylands appear to be one of the most affected by climate change, given the already existing water stress, land degradation and the limited capacity to adapt in these regions (IPCC 2007a; MA 2005 a[3]).

Africa

According to the IPCC report, between 75 and 250 million people in Africa are expected to be affected by increasing water scarcity . In addition, climate variability and change is predicted to adversely affect agricultural production which is likely to exacerbate malnutrition. For instance, yield from rain-fed agriculture is projected to decrease by up to 50% by 2010 (IPCC 2007a). In addition, food security will be negatively impacted by decreasing fish resources in the large lakes due to rising water temperatures. Water borne diseases are likely to increase due to the increasing risks of floods as well as the unsustainable consumption of ground water aquifers. As regards malaria, it is expected that in some cases it will increase whereas in others it will decrease. Overall, Africa is expected to be one of the most vulnerable continents to climate change, among others because of its low adaptive capacity.

Asia

IPCC projects a decrease of crop yields of up to 30% in Central and South Asia, where most of the dry areas are located. Given the rapid population growth and urbanization, developing countries in particular will face the risk of malnutrition. The likelihood of floods and droughts

[3] This statement is based on the fact that drylands people belong to the poorest people in the world, are highly dependent on climate-sensitive resources, live in areas of water-stress and have generally a low adaptive capacity.

and thus also diarrhea disease is expected to increase while freshwater availability is projected to decrease especially in large river basins (IPCC 2007a).

Australia and New Zealand

Water scarcity is expected to increase in southern and eastern Australia as well as in the northern and eastern parts of New Zealand. In addition, because of projected droughts and fires agricultural productivity and forestry is expected to decline. Even though the well-developed economies of Australia and New Zealand dispose over a comparatively high adaptive capacity and are expected to cope considerably well with future changes, the limited resilience of the natural system will constrain them.

Europe

Southern Europe as well as Central and Eastern Europe are expected to face increasing water stress and in Southern Europe the likelihood and frequency of wildfires is expected to impose further pressure on a region already vulnerable to aridity (IPCC 2007a).

Latin America

In eastern Amazonia it is expected that tropical forest will be replaced gradually by savanna ecosystems due to increases in temperature, which are likely to contribute to an increased loss of species. In the semi-arid and sub-humid areas climate change is projected to negatively affect agricultural productivity due to salinisation and degradation. Likewise the productivity of some important crops as well as of livestock is expected to decline (IPCC 2007a).

4.3.4 Indigenous Peoples, Drylands and Adaptation

Impacts on traditional people and adaptation

> *"Vulnerable regions face multiple stresses that affect their exposure and sensitivity as well as their capacity to adapt. These stresses arise from, for example, current climate hazards, poverty and unequal access to resources, food insecurity, trends in economic globalization, conflict, and incidence of disease such as HIV/AIDS".* (IPCC 2007a)

While drylands people are acknowledged to be among the most vulnerable communities due to a combination of political, economic and social factors as well as erratic rainfall (Trench et al 2007), it is these people who have an extensive knowledge about adaptation to climate variability and who have successfully managed and lived from dryland ecosystem services over centuries. Drylands are characterized not so much by a shortage of water, but by its erratic availability and a variable climate. Consequently, some argue that for instance pastoralists will be best equipped to adapt to climate change (WISP 2007) given their traditional knowledge and management systems. However, because of their political and economic marginalization, their adaptive capacities have been severely undermined and they have become in many cases more vulnerable than other communities. If adaptation and development strategies embrace the sustainable management of drylands and promote the adaptive capacity of indigenous peoples and local communities such as pastoralists, there is a potential that "pastoralism may in fact provide food resources where climate change lead to lower reliability of marginal farming" (WISP 2007).

On the one hand traditional drylands people have had to adapt constantly to a highly variable climate and thus have a vast adaptive knowledge. On the other hand, political and economic marginalization as well as other socio-economic factors eroded their adaptive capacities and made them more vulnerable. Traditional drylands people often live in remote places of a country, characterized by poor infrastructure, limited basic services and a poor government presence. In addition, privatization of land, borders and inadequate policies among others

have further marginalized drylands people and often led to an erosion of their traditional management practices.

Case study: Sudan – Community based rangeland rehabilitation

The drought-prone Bara province is situated in western Sudan and is mainly composed of desert scrub vegetation and ondulating sand dunes. The average rainfall is around 250 mm per year with significant seasonal and inter-annual rainfall variability. The land is becoming increasingly degraded as a result of recurring droughts, cultivation of marginal lands, overstocking of livestock and fuelwood gathering. Since 1992 community based rangeland rehabilitation (CBRR) for carbon sequestration measurements have been implemented in 17 villages in central Bara province. These measurements mainly consisted of the implementation of simple model community-based natural resource management to prevent overexploitation of marginal lands and rehabilitate rangelands and the diversification of local production systems to ensure sustainability of the approach as well as to improve socio-economic conditions. The outcomes of the CBRR project were very successful. Over 700 ha of rangeland were improved. Other achievements of the project included: the establishment of local institutions to coordinate community natural resource management and community development activities, regeneration and stabilization of five km of sand dunes to halt expansion of the desert, construction of windbreaks to protect farms from soil erosion, restocking of livestock by replacing goat herds with more resilient and less damaging sheep, creation of water management sub-committees to better manage wells and the preparation of a drought contingency plan. The main lesson learned was that in order to secure the long-term effectiveness of the achievements of this project it is crucial to build the capacity of the affected communities in order to enable them to cope with climate-induced stresses (IISD, 2003).

4.3.5 The way forward

> *"We know the drought will come. What is important is that we are ready when that comes so that we don't go out with a bowl in hand begging for food."* Kofi Annan, Financial Times, 6 June 2007 (quoted from Trench et al. 2007)

A good starting point to reduce the vulnerability of drylands people to climate change is to reverse their marginalization and to provide them with adequate services and support. This requires recognition of the traditional climate coping strategies of dryland people as well as of their ability to manage drylands in a sustainable way and thus maintain the resilience and protective functions of drylands against natural hazards. In addition, the resilience of dryland communities can be improved through a wide range of participatory ecosystem management and restoration activities, including modern approaches, which enable them to better cope with climate-induced stresses, as it has been demonstrated in the case study above.

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4.4 Watersheds and climate change

4.4.1 Introduction

The threats to freshwater ecosystems from climate change are immense. More than 20% of the world's 10,000 freshwater species have become extinct, threatened or endangered in recent decades (CBD, 2005). Furthermore, freshwater environments tend to have the highest proportion of species threatened with extinction (MA, 2005), and climate change threatens to alter all the rules that rivers have lived by for thousands of years. Adaptive management to climatic conditions is a necessity within all river basins. Many of the world's indigenous peoples live in isolated communities and their livelihoods depend on nature and on predicting the weather, making them vulnerable to increasingly unstable weather patterns.

4.4.2 Climate change impacts on fresh water resources and adaptation

Changes in climate could exacerbate periodic and chronic shortfalls of water, particularly in arid and semi-arid areas of the world (Watson et al., 1998). Given the limited technical, financial, and management resources in many developing countries, adjusting to shortages and/or implementing adaptation measures imposes a heavy burden on the economy. Flooding is likely to become a greater problem in many temperate and humid regions. This requires adaptation not only to droughts and chronic water shortages but also to floods and associated damages, raising concerns about dam and levee failures (Watson et al., 1998).

According to the IPCC report, there is high confidence that the impacts of climate change on freshwater systems and their management are mainly due to the observed and projected increases in temperature, sea level and precipitation variability. Specific impacts in various parts of the world are summarized in Figure nine. Seasonal changes and decreased water available from glaciers, will affect more than one sixth of the world population that live in glacier- or snowmelt-fed river basins. People living in coastal areas will be impacted by decreased availability of freshwater due to the extended salinisation of groundwater. Flood and drought risk is projected to grow as precipitation intensity and variability increases.

Many semi-arid and arid areas, such as the Mediterranean basin, western USA, southern Africa and north-eastern Brazil, will suffer a decrease of water resources due to climate change. Increasing precipitation variability coupled with the rapid increase of population and water demand will further exacerbate vulnerability of these areas

Freshwater pollution is being intensified by higher water temperatures, increased precipitation intensity and longer periods of low flows. There is a wide range of pollutants including sediments, nutrients, dissolved organic carbon, pathogens, pesticides, salt and thermal pollution. These have significant impacts on ecosystems, human health, and water system reliability and operating costs.

Water demand is expected to grow in the near future due to population growth and increases in irrigation. Climate change will aggravate the impact of this increased water demand. Unfortunately, current water management practices are not adequate to reduce the negative impact of flood risk, water supply, health, energy and ecosystems.

However, there are various approaches to reduce the potential vulnerability of water systems to climate change. Options being explored include pricing systems, water efficiency initiatives, engineering and structural improvements to water supply infrastructure, agriculture policies, and urban planning/management (Watson et al., 1998). Using traditional knowledge that has evolved over time is also an option in some cases, although the rapid onset of

changing climatic conditions means that there are often limited resources and skills in remote communities to effectively deal with increasingly frequent adverse conditions such as flooding and droughts.

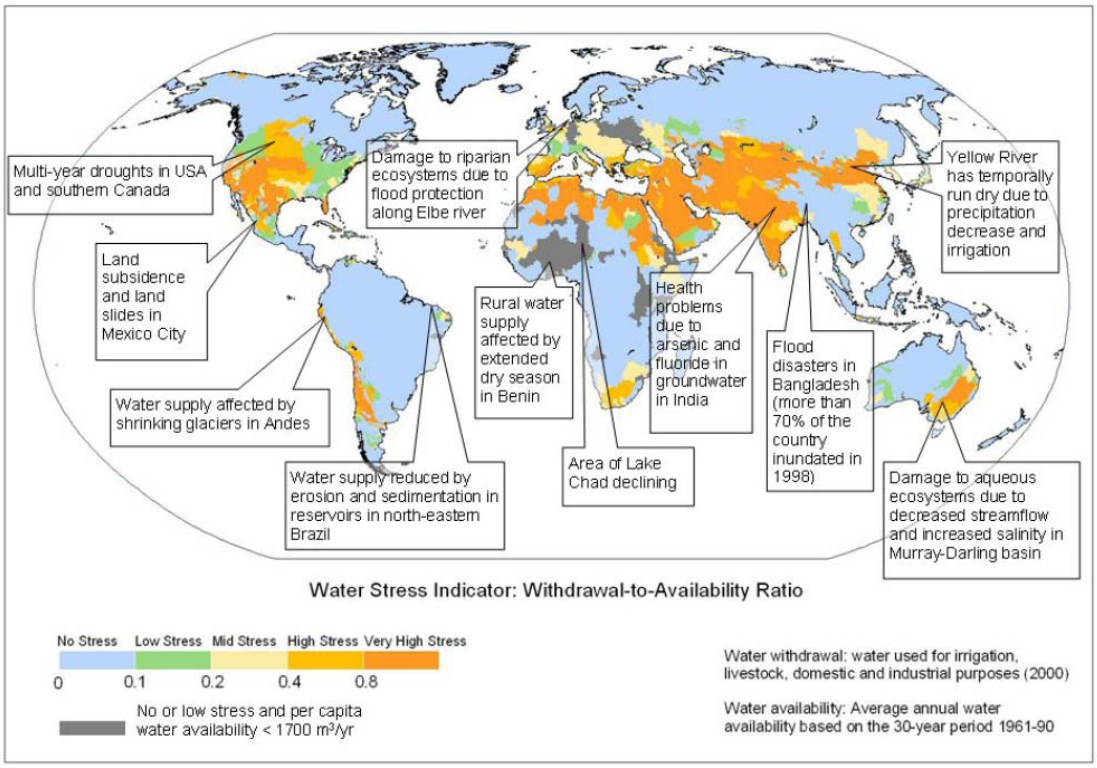

Figure 9. Examples of current vulnerabilities of freshwater resources and their management; in the background, a water stress map based on the 2005 version of WaterGAP (Alcamo et al., 2003a) – from IPCC 2007

4.4.3 Indigenous peoples in watershed areas and inland deltas - Case studies

Case Study 1: Indigenous and traditional peoples in Honduras – Using traditional techniques to protect watersheds

In the remote village of Guarita in Honduras, traditional techniques have become the starting point for climate change adaptation. The village was one of the few places in the region that successfully avoided the worst destruction from Hurricane Mitch in 1998. The traditional Quezungal farming methods that are practiced by the local villagers protected the upper catchment and only 10% of crops were lost. Traditional farming in this area involves planting crops under trees whose roots anchor the soil, pruning vegetation to provide nutrients to the soil and conserve soil water, and terracing to reduce soil erosion. On the other hand, methods that are taught at agricultural colleges and then applied to the surrounding areas are damaging as they are more suited for the plains rather than farmland in hill terrain. The traditional Quezungal method avoids widespread slash and burn techniques and also improves soil fertility. The success in the village is being actively promoted by the Government of Honduras in collaboration with the UN Food and Agricultural Organisation (FAO) (Bergkamp et al., 2003).

Case Study 2: Indigenous peoples in Nicaragua

Miskito Indians make up the majority of Nicaragua's 85,000-strong indigenous population. They live in Nicaragua's western territories and subsist on crops that are planted on a few hectares of land and food hunted from the jungle and rivers. Isolated from modern farming techniques and crippled by poverty after years of economic neglect and discrimination, the Miskito are already being severely affected by changes in climate. Floods occur in the summer followed by drought in the winter, so planting season is completely out of sync with the traditional rhythms of the Miskito culture.

Furthermore, temperatures across Central America are expected to rise by 1°C-3°C and rainfall will decrease by 25% by 2070 (Kelly, 2007). Droughts, hurricanes and unseasonal flooding are just a few of the expected consequences of such a rapidly changing climate.

During the rainy season the Rio Coco usually flows but recently the river has been extremely low. The normal mode of transportation is by boat so basic supplies such as salt and drinking water can no longer reach the villages as there is also a lack of roads in the area. In addition the low volume of water means that pollution becomes concentrated and people are more susceptible to cholera and tuberculosis.

Massive deforestation is occurring in the area, an estimated 50% of rainforest has been logged in the last 50 years, which is also believed to be a contributing factor to the deterioration of river flows in the region. There is now a ban on deforestation, but there is no effective policing resulting in commercial logging operations pushing deeper into the forest.

Oxfam have aided by installing weather monitoring stations along the banks of the Rio Coco to help Nicaragua's indigenous peoples deal with the impact that increasingly unpredictable weather patterns are having on their way of life. However, the long-term ability of the Miskitos to adapt is looking increasingly uncertain. Further efforts are needed beyond traditional knowledge and skills to adapt to the ever increasing change in climate (Kelly, 2007).

Case Study 3: Indigenous and traditional peoples in Tanzania

The decline in precipitation coupled with a local warming trend in the second half of the 20th century means that Mount Kilimanjaro's glaciers are now projected to disappear by the year 2020.

Recent studies indicate that the greatest risk of increasing temperatures and decreasing precipitation is an increased intensity of forest fires. In fact, fires have already seriously impacted the hydrological balance of the mountain's drainage basins. Continued trends in climate, fire frequencies and human impacts could result in the loss of the remaining sub-alpine forest, and Mount Kilimanjaro would lose its most effective water catchments. Hence, climate change adaptation strategies need to focus on conservation plans for the Kilimanjaro ecosystem and urgent adaptation measures in the agriculture and water sectors (PBWO/IUCN, 2007).

Cultural systems are shaped by the natural environment so are integral resources to communities and also form a basis for many of the society's beliefs, cultures and practices. Therefore, future watershed adaptation strategies need to examine the possibilities existing within the indigenous knowledge systems, community structures, institutional management agencies and other resource users for sustainable mountain and site-based resources conservation in the Kilimanjaro area (Mwangi, 2002).

Case Study 4: Experiments with traditional practices in Andra Pradesh, India

Crops in Andra Pradesh, India are usually not grown in irrigation tank areas before the tanks are half full of water, despite the fact that enough soil moisture would be available in the command areas at an earlier time. Experiments were undertaken to adapt this traditional practice to future changes in the hydrological cycle when less water may be available. Experimentation with early deep seedling and weeding in June demonstrated that under specific conditions a crop can be grown with considerably less water. This is important during dry years when not enough water is available in the tanks and reservoirs. Experiments carried out during drought conditions showed that although yields per hectare decreased, the total yield in the command areas would increase by as much as 50% (Bergkamp et al., 2002).

Case Study 5: Ancient and present use of rainwater harvesting in South Asia

Over thousands of years, people living in various geographical and climatic regions of the world have evolved diverse indigenous regimes of rainwater harvesting and management as an adaptation to climate change. In South Asia, rainwater harvesting has a history of continuous practice over 8000 years and is still used today. Rainwater harvesting was used as the glaciers retreated and climate fluctuated around 9,600 BC. This adaptation method has been pivotal to the mergence and diversification of food production. Construction of early rainwater harvesting systems required simple scooping of the earth and putting up embankments or erecting elongated soil heaps along farm boundaries. But the benefits of such innovations for early farmers may have been substantial.

The earliest examples of rainwater systems in India include the havelis of Jabalpur, bandh and bandhulia of Satna, virda of Gujarat, khadins of Rajasthan, ahar-pynes of Bihar, eri of Tamil Nadu, dhora of Aravalis and there are similar other earthworks throughout the country. These earthworks can still be seen today and provide useful insight into the dynamics of rainwater harvesting and climate relationship in diverse geographic regions across India.

Rainwater harvesting is still used in India today, even more so in response to recent climate extremes. This demonstrates the resilience of human society to absorb shock, learn and build on historical adaptive processes (Pandey et al., 2003).

4.4.4 Way forward

Some countries and regions are in the process of developing adaptation procedures and risk management practices in the water sector (e.g. Caribbean, Canada, Australia, Netherlands, UK, USA, Germany). Some adaptation strategies in these areas have been put into practice with varied degrees of success. However, the global problem of climate change is difficult to describe and understand on a local scale especially in communities that are struggling with daily survival. Specific use of traditional and indigenous adaptation practices to climate variability combined with scientific knowledge is a possible way forward to develop and implement strategies.

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4.5 Conclusion

The case studies in the previous sections demonstrate that indigenous and traditional peoples are going to be particularly burdened by the costs of climate change impacts and show evidence that the dangers of climate change are already threatening traditional cultures. The degree of vulnerability varies from one group to another and can be unevenly distributed across and within communities. Women are expected to be particularly affected by the effects of global warming as a result of their disproportionate involvement in reproductive work, their frequently insecure property rights and access to resources, as well as of their reduced mobility due to caring for children and the elderly in situations of stress.

The case studies above further reveal that there is already a long record of adaptations to climate variability practiced by indigenous peoples which may ultimately enhance their resilience. Examples of such traditional and innovative adaptation practices include: shoreline reinforcement, improved building technologies, increased water quality testing, rainwater harvesting, supplementary irrigation, traditional farming techniques to protect watersheds, changing hunting and gathering periods and habits, crop and livelihood diversification, use of new materials, seasonal climate forecasting, community-based disaster risk reduction and so on.

The capacity to adapt to climate change can be asymmetrically distributed within a community (depending on age, social status or sex) and may change over time. Adaptive capacity depends on a range of factors, some of which coincide with the determining factors of vulnerability described in chapter two of this report. The determinants of adaptive capacity include: social capital, social networks, values, perceptions, customs, traditions, and levels of cognition. Additionally, the capacity to adapt is also affected by external factors including violent conflicts or the spread of infectious diseases (IPCC, 2007b).

However, even if the capacity to adapt is given within a society, successful adaptation may not occur. Research has shown that in some cases societies are reluctant to adapt even though they would actually possess the capability to adapt. There are significant issues which hinder adaptation including poverty, policies, lack of resources, financial or technological limits. In the case of indigenous and traditional peoples, social and cultural barriers, insecurity of rights and loss of traditional knowledge may hold back adaptation (IPCC, 2007b).

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5 Synthesis

Many case studies in the previous chapters prove that climate change is having already or is expected to have serious impacts on traditional and indigenous peoples. Over the past, these communities around the world have adapted their livelihoods to a wide variety of disturbances caused by environmental variability and change, in order to survive, and there is a wide range of case studies documenting these efforts. Furthermore, there is evidence that these adaptation practices do have the potential to alleviate adverse impacts and to capitalise on new opportunities brought about by climate change. However, further research and investigations are needed to explore whether the adaptive capacity of traditional and indigenous peoples will be sufficient to cope with the predicted future hazard level, which is expected to be significantly higher than the level of hazards experienced until now. Hence, it is essential to further explore culturally appropriate ways to enhance the resilience of traditional and indigenous peoples and to reduce factors which are hindering adaptation.

Furthermore, even though there is much evidence suggesting that indigenous and traditional communities are going to be disproportionately affected by the impacts of climate change and that they could provide valuable input towards identifying measures for climate change adaptation and mitigation, indigenous peoples remain hardly recognized in climate change policies and mechanisms, internationally and nationally, and their own potential to adapt is still barely understood and supported. Given the fact that many traditional and indigenous peoples live in areas of elevated risk, as it has been showed in chapter three, it is advisable that these peoples across the world are being included in the international, regional and local climate change discourse, and that an increasing focus on investigating, documenting and disseminating traditional adaptation strategies to climate change is adopted.

IUCN, as the world's largest and most important conservation network, is in an advantageous position to press forward the issues mentioned above. By doing so, IUCN will significantly contribute to the conservation of the world's cultural and biological diversity. Losing indigenous and traditional cultures and their traditional knowledge, which is highly relevant for the conservation of biological diversity, and the ecosystems they dwell in, would be a major loss for humanity. Hence, supporting traditional and indigenous peoples in adaptation and mitigation processes will not only enhance their resilience to climate change, but at the same time also help preserve the world's culturally and biologically most diverse areas, which largely corresponds with IUCN's mission *to influence, encourage and assist societies throughout the world to conserve the integrity and diversity of nature and to ensure that any use of natural resources is equitable and ecologically sustainable.*

The following sections provide recommendations for policy formulation and implementation, as well as for further research to improve understanding of the impacts of climate change on ethno-cultural diversity and to build capacity to enhance resilience of indigenous and traditional peoples to climate change.

Policy formulation

- Promote **land tenure and access rights** as well as **access rights to natural resources** of indigenous and traditional peoples, including in the context of mitigation and adaptation measures such as biofuels plantations or carbon offset projects
- Promote **entitlement to power** and **self determination**

- Include indigenous peoples within **negotiations on climate change** of governments and international organisations
- Facilitate **access to (scientific) information** and **technology**
- **Recognize** indigenous and traditional peoples' own **coping strategies** to adapt
- **Incorporate indigenous knowledge and perceptions** into the climate change policy
- Enable indigenous peoples to **participate** and **actively take part in decision-making** within climate change policy making at regional, national and local level in terms of mitigation and adaptation
- Support **the protection of natural resources** including habitats, species and culturally important resources
- Support countries in the process of developing **National Adaptation Programmes of Action** (NAPAs) and ensure the integration of indigenous and traditional knowledge
- Address specific **risk management strategies** in areas where traditional and indigenous peoples live and where projected hazards will have the most serious impacts
- Take into account the **implications of emission reduction initiatives** under international mechanisms, such as the Clean Development Mechanism, on indigenous and traditional peoples cultures and livelihoods
- Promote the inclusion of indigenous knowledge systems in **climate impact and vulnerability assessments**
- **Explore carbon offset strategies** that indigenous peoples practice and for which they should be rewarded through payments and other means.

Policy implementation

- Promote innovative, culturally appropriate **technology transfer**
- Improve the overall situation of indigenous peoples: p**overty alleviation**, **health care services** and **food security**
- Improve social and physical **infrastructure**
- Maintain or enhance **livelihood diversification**
- **Conservation of biodiversity** (including agro-biodiversity) in order to increase resilience of traditional and indigenous peoples and to enhance their capacity to adapt
- Support a **network of indigenous peoples** enabling them to share their knowledge and lessons learned
- Develop and implement **risk management strategies** including early warning systems or evacuation strategies

- Make full use **of the agenda of the World Conservation Congress in 2008** to advance the discussion of the topic of 'Indigenous and Traditional Peoples and climate change', with specific attention to issues including disparities and vulnerability of impact, mitigation, adaptation, poverty, social and cultural impact, and other climate change related issues and invite indigenous peoples to the WCC
- **Implement recommendations from climate impact and vulnerability assessments** which take into account indigenous knowledge systems, culture, social values, spirituality and ecosystems; as well as the full and equal participation of indigenous peoples in all aspects and stages of the assessment
- **Capacity building** and **empowerment** of indigenous peoples to deal with climate change
- **Promote indigenous practices** including sustainable water use system, traditional coastal management or erosion control etc. for adaptation and mitigation
- **Create awareness on traditional adaptation and mitigation strategies** and **expand knowledge** on these practices

Further research

- **Identify indigenous peoples living in the most vulnerable areas** to climate change
- **Improve knowledge** on the **impacts of climate change** on vulnerable cultures
- **Monitor climate change impacts** on ecosystems on which indigenous and traditional peoples' livelihoods depend
- **Collect** and **analyse** information on **past and current practical adaptation actions and measures**
- Establish networks of **conjoined research and action** between indigenous peoples and scientists
- Investigate how to best **triangulate scientific and indigenous knowledge** in the development process of adaptation and mitigation strategies to climate change
- Monitor the **implications of mitigation efforts** under international mechanisms, such as the Clean Development Mechanism, on indigenous and traditional peoples
- **Monitor progress on traditional and non-traditional adaptation** and assess the direct and ancillary effects of such measures
- **Investigate** the **synergies and trade-offs** between various traditional and non-traditional adaptation measures, and between adaptation and other development priorities
- **Explore economic and social costs and benefits** of adaptation measures

- Explore options to advance approaches to **Reduced Emissions from Deforestation in Developing countries (REDD)** that foresee benefit sharing with traditional and indigenous peoples in a way that is culturally appropriate.

ANNEX I: Definition of key terms

Climate change in IPCC usage refers to any change in climate over time, whether due to natural variability or as a result of human activity. This usage differs from that in the Framework Convention on Climate Change, where *climate change* refers to a change of climate that is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and that is in addition to natural climate variability observed over comparable time periods (IPCC).

Adaptive capacity is the ability of a system to adjust to climate change (including climate variability and extremes) to moderate potential damages, to take advantage of opportunities, or to cope with the consequences (IPCC).

Vulnerability is the degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and extremes. Vulnerability is a function of the character, magnitude, and rate of climate change and variation to which a system is exposed, its sensitivity, and its adaptive capacity (IPCC).

Indigenous, tribal and traditional peoples. IUCN uses the "statement of coverage" in Art. 1 of the International Labour Organization's Convention 169 on Indigenous and Tribal Peoples in Independent Countries (I.L.O. 169), which states that the Convention applies to:

(a) Tribal peoples in independent countries whose social, cultural and economic conditions distinguish them from other sections of the national community, and whose status is regulated wholly or partially by their own customs or traditions or by special laws or regulations;

(b) Peoples in independent countries who are regarded as indigenous on account of their descent from the populations which inhabited the country, or a geographical region to which the country belongs, at the time of conquest or colonisation or the establishment of present State boundaries and who, irrespective of their legal status, retain some or all of their own social, economic, cultural and political institutions.

In the context of its conservation activities, IUCN applies its indigenous peoples policies also to "traditional peoples", defined in the sense of the Convention on Biological Diversity (CBD): "communities embodying traditional lifestyles relevant for the conservation and sustainable use of biological diversity".

ANNEX II: The Emission Scenarios of the IPCC Special Report on Emission Scenarios (SRES)

A1. The A1 storyline and scenario family describes a future world of very rapid economic growth, global population that peaks in mid-century and declines thereafter, and the rapid introduction of new and more efficient technologies. Major underlying themes are convergence among regions, capacity building and increased cultural and social interactions, with a substantial reduction in regional differences in per capita income. The A1 scenario family develops into three groups that describe alternative directions of technological change in the energy system. The three A1 groups are distinguished by their technological emphasis: fossil-intensive (A1FI), non-fossil energy sources (A1T) or a balance across all sources (A1B) (where balanced is defined as not relying too heavily on one particular energy source, on the assumption that similar improvement rates apply to all energy supply and end use technologies).

A2. The A2 storyline and scenario family describes a very heterogeneous world. The underlying theme is self-reliance and preservation of local identities. Fertility patterns across regions converge very slowly, which results in continuously increasing population. Economic development is primarily regionally oriented and per capita economic growth and technological change more fragmented and slower than other storylines.

B1. The B1 storyline and scenario family describes a convergent world with the same global population, that peaks in mid-century and declines thereafter, as in the A1 storyline, but with rapid change in economic structures toward a service and information economy, with reductions in material intensity and the introduction of clean and resource-efficient technologies. The emphasis is on global solutions to economic, social and environmental sustainability, including improved equity, but without additional climate initiatives.

B2. The B2 storyline and scenario family describes a world in which the emphasis is on local solutions to economic, social and environmental sustainability. It is a world with continuously increasing global population, at a rate lower than A2, intermediate levels of economic development, and less rapid and more diverse technological change than in the B1 and A1 storylines. While the scenario is also oriented towards environmental protection and social equity, it focuses on local and regional levels.

An illustrative scenario was chosen for each of the six scenario groups A1B, A1FI, A1T, A2, B1 and B2. All should be considered equally sound.

The SRES scenarios do not include additional climate initiatives, which means that no scenarios are included that explicitly assume implementation of the United Nations Framework Convention on Climate Change or the emissions targets of the Kyoto Protocol.

Source:

IPCC, 2007. A summary report for policy makers in: Climate Change 2007: The Scientific Basis. Working Group I. Contribution to the Intergovernmental Panel on Climate Change Fourth Assessment Report. Cambridge University Press, Cambridge.