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Indigenous Peoples and Climate Change in the African Region: Traditional Knowledge and Adaptation Strategies

Technical Report

Presented to the World Bank, Trust Fund for Environmentally and Socially Development, by:

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For Human Rights & Empowerment of Marginalized Pastoralist Communities

THE RAINFOREST FOUNDATION UK

SECURING LANDS, SUSTAINING LIVES

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List of abbreviations

ACHPR	African Commission on Human and Peoples Rights
ADPPA	Association de défense et de promotion des Peuples Autochtones
AFD	French Development Agency
ASAL	Arid and semi-arid land
CKDN	Climate and Development Knowledge Network
CDM	Clean Development Mechanism
CFA	Communaute Financiere Africaine
DFID	Department for International Development (DFID)
ENSO	El Niño/Southern Oscillation
EU	European Union
FAO	Food and Agriculture Organization
FGDH	Forum pour la Gouvernance et les Droits de l'Homme
FLEGT	Forest, Law Enforcement, Governance and Trade
FoLT	Friends of Lake Turkana
GCM	Global climate models
GDP	Gross Domestic Product
GHG	Greenhouse gas
GNI	Gross National Income
HIPC	Heavily Indebted Poor Countries
IIPFCC	International Indigenous Peoples Forum on Climate Change
IMF	International Monetary Fund's
INS	Indigenous Natural Products
IPCC	Intergovernmental Panel on Climate Change
JJA	June-July-August
KMD	Kenya Meteorological Department
LAC	Legal Assistance Centre
MDG	Millennium Development Goals
MOLSS	Ministry of Labour and Social Security
MPIDO	Mainyoito Pastoralist Integrated Development Organization
NCCRS	National Climate Change Response Strategy
NTFP	Non-Timber Forest Products
OCDH	Observatoire Congolais des Droits de l'Homme
OVC	Orphans and vulnerable children
PPA	Participatory Poverty Assessments
RCM	Regional climate models
REDD	Reducing Emissions from Deforestation and forest Degradation
RFUK	Rainforest Foundation UK
RPP	Readiness Preparation Plan
SAEIA	Southern African Institute for Environmental Assessment
SLR	Sea-level rise
SME	Small and Medium-sized Enterprises
SON	September, October, November
TAA	Traditional Authorities Act
ToR	Terms of Reference

TFESSD	Trust Fund for Environmentally and Socially Sustainable Development
UNDP	United Nations Development Program
UNDRIP	United Nations Declaration on the Rights of Indigenous Peoples
UNEP	United Nations Environmental Program
UNFCCC	United Nations Framework Convention on Climate Change
VPA	Voluntary Partnership Agreement
WFP	World Food Program
WDR	World Development Report

Introduction

This Technical Report is elaborated as a key output under the regional research project on Indigenous Peoples and Climate Change: Traditional Knowledge and Adaptation Strategies, funded by the World Bank Trust Fund for Environmentally and Socially Sustainable Development (TFESSD).

The Report presents the findings of a comprehensive literature review, which aims to explore and present the existing expertise on indigenous peoples and climate change in the African region, with emphasis on the three ecological sub-regions, where further field research will be undertaken. These are:

- Tropical forest zone of the Congo Basin /case studies to be undertaken in the Republic of Congo (Congo Brazzaville);
- Arid/desert areas in Southern Africa (case studies to be undertaken in Namibia), and;
- Lakes and wetlands in Eastern Africa (case studies to be undertaken in Kenya)

The report has been compiled by Charapa Consult, Legal Assistance Centre (LAC), Mainyoito Pastoralist Integrated Organization (MPIDO) and Rainforest Foundation UK (RFUK).

LAC, MPIDO and RFUK will undertake the ensuing field research in Namibia, Kenya and the Republic of Congo (Brazzaville), respectively.

In accordance with the ToR, the review is based on available existing bibliographical data and knowledge concerning:

- Climate change impacts (historical and projective) on indigenous peoples (e.g. the Special Report on Emissions Scenarios from the Intergovernmental Panel on Climate Change - IPCC), and;
- Adaptation strategies and traditional knowledge of indigenous peoples, particularly regarding their land and natural resource use.

For each of the ecological sub-regions, the following types of data have been explored:

- Meteorological data
- Agricultural data (e.g. crop production, livestock raising, agro-forestry)
- Socio-economic and poverty data
- Anthropological studies

The compilation of data will be continued throughout the posterior case study research, where it is expected that additional reports, maps, administrative registers etc. will be locally available.

Based on the key climate change phenomena identified for the respective ecological sub-regions, a limited number of key first order climate change impacts[1] are selected for each ecological sub-region. The fieldwork will subsequently focus on these key impacts when assessing local perceptions and adaptation strategies, including the use of traditional knowledge and new technological information.

The report is structured as follows:

Section 1 provides an overview of climate change, impacts and projections of relevance to indigenous peoples at the regional level. The section concludes with a description of selected case study sites and first order climate change impacts, to be further explored through the case studiess.

Section 2 presents the findings from a thorough literature review of climate change impact and indigenous peoples for the Republic of Congo, while Section 3 and 4 doe the same for Kenya and Namibia, respectively.

1. Regional climate change impacts on Indigenous Peoples

1.1. Regional climate change phenomena

1.1.1. Trends and vulnerability

In its Fourth Assessment Report (2007), the Intergovernmental Panel on Climate Change (IPCC) strongly stressed the vulnerability of Africa, giving these general predictions for the future impacts of climate change on the continent:

"Africa is one of the most vulnerable continents to climate change and climate variability, a situation aggravated by the interaction of 'multiple stresses', occurring at various levels, and low adaptive capacity (high confidence)" (Boko et al 2007, p. 435).

IPCC summarizes that Africa's "agricultural production and food security (including access to food) in many African countries and regions are likely to be severely compromised by climate change and climate variability (high confidence)… climate change will be likely to reduce the length of growing season as well as force large regions of marginal agriculture out of production. Projected reductions in yield in some countries could be as much as 50% by 2020, and crop net revenues could fall by as much as 90% by 2100, with small-scale farmers being the most affected… some countries that currently do not experience water stress will become at risk of water stress (very high confidence)" (Boko et al 2007, p. 435).

IPCC further states that the African continent is very vulnerable to climate change and climate variability due to endemic poverty, weak institutions, and complex disasters and conflicts. Drought has spread and intensified since the 1970s, and the Sahel and southern Africa have already become drier during the 20th century. Water supplies and agricultural production will likely be severely compromised. Forests, grasslands and other natural ecosystems are already changing, particularly in southern Africa. By the 2080s, the amounts of arid and semi-arid land

[1] "First order climate change impacts" refers to the immediate physical impacts of climate change; for example, in the case of sea-level rise, two first order impacts might include coastal erosion and salinization of soils and groundwater supplies. Social impacts are typically second and third order impacts, based on an impact on the biophysical environment.

in Africa will likely increase by 5-8 per cent (Boko et al 2007, p. 435 drawing on Christensen et al 2007). This is further documented by Williams and Kniveton (2011)

In a global estimate per continent and region, the World Bank (2008) and Müller et al (2009) find that Sub-Saharan Africa and South Asia stand to lose the highest agricultural yield by 2050, given current agricultural varieties and practices (World Development Report, WDR, 2010 p.145).

Williams and Kniveton (2011) argue that, despite the particularly high vulnerability of Africa to climate change and variability, there still remain large knowledge gaps on the manifestations of future climate change and variability for the region and the associated negative impacts of climate change. They point to two main reasons – lack of reliable data and lack of scientific climate expertise and cite Washington et al (2004, 2006) for Africa having the worst climate observing system of any continent.

1.1.1. Intensity, variability and seasonality

The regional climate projections from the 2007 IPCC Climate Change Working Group I: *The Physical Science Basis* still presents the most comprehensive projections available. For Africa, the Working Group finds that: "smaller values of projected warming, near 3°C, are found in equatorial and coastal areas and larger values, above 4°C, in the Western Sahara" when comparing the means of the following two periods: 1980 to 1999 and 2080 to 2099. Christensen et al (2007, p. 871) indicate that the largest temperature responses in North Africa are projected to occur in June-July-August (JJA), while the largest responses in southern Africa occur in September, October and November (SON). But the seasonal structure in the temperature response over Africa is modest as compared to extra-tropical regions. The basic pattern of projected warming has been robust to changes in models since the IPCC 2001 assessment (known as the TAR), as indicated by comparison with Hulme et al. (2001). To date there is insufficient evidence from regional climate models (RCMs) to modify the large-scale, temperature projections from global climate models (GCMs).

In short, the climate of Africa is warmer than it was 100 years ago and model-based predictions of future greenhouse gas (GHG) induced climate change for the continent clearly suggest that this warming will continue and, in most scenarios, accelerate (Hulme et al., 2001; Christensen et al., 2007). Observational records show that during the 20th century, the continent of Africa has been warming at a rate of about 0.05°C per decade with slightly larger warming in the June–November seasons than in December–May (Hulme et al., 2001).

According to UNFCCC, climate change is an adjustment of climate, which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is, in addition to natural variability, observed over comparable time scales. Climate variability refers to the variations in the mean state and other statistics of the climate on all temporal and spatial scales beyond that of individual weather events. Therefore, climate variability is the departure from normal or the difference in magnitude between climatic occurrences.

By 2000, the five warmest years in Africa had all occurred since 1988, with 1988 and 1995 being the two warmest years. This rate of warming is not dissimilar to that experienced

globally, and the periods of most rapid warming—the 1910s to 1930s and the post-1970s—occurred simultaneously in Africa and the rest of the world (IPCC, 2001).

The projections for rainfall are less uniform. Hulme et al. (2001) illustrate the large regional differences that exist in rainfall variability. East Africa appears to have a relatively stable rainfall regime, although there is some evidence of long-term wetting. Similarly, there is likely to be an increase in annual mean precipitation in East Africa (Christensen et al., 2007). The IPCC (2007 (a)) reports increased inter-annual variability in rainfall across southern Africa since 1970, with higher rainfall anomalies and more intense and widespread droughts. Frequency and intensity of extreme hydrological events in the southern African region has increased markedly (Warburton & Schulze 2005)

As IPCC finds in 2007 "Climate variability and change could result in low-lying lands being inundated, with resultant impacts on coastal settlements (high confidence). Climate variability and change, coupled with human-induced changes, may also affect ecosystems e.g., mangroves and coral reefs, with additional consequences for fisheries and tourism." (Boko et al, IPCC 2007, p. 435). Warburton and Schulze (2005a) compare the 1950 - 1969 and 1980 - 1999 timing of the 3 months of highest accumulated winter streamflows and show that, inter alia, Namibia's Orange River primary catchment (in South Africa) displays a shift to 2 months later in the latter period.

1.1.2. Predictability

One of the most challenging issues for rural citizens is the increasing lack of predictability. Meteorologists prefer good weather data dating 100+ years back and with various climate models in order to predict for very large areas over a very large time-span. The smaller the area and the shorter the timeframe, the less predictable forecast. Even at regional scale, the possible impacts of increasing temperatures, rainfall variability, changes in mean rainfall and hydrological processes are most uncertain.

While climate models agree on increased drought for Africa in the 21st century, there is no robust agreement in their predictions of rainfall (Giannini et al 2008). Actually, an interesting and alarming finding from the IPCC 2007 report on Africa is that there is no agreement between the models – as both increases and decreases in rainfall is projected (Giannini, 2010). It is evident that present and future predictability of climate change is not the same everywhere, and that gaps in knowledge of basic climatology are revealed by a lack of agreement between climate models in some regions (Wilby, 2007). While there is now higher confidence in projected patterns of warming and sea-level rise, there is less confidence in projections of the numbers of tropical storms and of regional patterns of rainfall over large areas of Africa (Thornton et al., 2008).

Predicting the nature of climate change in individual countries and locations is notoriously difficult. In fact, increasing unpredictability of rainfall, drought and flooding patterns seems to be a key characteristic of climatic change on the continent (Brown & Crawford 2009). Several studies have furthermore pointed out that different regions will be differently affected, with some areas experiencing increasing overall rainfall, and others less (Stern 2006).

Increasing levels of uncertainty makes decision-making more difficult – at all levels of administration. This is the major challenge of planning of future adaptation and development –

which scenarios to adapt to? As the following section on adaptation and indigenous peoples' knowledge will demonstrate, Unforeseen impacts and lack of predictability have severe impacts; not only for immediately evident consequences such as food security, access to water, grazing land etc. but also for social structures, trust, authority and social and cultural cohesion.

1.1.3. Impacts

The World Bank estimates that 70% of the population of Sub-Saharan Africa is employed in the agriculture sector, which in turn constitutes 30% of the region's Gross Domestic Product (GDP). This makes the region particularly sensitive to environmental variability. In this sense, the apparition of this new challenge, costly in terms of resources, is added to those that the countries in Africa face already (World Bank 2001).

Climate change has a multiplier effect on risks, and due to its potentially disastrous effects and its scope, it fundamentally alters the socioeconomic environment of developing countries. As such, it has become a potential source of economic and social stagnation and regression (Nkodia oct 2011).

Although climate change is affecting all countries of the world, a major impact of climate change in sub-Saharan Africa is its adverse effects upon the natural resource base (Kurukulasuriya and Mendelson, 2006) and countries in this region of Africa are expected to be hit earliest and hardest (IPCC, 2007) because their environments are closely linked with climate, and the livelihoods of its inhabitants are largely dependent on the utilization of land-based resources (soils and forests) as well as on freshwater, lacustrine and riverine systems as sources of potable water, fish and transport.

As a result of this dependency and widespread poverty, the communities in sub-Saharan Africa are particularly vulnerable to the effects and impacts of climate change and are likely to be adversely affected in terms of food security, sustainable water supply and by extreme climate and severe weather phenomena such as floods, droughts and threats of desertification. In addition, these impacts are likely to be exacerbated by the lack of financial and technical means with which to reduce their vulnerability to global climate change.

These effects include the use of water resources of poor quality, abandonment of the rural economy, displacement of populations and infrastructures, and the spread of epidemics.
Therefore, adaptation is not an option for Africa, but a necessity. The challenge lies in the fact that Africa's adaptive capacity is low due to the extreme poverty of many of its people, compounded by frequent natural disasters such as droughts and floods, and poor institutional and infrastructural support (Opere et al, 2011).

Differential responses to climate change by species in ecosystems may lead to disruption of important functional interactions, with potentially highly serious consequences for the provision of ecosystem services such as pest control, pollination, seed dispersal, decomposition and soil nutrient cycling. In addition to the effects on natural ecosystems, these could have socio-economic consequences for agriculture. Certain ecosystem types will be particularly vulnerable: ecotones (transition areas between different ecosystems, with high species and genetic diversity), which are important for adapting to climate change are highly threatened by climate change especially in semi-arid drylands prone to desertification. These are amongst the

so called biodiversity ‘hotspots’. Hotspots are areas where species diversity and endemism are particularly high and where there is an extraordinary threat of loss of species or habitat, the most vulnerable are the woodlands and savannas. There are 25 internationally recognized hotspots; six of them are in Africa (Mittermeier et al., 1999).

Desertification in Africa is strongly linked to poverty, migration and food security, since people living in poverty have little choice but to overexploit the land. Currently two thirds of the continent is desert or dry land, a situation that is going to be aggravated by climate change (FAO, 2003). Due to the social and economic importance of natural resources in many African countries, combating desertification and promoting development are virtually one and the same thing.

Agriculture represents 30% of Africa’s Gross Domestic Product (GDP) and climate change threatens this economy because agriculture in Africa is climate-dependent (Mendelsohn, 2000).

The African agricultural sector relies heavily on direct rainfall, and patterns in economic growth closely follow precipitation patterns. For example, maize, sorghum, millet and groundnut yields have a strong association with the year to year variability of ENSO (El Niño/Southern Oscillation) in Africa. If global climate change moves more towards El Niño-like conditions, crop production will decline and in southern Africa productivity is expected to drop by 20–50% in extreme El Niño years (UN, 2008). Staple crops such as wheat and corn that are associated with subtropical latitudes may suffer a drop in yield as a result of increased temperature, and rice may disappear because of higher temperatures in the tropics (Odingo, 1990). In addition to climate change effects, food production in sub-Saharan Africa has not kept pace with the growing population.

There are five main climate change related drivers in the agriculture sector: temperature, precipitation, sea level rise, atmospheric carbon dioxid content and incidence of extreme events.

These may affect the agriculture sector in the following ways:

- Reduction in crop yields and agriculture productivity: There is growing evidence that in the tropics and subtropics, where crops have reached their maximum tolerance, crop yields are likely to decrease due to an increase in the temperature.
- Increased incidence of pest attacks: An increase in temperature is also likely to be conducive for a proliferation of pests that are detrimental to crop production.
- Limit the availability of water: It is expected that the availability of water in most parts of Africa would decrease as a result of climate change. In particular, there will be a severe down trend in the rainfall in southern African countries.
- Exacerbation of drought periods: An increase in temperature and a change in the climate throughout the continent are predicted to cause recurrent droughts in most of the regions.
- Reduction in soil fertility: An increase in temperature is likely to reduce soil moisture, moisture storage capacity and the quality of the soil, which are vital nutrient sources for agricultural crops.
- Low livestock productivity and high production cost: Climate change will affect livestock productivity directly by influencing the balance between heat dissipation and heat production and indirectly through its effect on the availability of feed and fodder.

- Availability of human resource: Climate change is likely to cause the manifestation of vector and vector born diseases, where an increase in temperature and humidity will create ideal conditions for malaria, sleeping sickness and other infectious diseases that will directly affect the availability of human labour in the agriculture sector.
  (Opere et al. 2011)

Africa's social and economic development is constrained by climate variability and change, habitat loss, over-harvesting of selected species, the spread of alien species, and activities such as hunting and deforestation.

Box 1. Highlights of the projected impacts of climate change on the African region
• **Freshwater.** By 2020, scientists predict that 90 million to 220 million people would be exposed to increased water stress due to climate change. This magnifies water woes in a region already dealing with water-related problems. • **Food.** Yields from rain-fed agriculture could drop by up to half by 2020. Agricultural production, including access to food, in many African countries and regions is projected to be severely affected by climate variability and change. The area of land suitable for agriculture, length of growing seasons and yield potential are expected to shrink-- particularly along the margins of semi-arid and arid areas. Food security would be adversely affected, and malnutrition exacerbated. By the 2080s, a significant decrease in suitable rain-fed land extent and production potential for cereals is estimated under climate change. Furthermore, for the same projections, for the same time horizon the area of arid and semi-arid land in Africa could increase by 5-8% (60-90 million hectares). The study shows that wheat production is likely to disappear from Africa by the 2080s. In some countries, additional risks that could be exacerbated by climate change include greater erosion, deficiencies in yields from rain-fed agriculture of up to 50% during the 2000-2020 period, and reductions in crop growth period. A recent study on South African agricultural impacts, based on three scenarios, indicates that crop net revenues will be likely to fall by as much as 90% by 2100, with small-scale farmers being the most severely affected. However, there is the possibility that adaptation could reduce these negative effects. In Egypt, for example, climate change could decrease national production of many crops (ranging from –11% for rice to –28% for soybeans) by 2050 compared with their production under current climate conditions. Other agricultural activities could also be affected by climate change and variability, including changes in the onset of rain days and the variability of dry spells. • **Human health.** Scientists predict a 5-7% potential increase in malaria distribution by the end of the century. Previously malaria-free highland areas in Ethiopia, Kenya, Rwanda and Burundi could also experience malaria starting from around mid-century, potentially exposing communities with little or no immunity to a debilitating illness. • **Coastal populations.** Towards the end of the 21st century, projected sea-level rise will affect low-lying coastal areas with large populations. The cost of adaptation could amount to at least 5-10% of Gross Domestic Product (GDP). By 2015, three coastal megacities of at least 8 million inhabitants will be located in Africa. The projected rise in sea level will have significant impacts on these because of the concentration of poor populations in potentially hazardous areas that may be especially vulnerable to such changes.
Source: Based on the Fourth Assessment Report of the IPCC

1.2. Adaptation strategies and indigenous peoples' knowledge in Africa – regional perspective

1.2.1. Knowledge and marginalization in decision-making

Although there is no formal definition of indigenous peoples, the African Commission on Human and Peoples Rights (ACHPR) has adapted internationally recognized identification criteria to the African context. The main characteristics of indigenous peoples in Africa, highlighted by ACHPR (ACHPR, 2005) are:

- Cultures and ways of life differ from the dominant society
- Cultures are under threat
- Importance of rights to lands and natural resources
- Suffer from discrimination and regarded as "less developed"
- Political and social marginalization

- Self-identification as indigenous

Based on these criteria, it is broadly agreed that pastoralist and hunter-gatherers communities constitute indigenous peoples in Africa. This implies that indigenous peoples in Africa are generally directly dependent upon natural resources for sustaining their livelihood and have developed specialized knowledge about the ecosystem as well as adaptive strategies to cope with changes and variations. The adverse impacts of climate change thus affect indigenous peoples disproportionately, given their greater natural resource dependency. In parallel, they are among the most resourceful in adapting to climate change, given the resilience, flexibility and adaptive capacity of traditional knowledge and institutions (Kronik and Verner 2009). However, their potential for adapting to climate change is being limited by their condition as politically and socially marginalised as well as discrimination against their traditional livelihoods.

Indigenous peoples' traditional institutions are, in most countries, not officially recognized and are marginalized in decision-making (see e.g. Thornberry and Viljoen, 2009). Moreover, only few countries in Africa have elaborated legislation or policies to protect indigenous peoples and most communities do not have recognized rights to land, territories and resources. Further, "due to the fact that indigenous peoples' methods of land use are often considered outdated, the assumption may be that indigenous peoples' lands are not used 'productively'. This could be considered to constitute a form of discrimination…" (ibid, p.viii).

The generally marginalized position of indigenous peoples is replicated in climate change-related policies and programs and while indigenous peoples have limited capacity and resources to engage in international policy-processes, decision-makers are often unaware or reluctant to provide the space for indigenous peoples' participation.

However, there is ample evidence in the literature to suggest that climate change adaptation policies and measures are unlikely to be successful or minimize inequality unless the political dimensions of local adaptation are considered (Eriksen and Lind, 2009). Strengthening adaptive capacity may require addressing imbalances in the distribution of powers and resources within a political system that produces and maintains development inequalities. Hence, adaptation may need political solutions, for example, redistribution of development resources to marginalized drylands and consideration of development inputs that support indigenous peoples' own aspirations, e.g. to maintain their involvement in livestock-keeping. Eriksen and Lind show that government and aid interventions can exacerbate people's vulnerability, including their ability to manage the consequences of climate change. Within development policy and practice, there is a need to appreciate and depart from indigenous peoples' understandings and explanations of the insecurities, assets and opportunities with which they live.

Thomas and Twyman (2005) suggest that climate change policies need to be oriented toward enabling, rather than inhibiting, local and regional adaptation options. Such policies would imply a shift away from adaptation policies that prescribe practices to those that enable greater local freedom to choose appropriate practices and to adapt to both climatic and non-climatic stressors at the same time. In effect, this means a shift in power relations between policy-makers and local communities.

Eriksen and Lind find that the ability of vulnerable groups to influence decision-making processes and structures more generally (Campbell 1999; Thomas and Twyman 2005), may be as important for local adaptation as the ability to influence specific climate change adaptation policies. Experience from African countries shows that real local participation and inclusion of

household-level strategies in climate change adaptation policies remain a challenge (UNFCCC 2007; Eriksen et al, 2008).

These academic findings and recommendations are fully in line with indigenous peoples' internationally recognized rights (as enshrined in the UN Declaration on the Rights of Indigenous Peoples), which provides for indigenous peoples' rights to consultation and consent and to participate in decision-making that concern them. Indigenous peoples in Africa are persistently claiming respect for these fundamental rights, including in the context of climate change (see e.g. Statements, Declarations and Work Programme of the International Indigenous Peoples Forum on Climate Change (IIPFCC)).

1.2.2. Relevance of traditional knowledge, practices and institutions for adaptation strategies

Indigenous peoples have accumulated large and sophisticated bodies of knowledge of annual seasonal cycles governing the interrelation of water, wind, temperature, flora, fauna and human activities, including adaptation and mitigation strategies. The ability to predict and interpret natural and climatic phenomena has been instrumental for the development of social structures, trust, and authority. In the context of climate change, the adaptation strategies developed to tackle the "normal span of variation" are often no longer sufficient, given the increased unpredictability in seasonal variation. This is further aggravated by other external and internal political, economic, environmental and social pressures, which undermine traditional institutions and practices. Thus, unpredictability of the seasonal variation undermines the array of solutions provided by cultural institutions and authorities. The resilience of a given indigenous institution will depend upon its continued relevance for its members and some indigenous peoples are compelled to change their livelihood so dramatically that they lose vital conditions for the development and reproduction of their knowledge, institutions and practices, which may be rendered superfluous or, eventually, lost.

Recent literature argues that the ability to withstand shocks and stresses to livelihoods is especially important in adapting to climate change and variability, and thereby is linked to vulnerability (Thomas et al. 2007). The World Bank (2000) links such factors as reliance on natural resources to high levels of vulnerability and low adaptive capacity in the developing world. However, as mentioned by Thomas et al. (2007) citing Salinger, Sivakumar, and Motha (2005), the resilience of human societies may be enhanced positively by people countering vulnerability, if wider dimensions of livelihood change permit this to occur (Robledo, Fischler, and Patiño 2004). These wider dimensions include well-functioning sets of regularized practices. Such institutions have been developed and actively maintained in indigenous communities; and they are a key identifier of the well-being of indigenous communities and their responsive capacity to social changes.

1.2.3. Intersection between local and global knowledge

In the literature, indigenous peoples' knowledge most often has been defined in juxtaposition to scientific knowledge, modern knowledge, and western knowledge. On that basis, indigenous knowledge may appear to scientists as "myth"—vague, subjective, context-dependent, open to multiple interpretations, and embedded in cultural institutions such as kinship. Cruikshank (2001) argues that local people may characterize scientific knowledge in similar terms: as "illusory, vague, subjective, context-dependent and open to multiple interpretations and embedded in social institutions like distant universities" (Cruikshank p. 390, cf Kronik and

Verner 2009, p. 152). This is further aggravated by the existing communication and capacity gaps; traditional indigenous knowledge is often inaccessible to scientists and vice-versa.

While science, through meteorology, has contributed to a global understanding about long-term climate change, it is highly relevant to understand how this claim to knowledge influences decision-making regarding future adaptation strategies, and how its meeting with local knowledge claims play out. Adger et al (2009, p.342) suggest, "the goals and processes of adaptation cannot be separated from the nature, status and legitimacy of knowledge claims about the future. (…) Science has claimed a greater degree of predictability for the climate system than it has offered for other, adaptation-relevant, dimensions of social change relating to economics, technology, demography and culture".

Moreover, indigenous peoples' knowledge is often treated as a-historical and timeless data that can be merged into current plans and programs. However, this approach does not consider the specific cultural, political, social and historical circumstances, which develop, maintain, and transmit indigenous knowledge. Rather than the modernist distinctions between "traditional" and "scientific" knowledge, the focus should shift to emerging intersections between global and local knowledge (Kronik 2010).

1.3 Key first order climate change impacts in the selected ecological sub-regions

1.3.1. Case study sites in three ecological sub-regions of Africa

The countries selected for case studies are Congo Brazzaville, Kenya and Namibia. These three countries adequately represent the ecological sub-regions stipulated in the ToR (tropical forest zone of the Congo Basin; arid/desert areas in Southern Africa and lakes and wetlands in Eastern Africa). The selection of the specific countries and communities has mainly been determined by the interest and availability of strong and capable partners with a proven record of commitment to indigenous peoples' rights, experience in climate change issues and participatory research. These are;

- Rainforest Foundation UK (RFUK), undertaking research in Congo-Brazzaville;
- Mainyoito Pastoralist Integrated Development Organization (MPIDO) for Kenya;
- Legal Assistance Centre (LAC) for Namibia.

In turn, these organisations are collaborating with the following local indigenous organizations and communities:

- Forum pour la Gouvernance et les Droits de l'Homme (FGDH), Congo-Brazzaville;
- Association de défense et de promotion des Peuples Autochtones (ADPPA); Association BaAka pour le développement;
- Southern African Institute for Environmental Assessment (SAEIA), and;
- Friends of Lake Turkana (FoLT)

1.3.2. First order impacts on the tropical forest zone in Congo Brazzaville

The first order impacts to be explored amongst the two indigenous communities BaAka and Babongo in the tropical forest area of northern Congo Brazzaville are the following:

Site 1: Likouala, northern forest region of Congo Brazzaville

The study area is located in the district of Dongou in the Likouala region, near the Congo river between the cities of Impfondo and Dongou, in the northern forest region of the country, characterised by rainfall occurring all year (1800 mm/year) with only two periods of reduced rainfall from December to February and in July. The population lives primarily from fishing, hunting and agriculture, with local BaAka indigenous peoples particularly dependent on the forest and its resources.

Based on literature review (see section 2 of this report), the main climate change impacts affecting this research site in the Republic of Congo are:

1. Rainfall instability and temperature rises leading to the deterioration of ecosystem services

- Studies predict greater increases in rainfall in the north of the country – where the district of Dongou in the Likouala region lies – than in the south, and temperature rises of over 0.6°C in the North. Together, these would have severe impacts on ecosystems that are already under severe pressure, including second order impacts on the availability of forest products (bushmeat, mushrooms, insects, honey, vegetables and plants) which are economically, socially and culturally very important for indigenous societies.
- This may also have second order impacts on agricultural production such as the shortening, or inexistence of one of the seasons, which could negatively impact food production patterns and require adaptation. Where crops have reached their maximum tolerance; crop yields are likely to decrease due to an increase in the temperature.

2. Increased rainfall lead to flooding of rivers and changing of river patterns

- As a result of climate change, greater increases in rainfall are predicted in the north than in the south of the country. This would have multiple impacts, including flooding of land near rivers at unusual times of the year and changing river patterns. Second order impacts of these may include hindrances to river transport, which is important due to the dependency of communities on the river for food and navigation.

These climate change impacts will be validated and their potential impacts explored in field studies, as part of the research project.

Site 2: Massif of Chaillu Niari, South-West Congo Brazzaville

The second research site is located in the region of Mpoukou Ogoué, in the district of Komono, department of Lékoumou, in the South-West of the country. The study will select one community among the villages of Omoi, Moétché and Ngonaka. The area constitutes part of the Massif of Chaillu Niari. Rainfalls vary from 1,200 to 1,700 mm per year. Their monthly distribution brings up a large dry season from three to four months (June-September) flanked by two rainy seasons (October to December and from February to May). Early dry season (January / February) is marked by spacing of rainfall and less violent thunderstorms. The population of the area consists of a mix of Bantu and indigenous peoples. Overall, Téké

people represent the majority, but other ethnic groups include the indigenous Babongo. The main subsistence activities of these communities are line, net and dam fishing (the latter being practised mainly by women), hunting, gathering, cropping of cassava, and small-scale animal rearing.

The main climate change impacts affecting this research site in the Republic of Congo are:

Salinisation of freshwater resources

- In coastal regions that have major lagoons or lake systems, changes in freshwater flows and a greater intrusion of salt water into lagoons are likely to occur. Potential second order impacts are that the species that are the basis of inland fisheries or aquaculture are affected. Due to communities' reliance on line, net and dam fishing this will be of high importance.

Improved conditions of vectoral transmitters of diseases/malaria due to rising temperatures

- Temperatures are predicted to rise more in the south of Congo than in the north, and by up to 1.1°C in coastal areas by 2050. Studies show that this is likely to heighten the conditions for transmissible diseases, particularly malaria. A second order impact of this increased presence of vectoral transmitters is human health implications. "The potential effect of climate change in areas of existing transmission is noticeable, with 28–42% of new person-months of exposure towards the end of the 21st century arising in areas presently suitable for the disease" (Tanser et al 2003).

These climate change impacts will be validated and their potential impacts explored in field studies, as part of the research project.

1.3.3. First order impacts of the arid/desert areas of Namibia

Two indigenous Namibian communities living in two different ecological zones have been selected for the focus of the research: the Hai||om San community living in the Tsintsabis area in central northern Namibia and the Topnaar Nama Community living in the Namib Naukluft Park along the Kuiseb River in western Namibia. Both communities depend on wild flora and fauna to supplement their diets and the Topnaar Nama are becoming increasingly dependent on small livestock farming as a means of livelihood.

The most likely first order impact that these indigenous communities will experience is:

- **Increasing environmental variability.** This means that high variation from the mean rainfall pattern will become more frequent and extreme. In other words, droughts will be more prolonged and intense, while abnormally high rainfall events are likely to become more frequent (like the extreme floods experienced in 2011, which used to be considered a one in a hundred year event).

Other first-order (bio-physical) impacts include:

Site 3: Tsinsabis, Central Northern Namibia

- Heat stress and higher rates of evaporation

- Lower soil moisture
- An overall trend towards declining annual rainfall
- Increasing runoff when rains come and lower rates of aquifer recharge (water stress).
- Increasing aridification leading to declining plant-cover and species shifts (more arid-adapted plant species moving-in, in place of more sub-humid species).
- Increasing rates of land degradation (desertification and, possibly, bush encroachment).
- Declining wildlife numbers (11% - 20%) and shifts towards more arid-adapted species (gemsbok, ostrich, springbok) (Turpie *et al* 2010)

Site 4: Kuiseb, Western Namibia

- Heat stress and higher rates of evaporation
- Probable (but as yet unquantified) changes to the fog-regime (less/more fog days will affect the levels of heat stress for humans, plants and livestock)
- Lower rates of aquifer recharge (water stress), lower water tables and a decline in plant cover in the Kuiseb linear oasis (higher losses of trees and other plants like the staple !nara)
- Increased runoff during abnormally high rainfall years inland, with prolonged and intense floods of the Kuiseb river (as in 2011). Although this replenishes the underground aquifers, it can wash away trees and !nara plants.
- SLR and the possibility of saltwater intrusion into coastal aquifers – this will affect the growth of some important plants (e.g !nara)

1.3.4. First order impact of the lakes and wetlands of Kenya

In order to pursue the broadest possible coverage and variations, the research will take place in two areas: Lake Turkana in the North-Western part of Kenya, which is the world's largest permanent desert lake. The area is mainly inhabited by the Turkana people, who are traditionally nomadic pastoralists, raising goats, camels, donkeys and zebu. Rampant and prolonged drought caused by climate change leads to declining pastures, making it increasingly difficult for pastoralists to survive on livestock herding. Reduced access to water resources has increasingly placed the local communities under intense pressure and lead to conflict. The other areas chosen for research is the Mau Forest, which has traditionally been inhabited by the Ogiek, sustaining their livelihood on hunting and gathering. Mau is the largest indigenous montane forest in East Africa and the largest water catchment area in Kenya. The first order impacts to be explored amongst these indigenous communities are the following:

5. Lake Turkana site, North-Western part of Kenya

- **Reduced levels of precipitation**

This has directly impacted on the livelihoods and food security of pastoral and fishing communities around lake Turkana.

  - The pastoral community of Turkana has in recent years made headlines regarding severe famines and droughts that ravage the region recurrently. The arid nature of the region's rangelands means that any failure of expected precipitation results in pasture loss, livestock deaths, and consequent food insecurity. Recurrent droughts

have eroded the pastoralists' livestock (primary) wealth, divesting them of a valued economic and cultural asset, exposed them to livelihood vulnerability, and reduced their resilience in climate change adaptation.

- To cope with reduced precipitation, nomadic Turkana pastoralists are more often forced to venture into hostile territories (often beyond national boundaries) in search of pasture and water. This has exposed them to increased inter-group conflict leading to alarming levels on insecurity in the region arising from resource conflict and livestock banditry.
- Climate change is having severe effects for the fishing community as well. Clearly documented drops of water levels in Lake Turkana are a direct correlation of reduced rainfall in the Ethiopian Highlands, the lake's main catchment basin. Reduced water levels translate into low fish catches, longer fishing hours and distance, increased conflict over fishing rights, and constant risks of over-exploitation. Planned upriver dam projects, by the Ethiopian Government, along the River Omo (the lakes single inlet) are also threatening to escalate the retreat of the lake's waters, a potential catastrophe for the community that depends on the lake for food and economic survival.

6. Mau Forest, Kenya

- **Reduced levels of precipitation**

Large sections of Kenya's population directly or indirectly depend on water sources originating in the Mau forest complex and are threatened by impacts of climate change. Most threatened, however, are the Ogiek who have traditionally inhabited the Mau and the Maasai pastoralists living in its fringes. Key issues are as follows:

- Threats to indigenous livelihoods systems (hunting and gathering and subsistence livestock rearing) from conversion of forestland into settlements and commercial farms, and illegal forest resource extraction.
- Reduced water catchment capacity and poor river flows regulation downstream resulting in flooding and lack of river water.
- Low groundwater recharge, soil erosion and consequent siltation of water systems around the Mau.
- Forests ecosystem degeneration threatening unique montane plant and animal species and the livelihoods of communities that depend on them for food, medicine and socio-cultural functions.
- Frequent droughts in the lower Mau lead to intense conflict from resource conflict and livestock deaths for lack of sufficient pasture and water.
- Threats to indigenous culture and loss of heritage for forest dwellers from a declining forest system.

2. Republic of the Congo

2.1 National and local climate change phenomena

The following section is organised as follows: it first provides a brief geographical and climate policy context of the Republic of Congo, and then is divided into two subsequent parts: showing existing climate trends and predicted climate change impacts in the future. The existing climate trends focus on temperature, rainfall and moist forests; the predicted climate change impacts focus on the and rainfall, temperature, coastal areas, and extreme events or shocks of the Republic of Congo. Finally, the main first order climate change impacts affecting case study area are identified.

2.1.1. Geographical and climate policy context

The geographical context of the Republic of Congo is the following: "Congo is located between 4°N and 5°S latitudes and between 11°E and 18°E meridians. It is limited on the north by Cameroon and Central-African Republic, on the East by the Democratic Republic of Congo, on the west by the Republic of Gabon and the South by the Atlantic Ocean and the enclave of Cabinda (Angola). The area of Congo is 342,000 Km2 and presents a relief that articulates around the basins of Congo and Kouilou - Niari. Congo has a humid and hot climate with a southerly preponderant atmospheric. Two vegetable formations share the totality of the territory: the forest (60%) and the savannah (40%)." (p. iv, République du Congo, 2001).

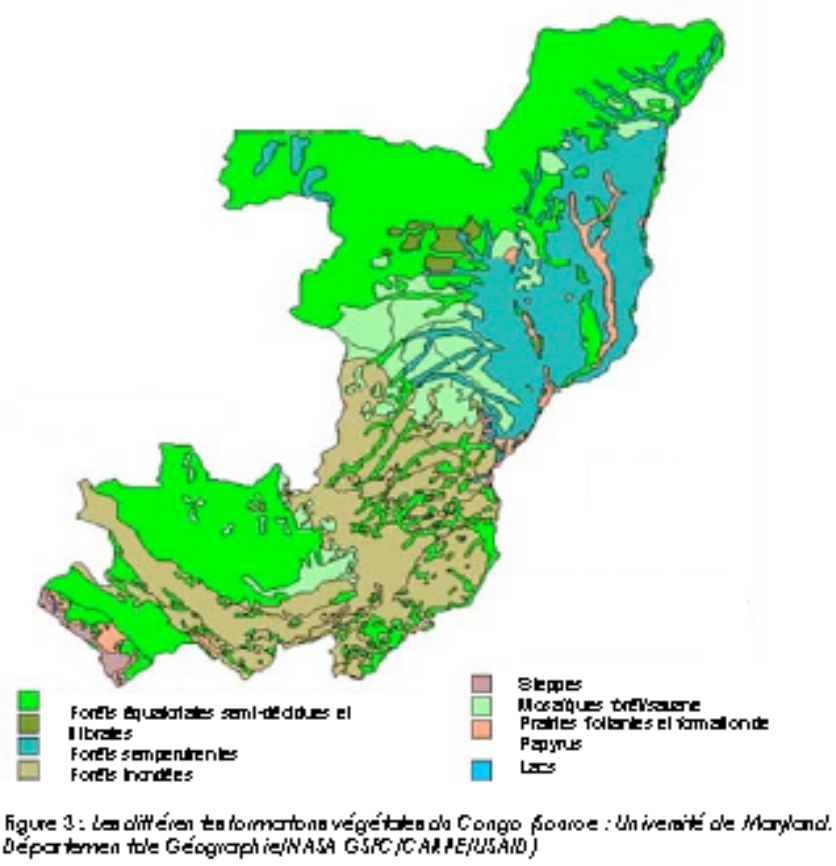
The Republic of Congo's official ratification of the United Nations Framework Convention on Climate Change (UNFCCC) was on 14 October 1996, and the Kyoto Protocol was ratified on 12 February 2007 (Okali, 2011, p. 79). Congo is also engaged in the reducing emissions from deforestation and forest degradation (REDD) process: the Readiness Preparation Plan (RPP) of the country was approved in June 2010, and both the World Bank managed Forest Carbon Partnership Facility and the UN-REDD Programme are active in the country.[2]

2.1.1. Existing climatic changes and trends

As noted by some scholars, the Congo Basin region has received little attention from the international climate change community and little documentation exists, even less for individual countries of the region (Bouka Biona & Mpounza, 2009). The Intergovernmental Panel on Climate Change(IPCC) in the Fourth Assessment Report of 2007 note that: "In the tropical rain-forest zone, declines in mean annual precipitation of around 4% in West Africa, 3% in North Congo and 2% in South Congo for the period 1960 to 1998 have been noted (e.g., Malhi and Wright, 2004)." (Boko et al., IPCC, 2007, p. 436)

[2] http://forestcarbonpartnership.org/fcp/node/81

Figure 2: Map of Republic of Congo. (Source: Bouka Biona & Mpounza, 2009)



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2.1.2. Temperature

Bouka Biona and Mpounza (2009) provide us with a graph showing the increase in maximum and minimum temperatures in the Republic of Congo from 1950 to 2000:

Figure 3: Temperature trends in Republic of Congo from 1950 to 2000 (Source: Bouka Biona & Mpounza, 2009).

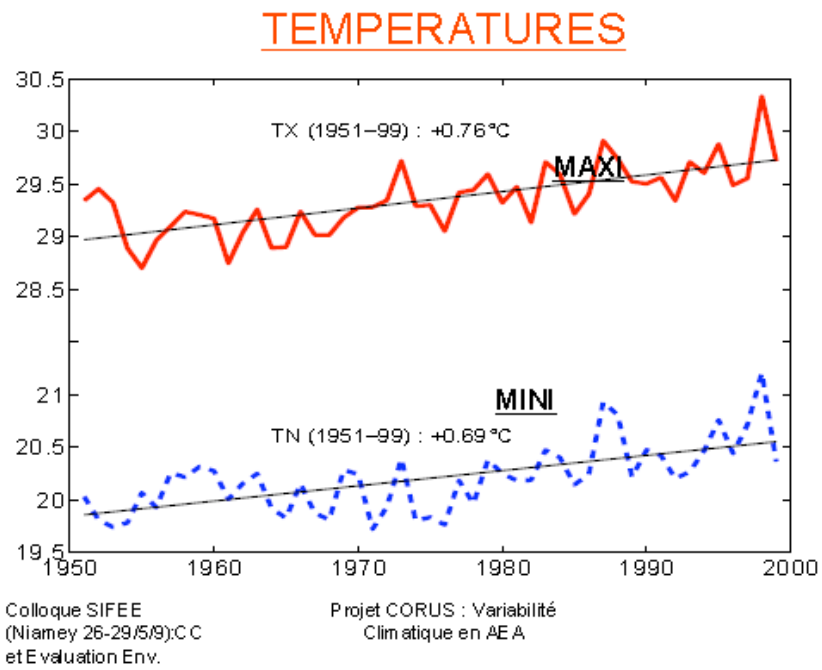


Figure 4 : Tendance des températures sur la période 1950-2000 en République du Congo.

2.1.3. Rainfall (pluviometry)

The same source also provides isohyetal (rainfall) maps of the Republic of Congo for the period 1951-70 and 1971-2000, showing a decrease in rainfall in this period.

Figure 4: Rainfall in Republic of Congo compared between 1951-70 and 1971-2000 (Source : Bouka Biona & Mpounza, 2009).

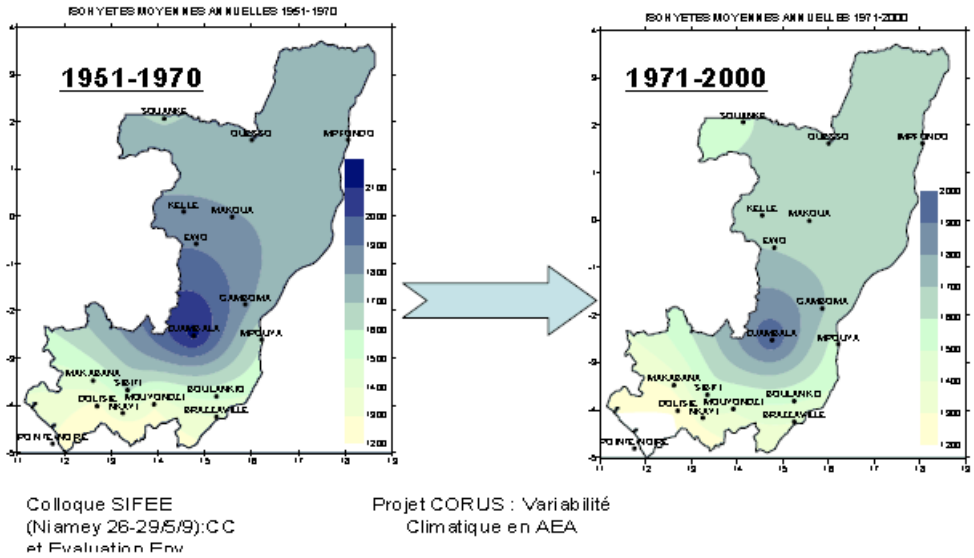


Figure 3 : Évolution des précipitations au Congo montrant l'impact du changement

This data is supported by other studies, which show reduced rainfall in recent decades: "Overall, in the West Africa/north Congo tropical rainforest belt rainfall levels were 10% lower in the period 1968 to 1997 than in the period 1931 to 1960 (Nicholson et al., 2000)." (Somorin, 2010, p. 4). There is also some evidence that large rivers in the Central Africa experienced reduced flow rates between 1990 and 1995 (Bouka Biona & Mpounza, 2009 citing Laraque et al. (2001)).

2.1.4. Humid forests

The Republic of Congo National Communication to the UNFCCC gives some information about long term climatic changes relating to forests in the country:

"Let us remember that in the past at the millennial scale quasi-continuous forest cover had partially fragmented, with intensity and a variable response time according to the fragility of the environment (climate and soil). The major modification is around 3000 - 2500 BP (*Before Present*), arid phase (Vincens and al., 1994). The humid condition restoration between 600 - 500 BP led to the resumption of erosion phenomena in the " Series of circuses " (Schwartz and al, 1995, 1996) and the reconquest of the forest over the savannah."(République du Congo, 2001).

Studies on the more recent impact of climatic variations on moist forests show mixed results. Lewis et al, 2009, in a study of 79 sites, found that above-ground carbon storage in live trees increased between 1968 and 2007, which may be linked to increased levels of CO2 in the atmosphere. This, the authors state is, "similar to [increases] reported for Amazonian forests per unit area providing evidence that increasing carbon storage in old-growth forests is a pan-tropical phenomenon". However, they do state the need for "Improved monitoring and modeling of the tropical environment… to better understand this trajectory." (Lewis et al, 2009).

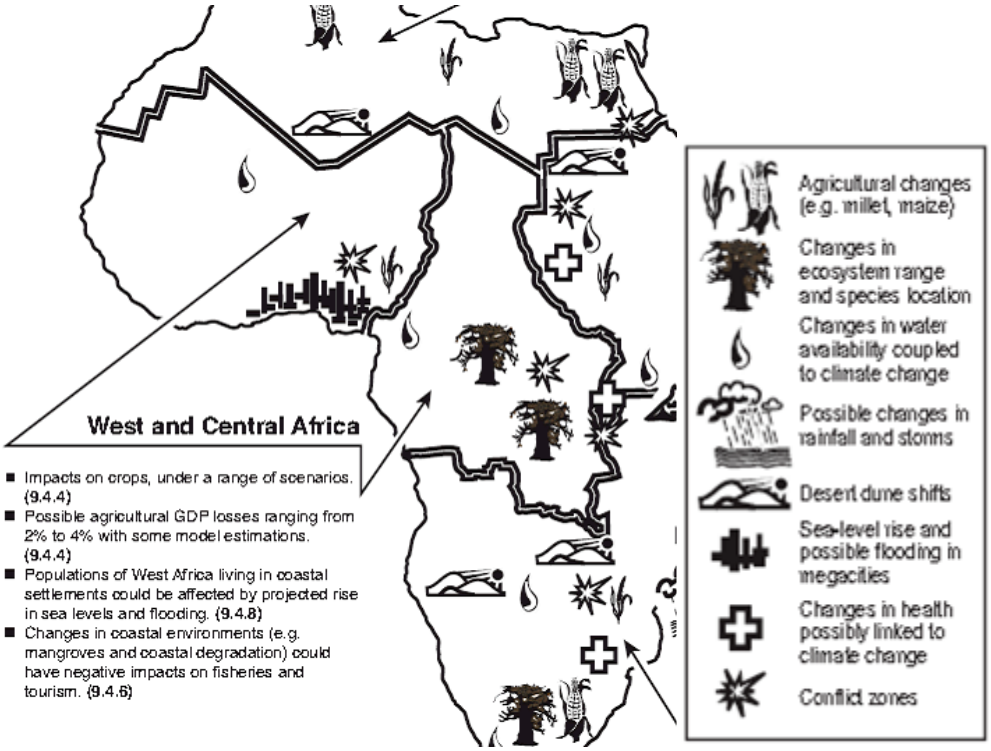
Conversely, other studies, "(e.g. Feeley et al., 2007) find the contrary – tree growth rates decreasing significantly in tropical moist forests in recent years", (Okali, 2011, p. 74).

2.2. Predicted and modeled changes in the future

The number of studies focusing specifically on the Congo Basin, or the Republic of Congo, is limited.

The IPCC report includes the following map showing impacts on Central Africa, these being, "changes in water availability coupled to climate change" and "changes in ecosystem range and species location".

Figure 5: Map showing climate change impacts in West and Central Africa (Boko et al, IPCC, p. 435).



The IPCC also states with reference to the Republic of Congo that: "In coastal regions that have major lagoons or lake systems, changes in freshwater flows and a greater intrusion of salt water into lagoons will affect the species that are the basis of inland fisheries or aquaculture" (Boko et al, IPCC, p. 448) and that, "Mangroves could also colonise coastal lagoons because of sea-level rise" (Boko et al, IPCC, p. 449).

Much of the information available about predicted impacts of climate change in Republic of Congo comes from the country's 2001 National Communication to the UNFCCC. This study was based on the Model for the Assessment of Greenhouse-gas Induced Climate Change/ Regional Climate SCENario GENerator (MAGICC/SCENGEN) (General Circulation Model) built on data from 1961 to 1990 (République du Congo, 2001). Other studies use a later version of the same model - MAGICC/SCENGEN 5.3 (Bouka Biona & Mpounza, 2009).

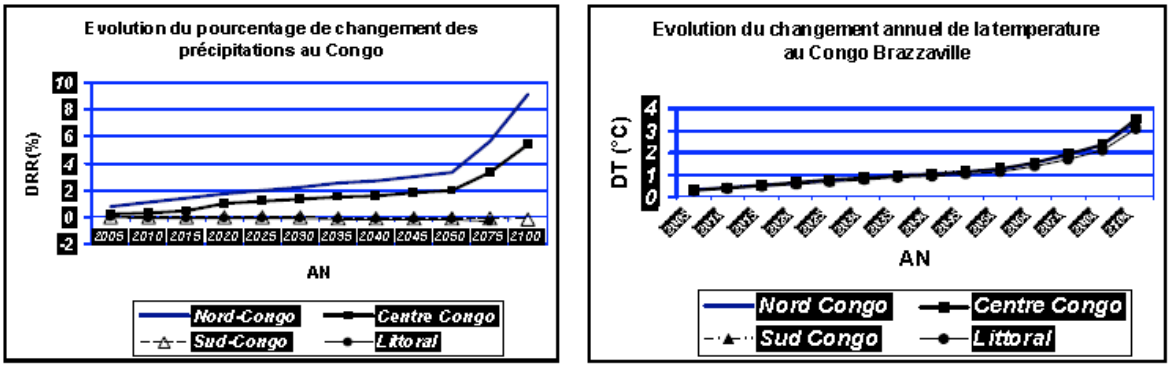
2.2.1. Temperature and rainfall

These future scenarios predict a general rise in temperatures across the entire country. If CO2 levels double in the atmosphere, temperatures could increase by up to 0.6°C in the North and 1.1°C in coastal areas by 2050, with peaks of 2.1°C in some areas (Plateau des Cataractes and la vallée du Niari). By 2010, temperatures could increase by 2 to 3°C. It is expected that the warming will be greater in the dry season than the wet season (République du Congo, 2001).

Figures from Brazzaville's *Université Marien Ngouabi* suggest that temperature will increase across the country by 0.7°C by 2025, 1°C by 2050 and 3°C by 2100 (Bouka Biona & Mpounza,

2009, p. 7). Equally, this source suggests that rainfall will increase by 1% by 2025, by 2 to 3% by 2050 in continental part of the country, and the precipitation in the rainy season will increase in the centre of the country by 8% in 2050 and up to 20% by 2100. There is also predicted to be greater increases in rainfall in the north than the south of the country (Bouka Biona & Mpounza, 2009, p. 7).

Figure 6: Graphs showing the predicted evolution of rainfall and annual temperature from 2005 to 2100, in North Congo, South Congo, Central Congo and coastal areas (Source: Bouka Biona & Mpounza, 2009)



2.2.2. Coastal zone and coastal erosion

Based on global sea level rise predictions of 50cm by 2100: "This expansion could cause floods in the bay of Loango, estuaries and lagoons… The penetration of salty water in the mangrove is also expected. Still on the basis of these thermal projections, the water resources production will be affected by equatorial and continental waters predominance, and by a reduction of in intensity of the Upwelling." (République du Congo, 2001).

It is estimated that between 2.3 and 4.3% of the beaches in Republic of Congo will be lost due to sea level rise and related erosion, which would threaten "many villages and public infrastructure in the Loango Bay" (République du Congo, 2001).

2.2.3. Extreme events (shocks)

The Congo National Communication states (author's translation from original French):
"The evolution of extreme events, such as floods, low flows and droughts can be foreseen, given that their effects are significant in the floodplain of the Congo Basin and in the Niari Valley... Remember that frequent storms, coupled with an atmospheric pressure a little higher and high winds, generate risks for certain coastal plains for example the flooding of marine waters on the coast." (République du Congo, 2001).

2.3. National and local climate change impact

As seen in the precedent section, there are few studies that enable to predict the specific ways in which climate will change within the Republic of Congo. However, if these general trends are analysed against the prevailing socioeconomic situation in the country, several areas of urgent attention emerge. From a social perspective, livelihoods, disease transmission, migration

flows, gender equality and education are particularly sensitive to impacts from climate changes and shocks. On the economic front, the Republic of Congo has already identified the agriculture, forest and energy sectors as immediate priorities for adaptation strategies.

Central Africa is particularly affected by climate changes. Poor populations in this regions live primarily in rural areas, and their subsistence depends on either soil or river resources or from employment in the informal sector. This, the impacts outloines in section 1.1.3. would all be of relevance to the Republic of Congo.

2.3.1. Social impact

Erratic and unpredictable rainfall patterns are already having important social and economic effects on river communities of the Republic of Congo. Navigation on main river arteries has been severely disturbed due to lower flows and droughts. Periods of navigation interruption show a clear upward trend.

Temperature rises, on the other hand, will very likely have severe impacts on human settlements and health, particularly as "heat islands" have already been identified in certain villages (Bouka Biona and Mpounza, 2009).

Specifically, temperature increase is likely to heighten the conditions for transmissible diseases, particularly malaria. According to a model designed specifically for the African case: "the potential effect of climate change in areas of existing transmission is noticeable, with 28–42% of new person-months of exposure towards the end of the 21st century arising in areas presently suitable for the disease" (Tanser et al 2003).

From a gender perspective, climate changes impact women disproportionately because resources for their economic independence are very dependent on natural resources- water, agriculture and forests. This has varied effects on other millennium development goals: women are key actors in reaching nutrition and education objectives, for instance. Climate change also impacts job markets. In central Africa, informal employment is widespread and transition to formal markets very difficult. In its turn, job market structures are deeply linked to migration flows. Policies addressing these issues must then take into account the possible impacts of climate change, if they are to be effective (Nkodia, Oct. 2011).

2.3.2. Influence of climate change on food security

According to Seppälä (2009), higher temperatures – along with the prolonged droughts, more intense pest invasions, and other environmental stresses that could accompany climate change – would lead to considerable forest destruction and degradation with negative effects on livelihoods and socio-economic development.

Major environmental challenges currently facing the continent include deforestation, soil degradation and desertification, declining biodiversity and water scarcity. There is an increasing literature on deforestation, land degradation, and water logging and their contribution to declining capacity of sub-Sahara Africa to feed itself (Food and Agriculture Organization (FAO), 2002).

An FAO (2008) report indicated that low crop yields and poor harvest attributed to frequent fluctuations in rainfall, coupled with food shortages, have always resulted in low incomes and

chronic food insecurity, a situation that leaves farming families acutely vulnerable to the smallest hazard or shock and takes them closer to the poverty line. A World Food Program (WFP) report of 2002 stated that in sub-Sahara Africa, because there are poor harvests, individuals often sell off livestock and assets to purchase food, hence completely depleting their livelihood capitals. Seppälä (2009) notes that the decreased rainfall and more severe droughts are expected to be particularly stressful for forest dependent people in Africa who look to forests for food, clean water and other basic needs. For these people, climate change could mean more poverty, food insecurity, deteriorating public health, and social conflict.

For these reasons, FAO (2003) considers that "poverty alleviation and environmental protection in sub-Saharan Africa will remain the most important priorities over the next two decades" and proposes the adoption of new approaches that give more priority to strategies for enhancing the contribution of forestry to the economic, social and environmental interests of Africa (Osman Elasha et el, 2011).

2.3.3. Influence of climate change on cultural resources and values

Forests provide many social, spiritual and aesthetic benefits. Social benefits provided by forests include recreation, tourism, education and conservation of sites with cultural or spiritual importance (FAO, 2005). In rural areas of Africa, tree shade is a gathering place where villagers confer to discuss their daily lives, solve their problems or enjoy tea and coffee. Sometimes big trees act as a market place where people exchange and sell goods. Sometimes trees act as courtyards where villagers meet to solve their local conflicts and disputes (Seppälä, 2009). In arid and semi-arid zones of Africa, forests occupy areas that are almost too dry to support forests and are consequently very sensitive to changes in the severity or frequency of droughts, which in turn could impact forest-related socio-economic and cultural aspects of local communities (Seppälä, 2009). It is important for forest managers and planners to take these cultural and spiritual values into consideration when developing forest development strategies and mitigation plans. It is equally important to consider them in community-level adaptation efforts.

In many countries certain cultural, social and spiritual values are associated with some Non-Timber Forest Products (NTFPs). The NTFPs, though not easily quantified, may in some cases be as important to people as the economic value (Davidson-Hunt *et al*., 2001); an issue that is often overlooked. (Osman Elasha et el, 2011).

2.3.4. Economic

As a consequence of erratic precipitation, as aforementioned, river trade has been severely affected: "Socioeconomic consequences are very important too, because the average traffic over Congo River has been reduced from 300,103 tons in 1990 to approximately 50,103 tons. This has also increased women's vulnerability, because they depend on river trade" (author's translation, Bouka Biona and Mpounza, 2009, p. 7).

2.3.5. Impacts on the agriculture sector

In particular, the Congolese agriculture is very sensitive to climate change. Currently instability of rainfall seasons is noted. They are characterised, by a shortening or a time gap or is by the inexistence of one of the seasons. The obviousness of this temporal variability raises the

problem of adaptation. The length of rainfall seasons restrains the possible speculation range. They will know in addition, a modification linked to a strong evaporation, hence water deficiency varying according to the inter humid period (the plateau des Cataractes and the Vallée du Niari). The tendency observed in the increase in extreme temperatures, namely the minimal temperature recovery in the vallée du Niari (20°C) could bring about favourable conditions to the planting of selected oil palm trees. Its area of expansion is going to increase north to the Southwards. Similarly, some cultivars of the leguminous food like *Cajamus cajan* (Angole peas) and *Vigna inguiculata* (Niébé) are going to adapt to a moderate pluviometry and the find best climate conditions (National communication).

2.3.6. Impacts on the forest sector

Africa's forests and woodlands have multiple uses for local communities, ranging from construction materials, foods, energy, medicines, catchment protection, soil protection, and shade, habitat for wildlife and bees, grazing as well as cultural values.

Expected decreases in rainfall, and increased severity and frequency of drought, can exacerbate current exploitation pressures on forests and trees and expansion of agriculture into forest lands (Osman Elasha et el, 2011).

The reference situation on sectors and/or identified zones reveals the fragility of ecosystems. In the past, at the millennial scale, quasi-continuous forest cover had partially fragmented, with intensity and a variable response time according to the fragility of the environment (climate and soil). The major modification is around 3000 - 2500 BP, arid phase (Vincens et al., 1994). The humid condition restoration between 600 - 500 BP led to the resumption of erosion phenomena in the "Series of circuses" (Schwartz and al, 1995, 1996) and the reconquest of the forest over the savannah.

2.3.7. Impacts on the energy sector

It is estimated that the demand in energy will increase by 508.2 MW by 2015 (World Bank, 1990) in the major cities (Brazzaville, Pointe -Noire…), while it is now 132 MW. This crisis will intensify as the powers of the dams (Djoué and Moukoukoulou) fluctuate from one month to other. This is the result of the irregularity of waterways flows (national communication).

2.3.8. Combined impacts on the Congolese ecosystems

All these climate factors will without any doubt have some effects on the totality of the ecosystems in the country. Naturally, some concerned sectors could adapt themselves. However, the Congolese forest, with its biological complexity, will confront a major crisis comparable to the upheavals which had marked the history of the biosphere because of the various and intensive anthropogenic constraints (national communication).

The vulnerability is due to lack of adaptation strategies, due to the lack of institutional, economic and financial capacity to support such actions. The utmost concern should therefore be a better understanding of the potential impact of the current and projected climate changes on African agriculture and to identify ways and means to adapt and mitigate its detrimental impact (Opere et al, 2011).

2.4. Factors that contribute to minimizing or increasing impacts of climate change

2.4.1. Natural environment

Approximately 60% of the total land area of the Republic of Congo is covered by rainforest (more than 22 million hectares – 11% of the forest cover of Central Africa (FAO, 2006)). Nearly 75 percent of Congolese forest, more than 15 million hectares, belongs to the realm of production, including 11.6 million hectares allocated to logging companies. The total coverage of protected areas represents more than 3.6 million hectares, or over 11 percent of the national territory.

The forest estate is comprised of two major northern and southern high-contrasted areas, which enjoy a wide variety of forest types and are separated by savannas of Batéké and the Niari valley. The first area located in the south is covering 5 million hectares including the forest of the mountainous region of Mayombe (1.5 million ha) and the Chaillu Massif (3.5 million ha). It is characterized by the abundance of valuable tree species such as okoume (Aucoumea klaineana) and limba (Terminalia superba). The northern area comprises more than 15 million hectares of rainforest, with high value commercial species such as sapelli (Entandrophragma cylindricum), Sipo (Entandrophragma useful), wenge (Milletia laurentii) or Padauk (Pterocarpus soyauxii) (WRI, 2007). These areas have different climatic conditions. The North region has a higher rainfall and a dry reduced season. Both areas are extremely rich in flora and fauna. For example, of the 10,000 plant species identified in the Congo Basin, 1,200 are endemic to the Republic of Congo.

Swamp forests (6 million ha) cover the huge space left in the Congolese Basin and the Sangha regions. The Congolese forests are part of the Congo Basin forest ecosystem, which is the world's second largest moist tropical forest, second only to the Amazon, and represents about one quarter of the globe's remaining closed canopy forest. The forests of the Congo Basin store a significant carbon stock (estimates range between 24 and 39 GT of carbon) and thus serve as an important buffer against global climate change.

Deforestation rates in the Congo Basin (0.17 percent/World Bank, 2011) are still low compared to large forest blocks in the Amazon or South-East Asia, but these rates are expected to amplify drastically in the coming decades, driven by a variety of forces such as industrial logging activities, road development, agricultural expansion (both for subsistence purposes and for commercial agriculture), as well as oil and mineral extraction. Curbing these accelerating deforestation rates means that less carbon will be released into the atmosphere, that habitat for endangered species is conserved, and that other important ecological forest functions (e.g. driving the cycle of rain, providing flood control) are maintained. At the global scale, tropical deforestation is estimated to contribute between 15 and 20 percent of global greenhouse emissions, adding to global warming and furthering the impacts of climate change (World Bank, 2011).

2.4.2. Socio-economic circumstances

The Republic of Congo has been affected by three armed conflicts between 1993 and 1999. These conflicts have caused population displacement and resulted in the disruption of the economy.

Since the ceasefire in 2000 and adoption of a new Constitution in 2002, the Republic of Congo has been at peace. Congo has the potential for building a strong and robust economy and attaining a high standard of living for its people: it has a relatively small population of 3.6 million, a significant endowment of oil, natural forests, arable land, a biodiversity of global importance, minerals, and a strategic location in Central Africa with a deep-sea port at Pointe-Noire that can serve as a gateway to the sub-region (World Bank, 2011).

Decentralisation is provided for in the 2002 national constitution that underpinned the country's return to democracy. Local councils have very limited power and still depend heavily on the central government for managing social and economic development.

The Congolese economy has grown significantly since 2008. Real GDP is estimated to have expanded by 8.8 percent in 2010, compared to 7.5 percent in 2009, based on continued high growth in the oil-sector as well as accelerated growth in the non-oil sector. Petroleum extraction has supplanted forestry as the mainstay of the economy. In 2008, oil sector accounted for 65% of the GDP, 85% of government revenue, and 92% of exports (World Bank, 2011). According to an industry survey conducted in 2007, logging generates 5% of GDP and 10% of non-oil GDP, creating 12,000 direct and indirect jobs and generating 110 billion CFA francs (Communaute Financiere Africaine franc**)** in turnover and 100 billion CFA francs in exports. The annual production capacity is currently estimated at 2 million m^3 (Congo Basin Forest Partnership, 2006).

However, the country continues to face fundamental development challenges. Poverty remains significant, with about half the population living below the poverty line and inequality remains high. Social indicators are still far below those of countries with comparable levels of Gross National Income (GNI) per capita and meeting the Millennium Development Goals (MDGs) remain a challenge (World Bank, 2011).

Global Human Development Indicators (UNDP, Human Development Report 2011)

Human Development Index	Rank 137 (over 187)
Health Life expectancy at birth (years)	57.4
Education index (expected and mean years of schooling)	0.523
Income - GNI per capita in PPP terms (constant 2005 international $)	3,066
Inequality- Adjusted HDI	0.367
Multidimensional Poverty Index (%)	0.208
Sustainability - Adjusted net savings (% of GNI)	-44.7
Demography – Population, total both sexes	4,139,700

Poverty, discrimination, non-respect for civil and political rights, difficulties to benefit from justice, health and education services highly affect the hunter-gatherers indigenous peoples living in the Congolese forests.

2.4.3. Discrimination

According to the report "Indigenous peoples of the republic of Congo: discrimination and slavery" published in November 2011 by Observatoire Congolais des Droits de l'Homme (OCDH), discrimination and exploitation of indigenous minorities are still deep and troubling. The report states that "Relationship between Bantus and indigenous peoples has turned into a relationship of "master-slave" over the time, the most common practice being that of forced labour: the person is required to work against their will under threat of violence or any other form of punishment or coercion".

Participatory studies developed by civil society groups in the Congo Basin region have shown that indigenous people working in local industries and services are often discriminated against in terms of conditions of recruitment, working conditions, salaries etc.

2.4.4. Civil and political rights

The right to citizenship is related to the fundamental recognition of the legal existence of the person. The birth certificate establishes this right first. Over 50% of indigenous children have no birth certificate, against 19% of children in the general population. The absence of this legal document also denies them access to many social services (schools, health, identity cards, passports etc.).The birth certificate is free, but indigenous people, often living in very remote areas, have poor access to authorized services.

In addition, indigenous peoples generally do not have identity documents to prove and to fully exercise their citizenship rights

2.4.5. Access to justice

Research in Ngoua II shows that indigenous peoples no longer believe in justice. Faced with the multiple atrocities to which they are subjected by the Bantu, they have no means of redress. According to sources, the village heads, who are Bantu, do not even take the time to consider their grievances. On the contrary, they systematically treat them as liars and thieves… Faced with such contempt, indigenous peoples prefer to keep a low profile and suffer at home rather than make a complaint to the police (OCDH, 2006).

2.4.6. Community health

Attitudes and discriminatory practices are reported. Consequently, the indigenous people, especially women, refuse to go to health centres and are moving more to traditional care. Access to health services is also limited by financial barriers. Finally, because of the lack of health infrastructures in the areas where indigenous peoples live, they are often forced to turn to traditional methods, in particular, plant pharmacopoeia, an area in which they have an excellent knowledge.

Co-existing alongside the Bantu has led to the appearance of illnesses previously not recognised by the indigenous communities, particularly, poliomyelitis, schizophrenia and fungal infections. The problem of housing and access to drinkable water are also very serious problems.

2.4.7. Education

One of the main issues in relation to education of indigenous peoples in Congo and in the whole Congo Basin region is that there is no official curriculum adapted to their way of life. In addition, indigenous peoples are worried they would not be able to pass on a traditional

education to their children, through the learning of various forest activities. To these issues must be added the costs of schooling and school supplies in local schools, which are beyond the reach of an indigenous family budget, and the fact that indigenous students are often the object of contempt on the part of their Bantu contemporaries, whose mockery and humiliating comments (OCDH, 2006).

2.4.8. Governance issues

Corruption remains one of the biggest challenges throughout the Congo Basin. Enormous natural resources have proven too tempting to some elites and international business concerns. Public services are unevenly provided and of poor quality, and civil servants are often so badly paid that they resort to petty corruption in order to survive. The institutions that are intended to provide checks and balances within the system are generally under-resourced and lack independence (Transparency International, 2011).

Corruption in forestry undermines not only the profitability and the sustainability of the world's forest resources but also weaken global governance systems in countries where it occurs. Several studies have shown links between the quality of governance and the rate of deforestation in the world's main forest producing countries.

The country qualified for debt relief under the World Bank and International Monetary Fund's (IMF) Heavily Indebted Poor Countries (HIPC) initiative. However, the decision was controversial and was partly premised on improvements in governance and transparency in the use of oil revenues (Human Rights Watch, 2006). The government of President Sassou-Nguesso initiated a national plan to fight against corruption and fraud. The Congo reached in January 2010 the completion point under the HIPC Initiative.

As with many other countries in the Congo Basin, the Republic of Congo has entered into a Voluntary Partnership Agreement (VPA) with the European Union (EU) under the Forest, Law Enforcement, Governance and Trade (FLEGT) initiative, which aims to ensure that timber imported into the EU comes from legal sources. A provision of the Agreement is the adoption of a national code on the rights of indigenous peoples.

Representation and participation of indigenous peoples in state structures has been negligible, resulting in structural and systematic discrimination and exclusion. Given the lack of administrative recognition of indigenous villages and the weak capacities of representative structures, indigenous peoples are not able to participate adequately in decision making, even at the most local levels.

For the indigenous peoples of the Congolese forest, their capacity to access, own, and control forest lands and resources is key to fulfil their livelihood strategies.

2.4.9. Land rights

Whilst customary law does recognize land and resources rights between ethnic groups, clans etc., the Congolese legislation gives little opportunities for forest communities to formally own and use forest lands and resources.

Under the Forest Law adopted in 2000 by the Ministry of Forest Economy, 18.96 million ha of forest (legally termed "private domain of the state") were classified as "forest for conservation" (3.7 million ha) and "forest for production of timber" (15.3 million ha).

According to the Congolese land tenure regime, forest lands are classified into various categories: lands unaffected by the action of man and lands transformed as a result of the action of man. Under the first category, the analysis of existing texts reveals an inability of forest people to have rights of ownership. They especially cannot take ownership because they cannot fulfill the precondition for ownership of a space, which is "development of the land" ("mise en valeur"). There is in fact a limited tolerance on possession. Under the second category, the law recognizes two types of access to property: the property by registration and ownership by recognition of customary land rights. The registration of a property results in an official certificate or land title recognized by the state. It is recognizable to anyone who has delineated an area, applied for registration and respected the long and expensive procedure that results in the issuance of a land title. This is a common property regime for urban and rural land, but that rural people have trouble keeping up.

The Congolese land tenure law proclaims "the recognition of customary land rights". The law does not give further clarifications about individuals and/or collective rights, about indigenous peoples etc. This is an important innovation with respect to the laws of the region. This recognition should lead to the establishment of property in parallel with that of registration. But the analysis shows that it amounts to an additional phase of the registration procedure. As required by the law, the procedures require "development of the land" ("mise en valeur"), which is incompatible with indigenous populations use of lands, as they occupy and use forest lands without having to "develop" them.

2.4.10.Resource rights

Analysis of the texts reveals that people are banned from using certain wildlife resources, as well as mining and hydrocarbons. In the forests of the private domain of the State, the law recognizes certain customary use rights of indigenous and local communities, but these rights are limited to domestic consumption and do not extend to the marketing of forest products, which are a vital source of income for poor and excluded local and semi-nomadic populations. There is no provision in the legislation to develop community forests, as a mean to allow communities to use and forest resources for development perspectives.

The new Forestry Code is based on the principle of 'sustainable management' of forest resources. Application texts for this law were adopted in 2002 followed by national guidelines for sustainable forest management, published in 2004. The legislative framework supports the development of management plans for logging concessions, although most of these are still in preparation. It also encourages the participation of local and indigenous communities in the management of forests but the mechanisms to allow this are unclear and field experiences show that communities often complain of not being involved in the management of resources.

2.4.11.Indigenous peoples' rights

In February 2011, the Congo adopted a new law on the protection and promotion of indigenous peoples. This law is the first of its kind in Africa, and its adoption is a historic development for indigenous peoples in the Congo and on the continent.

The law states that "the State ensures that indigenous peoples are consulted in a suitable manner" and presents legal developments to ensure civil and political rights, cultural rights, rights to education, to work and to lands and resources. Article 31 of the law states that indigenous peoples have individual and collective rights to own, posses, access and use lands and natural resources they traditionally use.

Analysis undertaken by the Rainforest Foundation UK (RFUK) concludes that "the law is not perfect. Indeed, some significant clauses from previous drafts of the law have been changed or removed. For example, one article on ensuring indigenous representativity in decision making at all levels from national to local level has been removed. This would have been key to ensuring more equality of indigenous peoples in national and local decision making, which at present they are completely excluded from. Another key clause that has been removed concerns the provision of judicial assistance to indigenous people. Given their severe levels of poverty, it is highly unlikely that they would be able to pursue any form of legal action, or indeed obtain legal representation if accused, without such a form of assistance. A number of articles in the law require further legislation to be developed so they can be properly implemented. This includes fundamental provisions on consultation of indigenous peoples. It is of utmost importance that indigenous peoples are able to participate in this process of implementation."

The application texts of the law have not been developed yet.

2.4.12.Physical assets

The Republic of Congo's existing infrastructure is concentrated in the developed south, reflecting the country's urbanization patterns.

Congo's power infrastructure is highly inadequate and inefficiently operated. While mobile telephony has expanded rapidly, internet services remain prohibitively expensive. Restoring the national transport network will require major investment and careful policy decisions in the port, road, rail, and river transport sectors. The country's access statistics are substantially ahead of those in its peer group, particularly with regard to piped water, stand posts and improved latrines. The access differential between urban and rural areas is quite large, and a new approach is required to meet rural needs (AICD, 2010).

A participatory assessment carried out in February and March 2007 by the Central emergency response fund of the United Nations in the north of the Republic of Congo confirmed that access to health facilities is limited by the lack of state health structures.

Because of their mobility, indigenous peoples in Congo do not amass material assets. Forests provide them a wide range of goods and-services that create opportunities for development and improving human well-being. These range from construction materials, foods, energy, medicines, catchment protection, soil protection, shade, habitat for wildlife and bees, grazing as well as cultural values (including sacred groves, shade, peace trees and plants, meeting places and training areas).

2.4.13.Culture and ethnography

With an estimated 3.7 million inhabitants spread over an area of 342,000 km^2, the Republic of Congo has a low population density of 10.8 inhabitants per km^2, with 60% of the population concentrated in the urban centers of Brazzaville and Pointe Noire. It is composed of different groups: Baya, Kongo, Kota, Mbere Nzabi, Mbochi, Makasi, Punu, Sangha, Teke, and indigenous hunter-gatherers living in the rainforests whose number is estimated at 50,000 (2% of the total population).

By the Bantus, indigenous peoples are called Babenga in the north of the Congo, and Babongo in Niari and Lékoumou departments, but are referring to themselves by various names such as Babenjele in the north. In general, the Babenga of Sangha and Likouala departments, in the north of the Republic of Congo, are called Baka. The Baka are divided into several sub-groups:

- The Bambendzele: this is the most numerous sub-group in northern Congo. They are found in the north of Likouala department and in Sangha department, particularly in Pikounda and Kabo;
- The Baluma, who are also found in Pikounda and in the border area between the departments of Cuvette and Sangha;
- The Mikaya, who live in the area between the town of Ouesso and Mokéko, including Mbalouma Peké;
- The Bangombe, of Cameroonian origin, who emigrated for economic reasons and are living in the border area between the Republic of Congo and Cameroon. They are also found in Mbalouma Peké;
- The Bakolu or Badzamba, who live in Bomitaba to the south of Epéna, in Likouala department.

CARTE DE LOCALISATION INDICATIVE DES GROUPES DES PEUPLES AUTOCHTONES DE LA RÉPUBLIQUE DU CONGO

Central to the identity of indigenous peoples is their intimate connection to the forest lands they have lived in, worshiped and protected for generations. Traditionally, indigenous peoples live in small egalitarian social groups; depending on hunting and gathering for their livelihoods. They are characterised by their mobility over a vast territory; moving, according to their needs, from one resource centre to another, gathering a vast range of forest products, collecting wild honey and exchanging goods with neighbouring settled societies. Hunting techniques vary among the forest peoples, and include bows and arrows, nets and spears.

Their practices and complex cultural rituals – such as Jengi, the spirit of the forest – are based on a respect for, and careful management of, the forest.

3. Kenya

3.1. National and local vulnerability and opportunities

Kenya is a country in which the livelihoods of the population as well as the prospects of economic development are directly dependent on the exploitation of land and natural resources. This means that climate change has a direct bearing on livelihoods security as well as economic development prospects.

Nearly 80 per cent of the population resides in rural areas, deriving livelihoods directly from land as farmers, pastoralists, fisher folk and hunter-gatherers. They use traditional production systems that depend directly on natural weather patterns. Even the country's economic development aspirations are grounded on the exploitation of land and natural resources in the form of tourism, agriculture and fisheries. Furthermore, less than 20 per cent of the country is classified as arable, and it is the portion that supports nearly 80 per cent of the country's population.

Nearly 80% of the country's land mass is comprised of arid and semi-arid lands (ASALs), which support more than 20% of the country's population. The ASALs are the mainstay of the livestock economy, hosting nearly 70% of the national herd. They are also home to over 90% of the country's wildlife, and thus critical for the tourism industry, which is the country's second largest foreign exchange earner after agriculture. Yet the full potential of the ASALs remain unrealized as a result of historical economic and political marginalization. The ASALs are currently characterized by the highest poverty rates - at more than 70%, being well above the national average. Their situation is further compounded by vulnerability to recurrent droughts and flash floods.

In 2009, the Government of Kenya issued an environmental atlas with the support of the United Nations Environment Programme (UNEP) outlining the major environmental threats and challenges facing the country (UNEP, 2009). The government acknowledges in the atlas that extreme climatic events such as floods and drought are affecting an increasing number of the rural population and have adverse impacts on economic performance. It further appreciates that the success of Vision 2030, Kenya's overall development plan 2008-30, will depend in large measure on how the environmental challenges arising from climate change are addressed.

Although it recognizes the challenge of climate change to the realization of key targets of economic development, Vision 2030 gives very scant treatment to climate change. It does however note that climate change may slow down the country's projected economic growth, firstly because "the economy is heavily dependent on climate-sensitive sectors, such as agriculture, tourism and coastal zones", and secondly, because its means for coping with climate related hazards is weak (Government of Kenya, 2007:105).

The country is already experiencing significant impacts of climate change. United Nations Development Program (UNDP) asserts that Kenya's mean annual temperature has increased by 1.0 degree Centigrade over the past 50 years, representing an average increase of 0.21 degrees Centigrade every decade. It is projected to increase by 1.0 degree Centigrade to 2.8 degrees by the 2060s. Further projections show that by the turn of the century temperatures in Kenya could increase by nearly 4 degrees Centigrade causing variability of rainfall by up to 20 per cent (Kabubo-Mariara and F.K Karanja, 2007).

ASALs are characterized by high temperatures and low precipitation, and unpredictable climate variability. These are the areas where the greatest impact of climate change is likely to be felt by people who are already disadvantaged in many respects. Elsewhere, the agriculture sector, comprised largely of rain-fed agriculture, highly dependent on predictable rainfall and temperature will suffer too. That will have devastating consequences for the country, as agriculture is the mainstay of the economy. It contributes 26 per cent directly and 25 per cent indirectly to the national Gross Domestic Product (GDP) annually, accounts for 65 per cent of the country's total exports and provides more than 70 per cent informal employment in the rural areas. The sector is both the driver of Kenya's economy and the means of livelihood for the majority of the country's population (Government of Kenya, 2010).

Thus, a combination of high dependence on natural resources as the basis of livelihoods and the foundation for economic development, high poverty levels and low capacity for adaptation, and the existence of other significant environmental stress, make Kenya highly vulnerable to the impacts of climate change. The impacts of climate change are likely to be manifested through increased incidences of droughts and floods, food insecurity, natural disasters, and land degradation. These impacts are bound to undermine the country's capacity to realize the Millennium Development Goals (MDGs), thus reversing gains already made and undermining prospects for social, economic, and environmental transformation.

Climate change will affect human health by increased exposure to malnutrition, infectious and communicable diseases, and as a result of death, disease and injuries arising from heat waves, floods, storms, fires and droughts. It will undermine food security through reduced productivity of land as a result of soil erosion, loss of soil fertility, flooding and biodiversity loss. There are already signs of more severe and frequent floods and droughts, with adverse impacts of livestock and crop production, as well as loss of lives, displacement and destruction of property. Frequent floods and droughts also exacerbate processes of land degradation including desertification, soil erosion and landslides, thereby undermining agriculture and livestock production.

There are ongoing policy, legal and institutional interventions that provide opportunities for addressing the impacts of climate change. The most significant of these is the promulgation of the new Constitution. Although it does not make any specific reference to climate change, the Constitution contains strong provisions regarding the sustainable exploitation, utilization, management and conservation of the environment and natural resources, imposing a duty on both the state and citizens in this regard. Furthermore, the Constitution introduces devolution and establishes devolved governments that will enable citizens to take charge of development planning and permit them to set priorities according to issues that are of immediate concern to them (Republic of Kenya, 2010). This provides an avenue for local-level adaptation to climate change through strategies and interventions designed by the local people in response to their specific realities.

In early 2010, the Government of Kenya adopted and issued the National Climate Change Response Strategy (NCCRS) to provide a framework and strategies for addressing the challenges of climate change (Government of Kenya, 2010). The Strategy seeks to strengthen and focus nationwide actions towards climate change adaptation and mitigation of Greenhouse Gases (GHG) emissions. Prepared through a participatory process that sought to involve all major stakeholders including the private sector and civil society, implementation of the strategy is to be done through the active engagement of all stakeholders. It thus provides an opportunity

for mobilizing citizens and other actors as well as resources and capacities to address the challenges of climate change.

In order to operationalize the NCCRS, the Government of Kenya is presently developing a comprehensive Climate Change Action Plan, with the support of a number of development partners, among them the Department for International Development (DFID) of the United Kingdom, the French Development Agency (AFD, the Government of Japan and UNDP. The Climate and Development Knowledge Network (CDKN) provides technical support to the process. Strong stakeholder participation in the process is ensured through their representation in the inter-ministerial committee, which provides guidance and leadership to the process (Republic of Kenya, undated).

The government is also working on a legal framework for addressing the challenges of climate change. A draft Climate Change Bill has been in circulation for the past two years, and the same has been discussed in different forums, including forums organized by indigenous peoples. Feedback provided by the different stakeholder groups are currently being reviewed to inform further revision of the draft Bill before it is presented to the public for further scrutiny. In summary, the ongoing policy, legal and institutional development processes, to the extent that they have privileged stakeholder participation, have provided significant opportunities for reflecting on and designing appropriate strategies for addressing the challenges of climate change.

3.2. National and local climate change phenomena

It is generally acknowledged that climate change will lead to increased occurrence and severity of weather phenomena. The implications of these are already being felt in a number of areas, and projections indicate that climate change will lead to impacts in many areas with significant implications for livelihoods and national development (see Box).

Areas in which impact will be felt

- rising temperatures
- inundation of low-lying coastal areas
- changes in rainfall patterns
- increase of environmental migrants
- shifts in crop growing seasons
- changes in disease vectors
- increased rate of extinction for many species
- severe water shortages
- heavy deluges and flooding

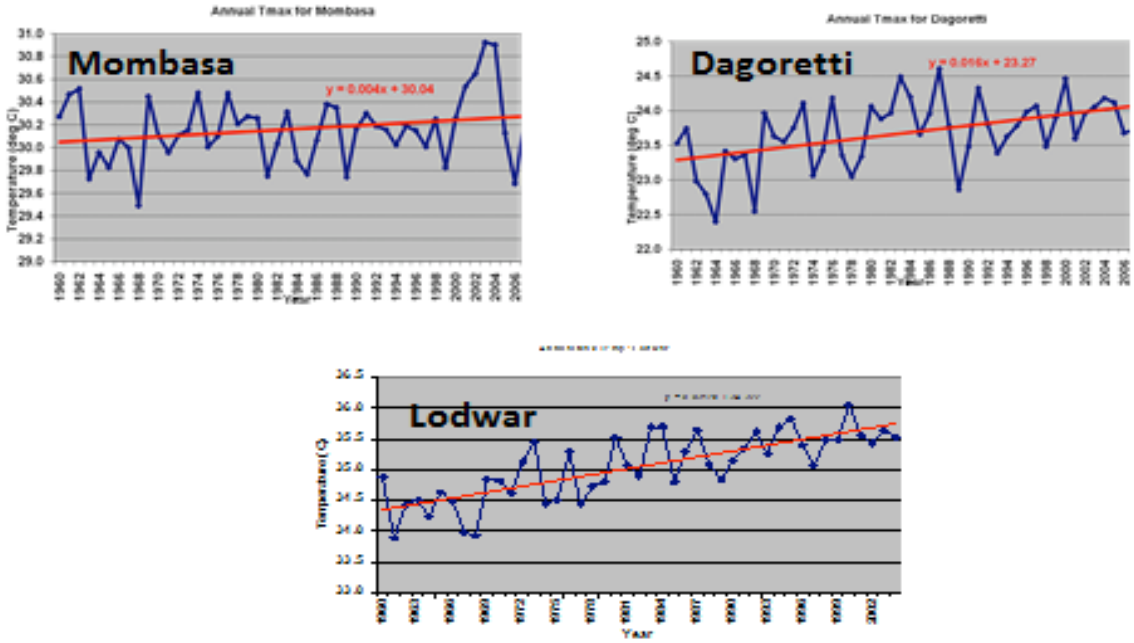
Kenya has a history of natural, weather-related disasters that leave in their trail diseases, death and suffering. Epidemics, floods and droughts are the most significant in terms of prevalence, the number of people affected, and the number of deaths (UNEP, 2009: 37). It is however floods and droughts that are the most prevalent weather related hazards. In recent years, both the frequency and severity of floods and droughts have increased, with consequent rise in losses resulting therefrom.

These natural hazards have been exacerbated in recent years by human-induced climate change. The increased frequency and severity of floods and droughts for instance have been explained at least in part by human activities that increase the incidence and pace of deforestation, desertification, coastal modification (for instance through removal of mangroves), and inappropriate land uses such as cultivation of fragile ecosystems including water catchment areas.

3.2.1. Temperature and rainfall trends

Temperature and rainfall changes in Kenya have been monitored by the Kenya Meteorological Department (KMD) for over 50 years. The trends indicate higher rises in temperature in Northern parts of the country as compared to other parts (compare Lodwar and the other regions, below). Additionally, the country has experienced generally increasing temperature trends over vast areas, depicting for inland areas a general warming trend over time. In the areas near large water bodies, particularly the coastal strip, minimum temperatures show no change, while maximum temperatures show increases since the 1960s. (Government of Kenya, 2010: 28)

Annual maximum temperature trends in Kenya



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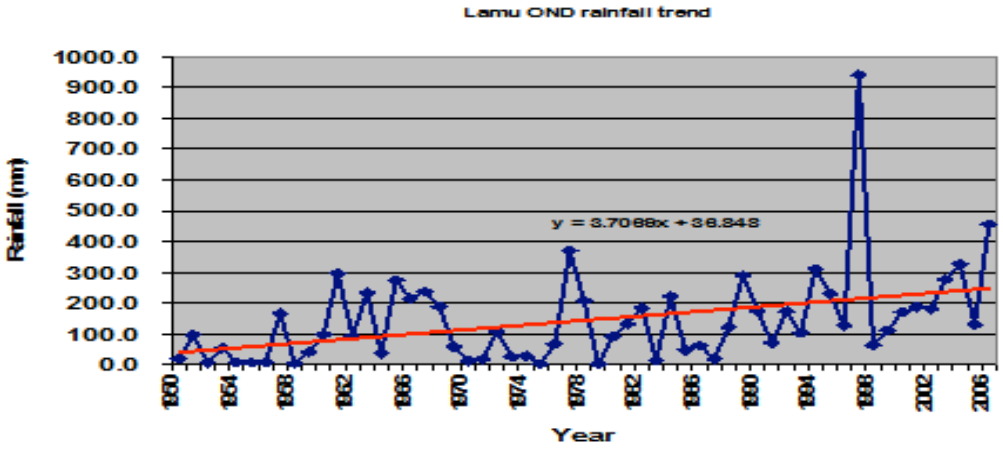
Rainfall trends at coast - Lamu

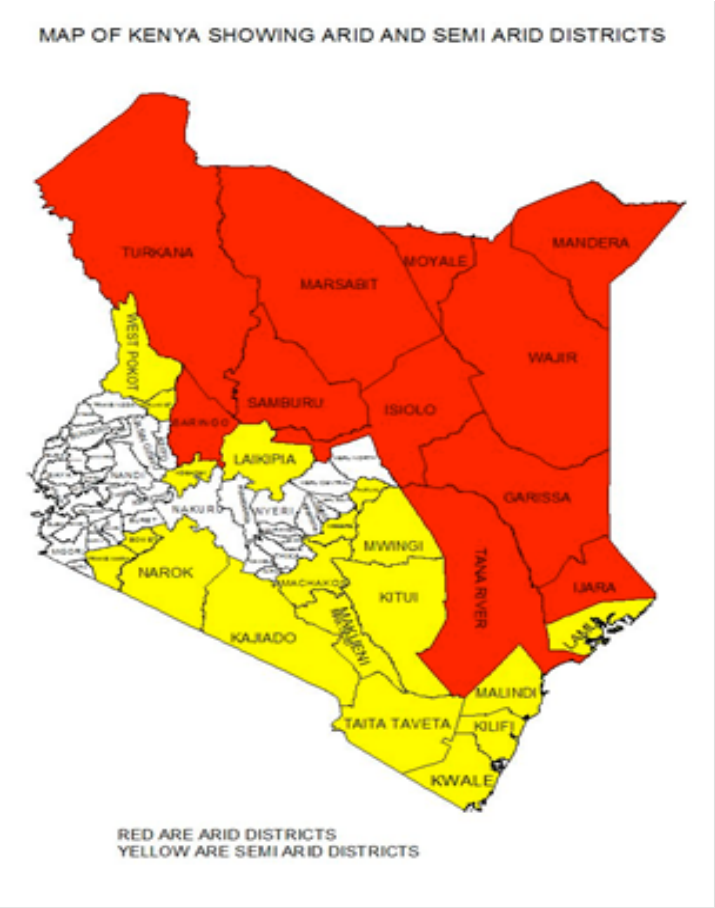


Source: Kenya Meteorological Department (MNKOAL, 2010)

Annual rainfall in Kenya follows a bimodal seasonal pattern with the long rains generally occurring in March to May, while the short rains occur in October to December. The predictability of rainfall patterns is traditionally useful for farmers to plan their farming activities. With climate change, the rainfall patterns are no longer predictable both regarding timing and levels. This disruption of seasonal patterns has seen the incidence of frequent droughts and crop failures. Most farmers have no access to relevant weather forecast data and information to help them contain their losses or diversify to more suitable crops.

3.3. National and local climate change impact

The ASALs are the areas that are currently most severely affected by climate change in Kenya. These are areas where the main economic activities, namely livestock production and subsistence farming, are dependent on rainfall. It is projected that these areas will become even more vulnerable to climate change, with the increase of both droughts and floods.



The sectors that are most affected by climate change are agriculture and livestock production, forestry, water resources, energy and infrastructure, tourism, and human health.

3.3.1. Agriculture and livestock production

The NCCRS notes that climate change is a critical factor in agricultural production in the way that it affects the four components of food security – food availability, food accessibility, food utilization and food system stability - in various direct and indirect ways (Government of Kenya, 2010:34).

The impacts of climate change on agriculture will be both positive and negative. On the positive side, it is projected that there will be increased levels of carbon dioxide and high temperatures leading to higher crop yields. On the other hand, projected shifts in rainfall patterns will have implications for the kind of crops to be grown, privileging the planting of early maturing crops. Extreme weather events will also lead to mass migrations, shortages of food and water, loss of lives and properties, etc.

Challenges of climate change compound the problems associated with agriculture. These problems include poverty among small-scale subsistence farmers, farming in marginal rainfall areas, over-cultivation and land degradation caused in part by rising populations and the

resultant land pressures, lack of technologies to improve production, lack of economic diversification, and lack of knowledge on the use of climate information to maximize agricultural production. Rather than focus on addressing these challenges and improving production, stakeholders are forced by climate change to focus on climate-related challenges.

Climate change threatens to reduce the reliability of water supplies for horticultural production, threatening what is presently the fastest growing agricultural subsector in the country. Horticulture is ranked third in terms of foreign exchange earnings from exports after tourism and tea, generating in excess of US$ 300 million in foreign exchange earnings annually. The main horticultural produce in Kenya includes fruits, vegetable and cut flowers.

The rapid growth of the horticultural industry in Kenya has come at a price. For one, it has led to an increase in irrigation, further stretching Kenya's already strained water resources. Furthermore, the overuse of water for horticulture production has taken its toll on water sources. This is particularly evident in Lake Naivasha, which has seen large growth of industrial horticulture and floriculture farms since the 1980s. This has compounded the situation around Lake Naivasha, which was already under pressure from the destruction of water catchments in the Mau Forest Complex that feeds the lake. Scientists have concluded that the water levels in Lake Naivasha are 10 feet lower than what is healthy for the lake and the ecosystem.

Livestock production is the main source of livelihoods for pastoral communities that inhabit the ASALs and who constitute nearly 30% of the population. It also makes a significant contribution to the national economy. The sector is very sensitive to climate change impacts, particularly the increasingly frequent floods and droughts that result in large losses of livestock through disease outbreaks and deaths. Drought has the most devastating consequences for livestock production as it leads to reduced forage availability and degrades the environment on which livestock depend for their survival. It is projected that climate change will lead to ever more floods, which in addition to causing livestock losses through drowning and diseases, will damage to livestock infrastructure, and otherwise undermine livestock production.

3.3.2. Forests and water resources

Kenya is acknowledged to be a forest cover deficit country, with the most recent estimates showing that the country has forest cover of 3% against a global standard of 10% (UNEP, 2009, KFWG, undated). This situation has come about as a result of poor forest governance that saw huge chunks of forest land appropriated and converted to other land uses. Other major threats to forests in Kenya are a function of rapid increase in population and the resultant demand for human settlements and agricultural land, grazing, sources of construction materials, food, fuel wood, essential oils and herbal medicines (IGAD, 2007).

Kenya has five water towers, namely: Mount Kenya, the Aberdare Range, the Mau Forest Complex, Mount Elgon, and Cheranganyi Hills. All of them are montane forests and constitute the five largest forest blocks in the country. The five water towers are under threat due to forest destructions through illegal extraction of forest resources and unplanned or ill-planned settlements. These activities have impacted negatively on the ability of the water towers to act as water catchments for Kenya's major rivers. This has resulted in major river basins indicating a decrease in runoff of up to 17% over the decade ending in 2000. In a context of general global warming, this is cause for alarm.

Forests also play an important role as the ultimate climate regulators, slowing down the spread of deserts, attracting clouds and promoting rainfall and serving as carbon "sinks". Kenya's

forests provide timber, fuelwood, wood for carving and other artefacts, basketry, and non-wood forest products, which include gum, resins, fodder, soil, murram, asparagus, mushroom, honey, stones, fibre, medicinal herbs and fruits. There is thus growing concern worldwide about deforestation, especially in developing countries, which undermines forest-dependent livelihoods while also exacerbating the effects of climate change.

Kenya's forests are dependent on rainfall for their overall health and sustainability. This means that the projected variation in rainfall patterns and quantity will have direct implications on the forests. Climate change will affect the growth, composition and regeneration capacity of forests resulting in reduced biodiversity and capacity to deliver important forest goods and services, and thereby contributing to increased desertification, deforestation and forest and land degradation, with adverse consequences for communities that depend on these environmental services for support to their livelihoods.

Although some theorists have argued that increased CO2 levels will have a positive impact on tree growth (Omenda, 1997), it is clear that the accompanying increase in temperature and reduced rainfall will more likely undermine the growth of forest resources. This may result in species shifts and possible extinction of others, leading to reduced supply of forest products. This will lead to reduced carbon sink, which in turn will lead to more atmospheric CO2 levels and thus further climate change.

Apart from the impact on forests arising from human activities, more severe droughts and floods have been seen to lead to higher mortality of plants, due either to nutrient leaching or water stress. These high mortality rates are likely to be further aggravated by reduced productivity, flowering and seed dispersal mechanisms. As regions become more unsuitable to indigenous plants, 'species shifts' will result in reduced biodiversity and the loss of local gene pools.

As regards water, Kenya is currently regarded as a water stressed country, with poor replenishment rate. The main challenge for Kenya is managing increasing water demand together with climate variability/change. The upshot of this is that water demand will be compounded by increasing population in addition to climate change. There are already indications of reductions in the overall quantity of water available or the timing of its availability. This has significant implications for agriculture as well as industrial and urban development. The diminishing water sources and decreasing rainfalls have also caused migratory communities to encroach into the land of other communities and privately-owned lands, sparking bloody conflicts. (Republic of Kenya and CAMCO, undated).

The major challenges facing the country with respect to the water sector include water pollution from urban and industrial wastes, degradation of water quality from increased use of pesticides and fertilizers, water hyacinth infestation especially in Lake Victoria, deforestation, soil erosion and desertification. The country is also faced with the challenge of recurring drought and flooding in an increasing number of areas during rainy seasons. Yet all sectors of the economy require increased access to water because of population growth and the country's development goals, particularly irrigated agriculture and the power sectors. In reality, the poor state of development and management means that all sectors remain highly vulnerable to interruptions in their water supplies.

Further adverse consequences of climate change in the water resources sector include drop in hydropower generation, and lower water quality as flooding causes increased siltation, siltation, sedimentation, and salination of water resources in coastal regions. Flooding also carries fertilizers and pesticides into water bodies adversely impacting on water quality and aquatic

life. Projected rise in sea levels will lead to the inundation and disappearance of coastal wetlands, the erosion of shorelines, increased salinity, and the intrusion of saline water into coastal aquifers.

There will be an increase in the spread of waterborne diseases such as cholera which have claimed hundreds of lives, and competition for access to water resources, especially in the ASALs are already triggering conflicts that may escalate into all out 'water wars'. The situation in the ASALs is further complicated by the drying up of seasonal rivers due to poor management of irrigation schemes and processes, over and above the drying up occasioned by prolonged droughts. There is already evidence of persistent crop failure and animal deaths resulting in increased environmental migration from the ASALs on account of increased aridity (Ngaira, 2009).

3.3.3. Energy and infrastructure

Energy production and good, functional transport and communications infrastructure are key to economic growth and eventual industrialization within the framework of Vision 2030. The main sources of household energy in Kenya are charcoal and firewood. Over 75% of Kenyans obtain their energy needs from these sources, which are derived from forests (CDTF, 2005). Demand for energy plays a significant role as a driver of deforestation and land degradation in Kenya.

Deforestation and increased droughts have undermined the availability of these energy sources. Flooding and siltation of dams have also adversely impacted upon hydro-electric power generation. During the drought of 1999 - 2000 hydropower generation saw a drop of nearly 40%, causing serious disruptions in power supply for industrial and domestic use. It is feared that global warming may also affect ocean currents and winds, which offer unexplored potential for coastal regions to install wind.

It is projected that increasing land surface temperatures will drive up demands for electricity for use in refrigeration and air-conditioning, while growing agriculture will require more energy for irrigation. With longer and more frequent droughts being projected, the need for increased energy supplies cannot be over-emphasized.

Floods, which are expected to increase with climate change, will cause havoc in the transport sector, particularly the road and rail network, washing out bridges and roads, and causing severe disruption in economic activity. During the 1997/1998 El Nino floods, sections of Nairobi-Mombasa highway, together with access roads across the country, were destroyed, paralyzing transport and market networks and costing huge losses to the aviation and shipping industries, with entire airports and docking facilities under water. Telephone and electricity supplies and other utilities were devastated by floods and falling trees. The damage rolls back gains in infrastructure development, while the cost of rehabilitation diverts resources from ongoing development investments.

3.3.4. Tourism and wildlife conservation

Tourism is one of Kenya's largest sources of employment and foreign exchange earnings. It is the second largest foreign exchange earner after tea. The sector depends in large part upon the wilderness and wildlife, which in turn depend for survival on either natural rivers or man-made wells and dams. Climate change thus has serious implications for the sector. Climate variability and changing weather patterns can affect the planning of tourism programmes and seriously affect the tourists' comfort, their travel decisions, and eventually their numbers. It can also have significant impact on tourism activities by altering the natural environment that

represents both a key attraction and a basic resource for the sector. Transport, which is at the heart of travel and tourism, can also be a major casualty of climate change.

Global warming is likely to disrupt and even destroy some of the best loved attractions such as the snow-caps of Mt. Kenya, the coastal rainforests and fragile marine ecosystems. With respect to the latter, 'coral bleaching' of the Kenya coral reef has been observed. Furthermore, sea levels are rising, and it is possible that some of the popular beaches will eventually disappear.

3.3.5. Human health

The health of a country's citizens is essential for its development, particularly because it has implications for the productivity of the population. Climate change and its manifestations – floods, droughts, epidemics – have been known to increase the incidences of diseases such as malaria, trypanosomiasis, schistosomiasis, and leishmaniasis. Cholera and other waterborne diseases become more prevalent with flooding and the consequent destruction of sanitation and sewerage infrastructure.

With climate change, Kenya will experience an increase in the incidence, geographical spread and number of people affected by the diseases listed above. This is bound to overstretch the country's under resourced public health sector, an eventuality that will adversely affect the country's economy as the government will be required to spend more and more in health care, while the population's productivity will be lowered.

3.3.6. Climate change impacts affecting case study area

The case studies in Kenya shall be conducted at three locations where three indigenous peoples' communities are resident. The locations are in Mau Forest Complex, where the Maasai and Ogiek communities will be targeted, and in Turkana where the Turkana community will be targeted. While more detailed baseline information on impacts of climate change in the these locations and among these communities shall be generated once the case study commence, it can generally be asserted at this point that these communities are sharing in the experiences of the impact of climate change that have been outlined above for the entire country.

The Mau Forest complex, where the Maasai and Ogiek communities will be the focus of study has been the subject matter of much concern across the country and even within the East African region as a result of the destruction and degradation that it has undergone in recent decades, and which have impacted negatively on the habitat and its water catchment role for significant areas of Kenya and Tanzania. Concerns about the Mau Forest Complex have focused attention of the country on climate change and its impacts, especially on water resources, agricultural production, wildlife and biodiversity conservation. A Government Task Force on the Conservation of the Mau Forests Complex was established by the Prime Minister of Kenya in July 2008 to look into the matter and recommend strategies for arresting the situation and rehabilitating the forest complex. The Task Force issued in March 2009 identified the Ogiek as the community whose livelihoods as hunter-gatherers had been most adversely affected by the destruction of the forest and whose land rights had been compromised through illegal excisions of land from the forest and allocation of the same to individuals and groups from other parts of the country. The report recommended, among other things that the government works with the community to reaffirm their land rights within the forest and to cooperate with them in the management of the forest resources (Republic of Kenya, 2009).

The Maasai community that will be the focus of the second case study in the Mau Forests Complex does not, unlike the Ogiek, live within the forest complex. However, they depend on the environmental services of the forest as water catchment. In the particular case to be studied, the community lives near Lake Naivasha, which also feeds off the Mau Forests Complex. The lake has in recent years suffered substantial degradation as a result of competing land uses, especially arising from the establishment of large horticultural farms for production of flowers for the European market around the lake. The farms have directly impacted on the availability and quality of water in the lake, in addition to blocking access to the lake for Maasai livestock. This has engendered conflicts that have at times turned violent, as the Maasai have sought to assert their historical rights to the lake and its resources in support of their livelihoods.

In Turkana, impacts of climate change on the ecosystem are most noticeable in the periodic floods and droughts that undermine agriculture and livestock production. Turkana has been characterised over the years by perennial emergencies, with famine relief becoming a near permanent feature of the local economy, largely because of the vagaries of extreme climate events that undermine production. More recently, Lake Turkana, the life-blood of much of the region has come under pressure from hydro-power developments by Ethiopia upstream that threatens to divert the lake's water supply and to undermine fishing, agriculture and livestock production that is dependent on this water source. The partner organization for the Turkana case study, Friends of Lake Turkana (FOLT) is directly involved in advocacy efforts at national, regional and global levels to halt this development and ensure the sustainability of the lake. The case will include a review and analysis of the advocacy effort and its implications for the people and the County.

3.4. Contributing factors

The degree to which climate change impacts upon the county and communities of Kenya, is a correlation of the degree of exposure and adaptive capacity. In the course of the study, a detailed investigation and analysis of these two factors will be undertaken to establish the factors that contribute respectively to containment and escalation of climate change impacts on the country, communities and individuals.

At this point, it can be asserted that the impact is increased by the lack of capacity at household, community and national levels for responding to the challenges of climate change in an effective and timely manner. This includes lack of adequate information and awareness for preparedness as well as for response to extreme climate events and hazards. Community frameworks for responding to such hazards have been undermined by various factors including increased frequency and scales of exposure. At the national level, lack of policies and institutional frameworks is to blame. Significant steps have been taken to address this lack of capacity at the national level through the adoption of the NCCRS and the ongoing development of the National Climate Change Action Plan. This study shall analyze these efforts to establish their impacts at all levels.

Having accepted that climate change is a reality that countries and communities have to live with, the main concern is how to contain its impacts upon communities and ecosystems by reducing the negative effects of the hazards. In this context, governments are concentrating their efforts on putting in place appropriate adaptation measures.

The NCCRS has identified specific interventions in different sectors for adaptation and mitigation to address the impact of climate change. The Table below highlights the key adaptation interventions articulated by the Strategy.

Proposed Adaptation Interventions by Sector

Agriculture, Horticulture and Food Security	▪ support for community-based adaptation strategies ▪ introduce of drought tolerant food crops ▪ promote of irrigation agriculture ▪ address land degradation through soil conservation measures ▪ promote conservation agriculture ▪ diversify rural economies ▪ reinvigorate agricultural research and development ▪ develop innovative insurance scheme for farmers against crop failure ▪ enhance agricultural extension services ▪ strengthen integrated and environmental friendly pest management systems ▪ develop proper food storage facilities
Livestock/Pastoralism	▪ breed animals from various agro-ecological zones ▪ develop special livestock insurance schemes ▪ improve vaccination and cross-border disease surveillance ▪ institutionalize early warning systems on drought, floods and disease outbreaks ▪ introduce community-based emergency fodder banks ▪ integrate indigenous knowledge systems in strategies for climate change adaptation ▪ promote economic diversification among pastoral communities
Water	▪ construct intra-basin and inter-basin water transfers ▪ invest in decentralized water recycling facilities ▪ enforce laws for efficient water use ▪ increase capture and retention of rainwater ▪ develop and maintain adequate water infrastructure ▪ build capacity for water quality monitoring ▪ de-silt rivers and dams ▪ protect and conserve water catchment areas
Health	▪ strengthen public health systems ▪ improve access to clean water and sanitary facilities ▪ heighten surveillance of new disease outbreaks ▪ set up immunization programmes against diseases associated with climate change ▪ choose healthy paths to a low-carbon future
Forestry	▪ intensify and sustain afforestation and reforestation programmes ▪ encourage agroforestry ▪ promote alternative livelihood systems ▪ promote alternative energy sources ▪ involve forest-dependent communities in forests management
Energy	▪ control river water abstraction upstream ▪ zero-rate taxes on renewable energy technologies ▪ promote the use of alternative renewable energy ▪ promote efficient firewood cookstoves, solar and LPG cookers

Rangelands, Wildlife and Tourism	▪ develop a National Wildlife Adaptation Strategy ▪ monitor, manage and remedy degraded rangelands ▪ encourage participatory approach to rangeland management ▪ create community wildlife conservancies ▪ improve wildlife species conservation efforts
Social Infrastructure and Human Settlement	▪ strengthen disaster preparedness ▪ develop climate change awareness programmes with all stakeholders ▪ ensure proper urban development planning ▪ diversify economic activities to improve resilience of rural communities dependent on climate-sensitive sectors ▪ decentralize emergency response to the community level
Physical Infrastructure	▪ invest more in alternative energy sources such as geothermal that are less sensitive to climate change ▪ ensure proper planning of infrastructure development through the use of geotechnical site investigations (GSIs)
Fisheries, Coastal and Marine Ecosystems	▪ promote sustainable fish farming ▪ map out areas that will require shore protection across the country ▪ establish a biodiversity monitoring network to identify species that will be affected by climate change and those that could be used as biological indicators ▪ encourage a coastal and watershed basin management approach ▪ implement adaptive management of fishing capacity based on environmental and climate forecasts ▪ conduct awareness campaigns on impacts related to climate change among different stakeholders ▪ provide economic incentives to diversify livelihood options to reduce dependence on climate-sensitive marine resources ▪ strengthen co-management and community-based management institutions

The NCCRS and the ongoing development of a National Climate Change Action Plan provide a useful opportunity for linking this study and its associated processes with national level policy and institutional frameworks in order to ensure that the findings of this study shall be mainstreamed into the national policy and operational framework. It will thus be necessary to make deliberate efforts in the course of the study to create awareness and capacity among the case study communities specifically and indigenous peoples of Kenya generally, to engage with these processes at local and national levels.

4. Republic of Namibia

4.1 National and local climate change phenomena

The following section provides broad geographical and climate information for the Republic of Namibia. It includes existing climate data and the expected climate changes for southern Africa as predicted by the IPCC (2007, 2007 (a)). In addition, recent models that have been run specifically for Namibia (in Turpie *et al* 2010) - which look at the general climate change predictions for the country as a whole - are presented and, thereafter, the predictions for specific case study area under review. Focus is placed on temperature, rainfall and sea-level rise (SLR) and the first order climate change impacts that will affect the livelihoods of the indigenous people (the Topnaar living along the Kuiseb River in the Erongo Region and the Hai//Kom San living in the area of Farm Tsinsabis in the Oshikoto Region). Information on geography presented below is gleaned from Turpie *et al* (2010)

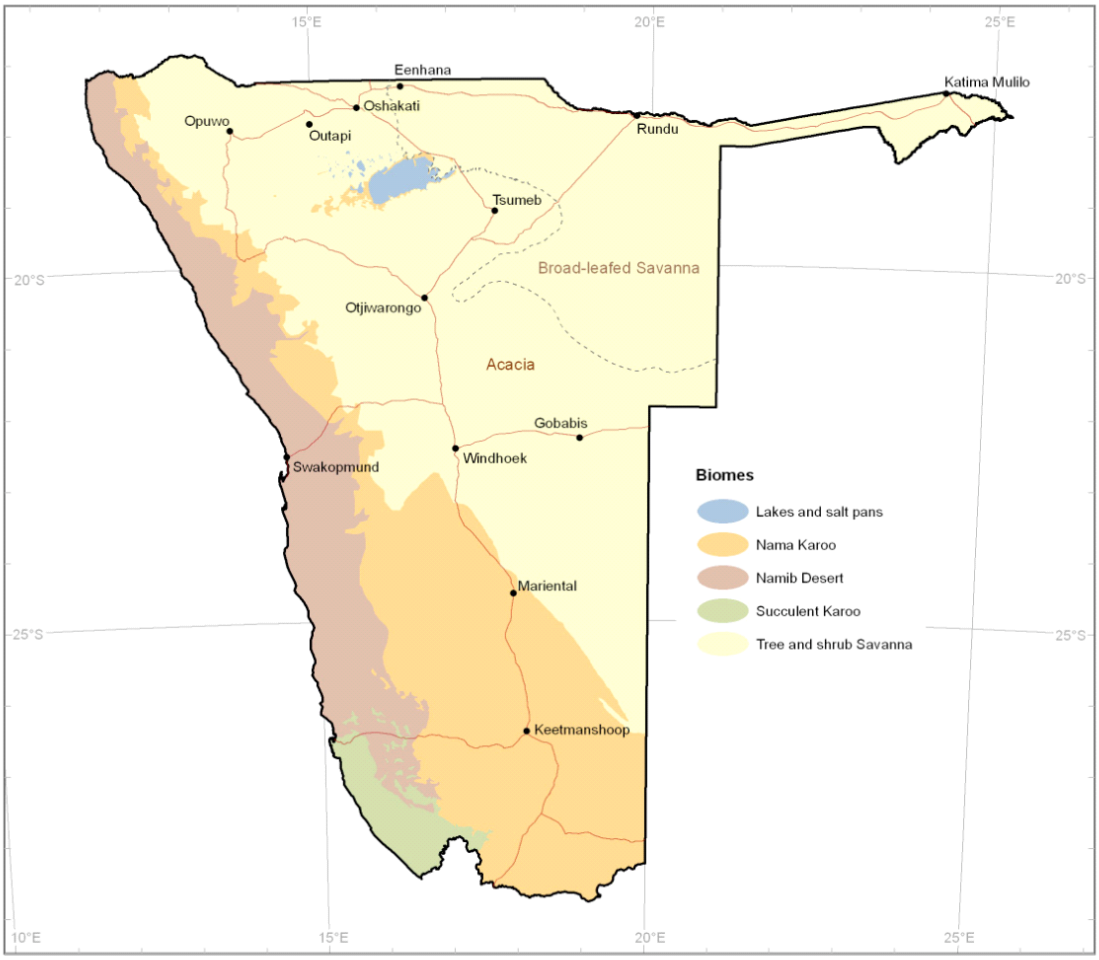
4.1.1. Geography and climate

Namibia covers an area of 823 680 km^2 on the Atlantic coast of southern Africa. It is located between 17° and 29° South and 11° and 26° East. In the north, south-central and southern areas a steep escarpment runs north-south and divides the country into low-lying coastal plains (70-100 km wide) to the west and a higher inland plateau to the east. The mountainous plateau gives way in the east and north to flat Kalahari sandveld, sloping gently to the east and south, and blown into dunes in some areas. Large isolated rocky outcrops (inselbergs) lie scattered throughout the central and western areas.

Namibia has only four perennial river systems, all of which originate in neighbouring countries and lie close to or on the political borders. All other rivers within the country are ephemeral and, for most of the year, are dry; flowing only briefly with characteristic 'flash floods' when enough rain has fallen over their catchment areas. The vegetation that lines the banks of these rivers supply important wood and *veldkos* (wild edible plants and animals) for communities and fodder for wildlife and livestock in the arid areas of Namibia. Large numbers of rural households, particularly during times of drought, depend on these resources for their survival (Jacobson, *et al* 1995).

Due to low availability of surface water, the water stored beneath ephemeral river courses or in underground aquifers (dependent on annual rainfall for recharge), provides essential water for rural and urban communities *(ibid)*.

Figure 7. Main biomes of Namibia (from Mendelsohn *et al.* 2002)

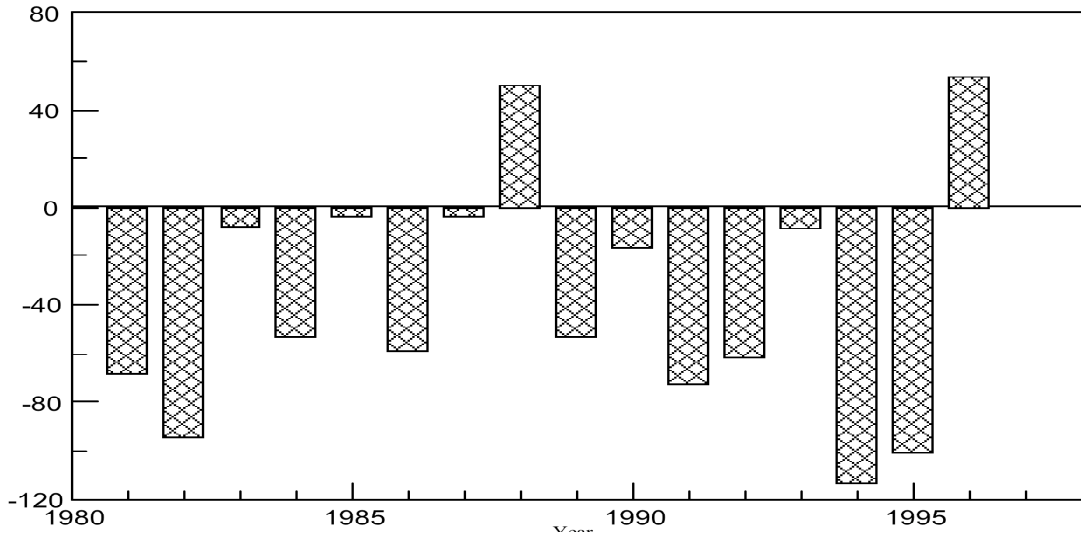


Namibia is characterized by five major biomes, (Figure 1) four of which are desert systems:-

- **The Namib**, (characterised by a vast coastal dune area to the south of the Kuiseb river and stony gravel plains) which runs along the entire west coast from the port town of Lüderitz into southern Angola;
- The **Succulent Karoo** (characterised by a high number of endemic floral assemblages) which lies south of Lüderitz and extends across the Orange River into South Africa;
- The **Nama Karoo** (which also supports a high degree of endemism)which occurs immediately to the east of the previous two desert systems and covers most of the southern third of Namibia, tapering to a narrow belt from central Namibia northwards;
- The **Southern Kalahari** (characterised by arid shrub savannah in the west and sub-humid tree savannah in the east) which extends eastwards towards Botswana.

Namibia is the most arid country in Africa south of the Sahara. Rainfall ranges from about 600 mm in the extreme north-east (in an area of < 6% of the country) to less than 50 mm in the extreme south and along the entire coast (Mendelsohn *et al.* 2002). Central- to north-western Namibia experiences one of the steepest rainfall gradients anywhere in the world, ranging from about 400 mm to less than 50 mm over a distance of just 230 km. Rainfall is highly variable and unpredictable with an inter-annual coefficient of variation that ranges from about 30% in the north-east to over 100% in the driest areas.

Figure 8. Deviation from average rainfall (mm) in Namibia (1981-1997) **[Hutchinson, P. unpublished data in Tarr,1999]**



The north and south of the country experience the highest temperatures with the average 199maximum for the hottest month being over 34°. For most of Namibia rain falls in the summer months of November to March but the Succulent Karroo in the south west receives a significant amount of its meagre rainfall in the winter months of June to August. About 22% of Namibia's land is classified as hyper-arid desert, 70% is classified as arid to semi-arid savannah and the remaining 8% (in the north east) is classed as dry sub-humid savannah (Mendelsohn *et al.* 2002). High temperatures and low humidity over most of the country for most of the year result in high rates of evaporation. The climate of the coastal belt to the escarpment differs from the rest of Namibia and is influenced mainly by the cold Benguela Current. Temperatures here are generally moderate, fog is frequent (about 125 days per year at the coast dropping to about 40 days per year 80 km inland) and wind is a dominant feature.

Namibia's climate has been arid for millions of years. As a result, the soils are generally poor and many plants and animals display a high degree of adaptation to dry conditions. The Kalahari sands in particular are extremely low in nutrients. The combination of poor soils and low rainfall means that primary production is low throughout the country, and highly dependent upon annual rainfall. This is reflected in both rain-fed crop production, which is limited to the northern and eastern parts of the country where output is marginal to low, and livestock production, which ranges from marginal in the south and west to moderate in the north and east.

High rainfall variability leads to a corresponding variability in runoff, soil moisture and stream flow (DWA, 1991). Due to the high inland temperatures vegetation suffers high levels of evapotranspiration. The rate of groundwater recharge is very low (< 1%) and the arid areas of the country (more than half of Namibia) contribute very little to the replenishment of vital groundwater supplies (ibid).

4.1.2. Climate policy context

Namibia ratified the UNFCCC in 1995 and acceded to the Kyoto Protocol in 2003. As a developing country, Party to the UNFCCC, Namibia is not required to reduce its emissions, but can trade carbon credits under the Clean Development Mechanism (CDM) of the Kyoto Protocol.

The trading in carbon credits may result in significant investments in Namibia by companies that wish to make use of opportunities such as agro-forestry or energy production. Namibia's 2nd national communication to the UNFCC and National Policy on Climate Change were completed in 2011 (GRN 2011 and GRN 2011(a)).

4.1.3. Existing climatic changes and trends

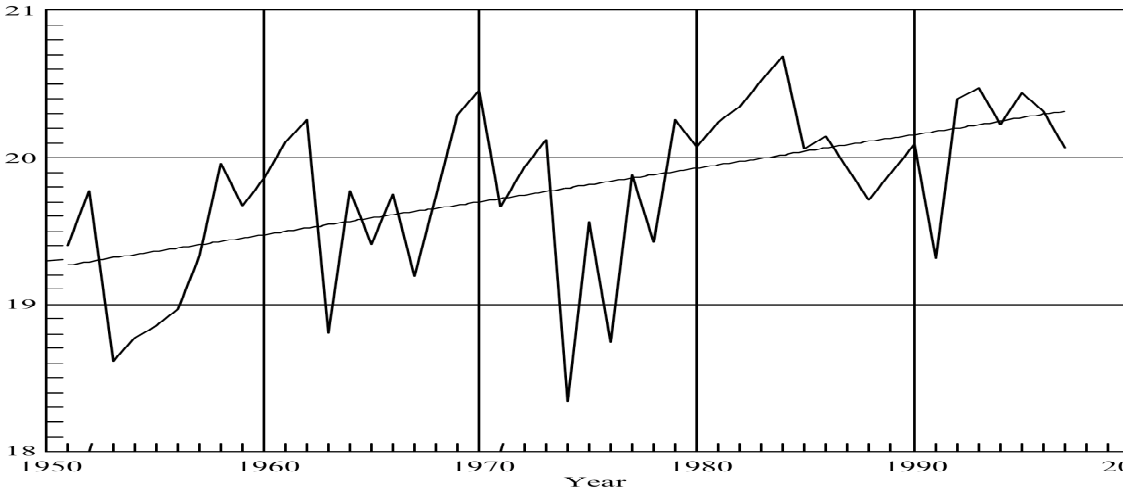
The IPCC Fourth Assessment Report[3] published in 2007 confirmed that global climate change is already happening. This report found that communities who live on marginal lands and whose livelihoods are directly dependent on natural resources are the most vulnerable to the impacts of climate change. The IPCC identifies the southern African region (particularly in the inland area around the Kalahari desert) as one that will experience some of the highest temperature rises and, as a result, some of the most extreme impacts of global warming. Available trends for southern Africa and Namibia are provided below.

Temperature

- The IPCC (2007) report states that between 1961 and 2000, there was an increase in the number of warm spells over southern Africa, and a decrease in the number of extremely cold days.
- Data from between 1950 and 1997 (Figure 3) show that mean temperatures for Windhoek displayed an average increase of 0.023°C per annum over that period (in Tarr 1999).

Figure 9. **Windhoek Mean Temperatures (^{O}C) (1950-1997)** [NMS, unpublished data]

[3] All climate and sea level change data in the IPCC Fourth Assessment Report of Working Group One represents an average prediction of several climate models for the A1B emissions scenario projected to the period 2080-2099



- The 1980s and 1990s were the hottest decades of the 20th century and together with global trends, several records were broken in Namibia for maximum temperatures during the summer of 1997/98. Since then, Warbuton and Schultz (2005) report that numerous new record temperature highs and lows were recorded over South Africa for 2003, 2004 and 2005.
- Potential evaporation, computed as a function of temperature parameters, appears to have increased over most of the interior of southern Africa (Warbuton & Schultz 2005a).
- Midgley *et al.* (2005) examined temperature records from all available long-term weather stations in Namibia and the northern Cape. Roughly half the stations showed significant increases in temperature over their recording period, while none showed a significant decline. The mean decadal increase across all stations during this interval was 0.2°C (s.d. = 0.1°C), an increase that is roughly three times the global mean temperature increase reported for the 20th century.

Rainfall, streamflows and water balance

- The IPCC (2007 (a)) reports increased interannual variability in rainfall across southern Africa since 1970, with higher rainfall anomalies and more intense and widespread droughts.
- Namibia's volumetric rainfall between 1915 and 1997 steadily declined (Hutchinson 1998, in Tarr, 1999).
- Central Namibia falls directly within the 'drought corridor' – the area between 20 to 25° S that experiences high dry spell frequencies linked to El Niño events. These phenomena have become more frequent and intense since the 1970s (Usman & Reason 2004). Lower flow regimes in major river basins in Namibia and the southern parts of Zambia are also linked to the more frequent occurrence of El Niños (Alemaw & Chaoka 2006).
- Frequency and intensity of extreme hydrological events in the southern African region has increased markedly (Warburton & Schulze 2005)
- Warburton and Schulze (2005a) compare the 1950 - 1969 and 1980 - 1999 timing of the 3 months of highest accumulated winter streamflows and show that, inter alia,

Namibia's Orange River primary catchment (in South Africa) displays a shift to 2 months later in the latter period.

- Midgley *et al.* (2005) state that water balance, a composite measure of temperature and rainfall that determines the water available to plants, has shown a significant decline at five of the fifteen weather stations investigated in Namibia and the northern Cape. No stations showed a significant increase in water balance over this period. These authors also report that a sign of climate change is indicated by the response of populations of *Aloe dichotoma* to apparent trends in recent climate. These responses indicate warming and drying trends in the southern parts of the country over the past 15 to 30 years.

Sea level rise

- Tide gauge records taken from Namibia (Lüderitz) and the west coast of South Africa (Port Nolloth and Simon's Bay) between 1960 and 1992 displayed increasing sea levels.The rate of rise was, on average, 27 mm per decade (Hughes *et al.* 1992).
- The IPCC's (2007 (a)) predictions for global SLR (a best-estimate rise of less than 2 mm per year) were lower than the actual rise (3.3 mm /yr) which occurred between 1993 and 2006 (Rahmstorf *et al*, 2007).

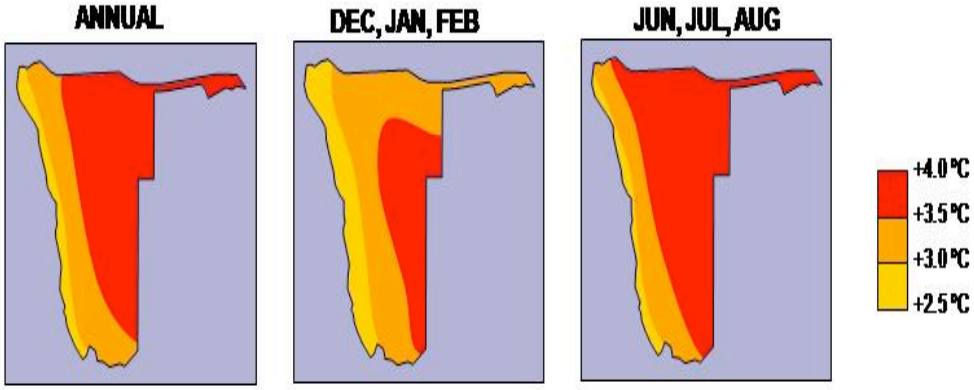
4.1.4. Namibia's predicted and modeled changes for the future

Temperature and rainfall

It is predicted with a high degree of certainty that Namibia (and the rest of southern Africa) will continue to experience an increase in temperature in forthcoming decades (IPCC 2007). Changes in precipitation remain harder to predict than temperature (ibid). Namibia's naturally high climatic variability compounds this uncertainty and, because of this, Turpie et al (2010) considered a range of outcomes by running 21 different models (based on the Assessment Report4, A1B emissions scenarios) which present a variety of high, median and low climate change estimates for the years 2050 - 2100.

In summary, their research suggests that:

- Maximum temperature increases (2 - 6°C) will occur in Namibia by the 2050 decade. Due to the influence of the cold Benguela current, warming in Namibia is likely to be considerably less near to the Namibian coast, than along the escarpment and inland regions of the country (Figure C). The Oshikoto Region falls within an area where extreme increases in annual temperature are expected (possibly in excess of 4° C).



Temperature changes over South Africa from the MMD-A1B simulation. Annual mean, December, January, February and June-July-August temperature change between 1980 to 1999 and 2080 to 2099, averaged over 21 models.

Figure 10. Predicted changes in temperature for Namibia (AR4; A1 B Emissions scenarios) Source: Turpie *et al* 2010

- The 21 models run by Turpie *et al* (2010) and the median of these, concur with the IPCC's predictions which indicate major decreases in precipitation across the southern African sub-continent. By 2080 the northern regions of Namibia (including the Oshikoto Region where the Hai//om reside) are expected to experience a 10% decline in rainfall while the central regions (including the inland Erongo region) could experience a 20% decline. These figures are predicted to worsen to 20% and 30% respectively by 2080

Soil Moisture and primary production

Increasing temperatures will be accompanied by increasing rates of evapo-transpiration at all localities, with maximum increases in the interior and over the Kalahari Desert (IPCC 2007). Turpie et al (2010) estimate that for every degree of temperature rise in Namibia, potential evaporation (already extremely high) will increases by 5%. Thus, soil moisture levels are projected to decline dramatically with the cumulative impacts of higher temperature, lower rainfall, lower humidity and higher rates of evaporation. This will have severe implications for plant growth and carrying capacity of rangelands throughout Namibia (although the CO_2 fertilisation effect may counter this in some areas – exacerbating the problems linked to some weed and alien invasive plant growth).

Changes to the fog regime

There are currently no credible projections of changes to Namibia's coastal fog regime, which is known to be vital for most endemic and many other plant and animal species that thrive outside the westward flowing ephemeral river systems (e.g the Kuiseb river which sustains the Topnaar community) in the coastal Namib Desert.

Coastal zone and coastal erosion

Coastal areas are likely to see increased incidence of flooding and inundation, affecting low-lying areas (IPCC 2007(a)). Saltwater intrusion into underground aquifers is also predicted which could influence the survival of certain desert plants (eg. the *!Nara* plant – an important

seasonal staple of the Topnaar living in the Kuiseb valley).

Variability and extreme events
The IPCC (2007 (a)) and Turpie *et al* (2010) predict that rainfall variability is likely to increase over southern Africa and extreme events such as droughts and floods are likely to become more frequent and intense.

4.2. Expected climate change impacts in the two study areas

Based on the predicted climate change impacts represented in IPCC (2007) and Turpie et al (2010), the traditional and indigenous peoples living in Namibia are expected to face increasing freshwater stress over the forthcoming decades. The following sections consider the other likely first order climate change impacts (e.g. on ecosystems and land productivity) that will directly impact upon the livelihoods of the two indigenous groups in Namibia under review – the Topnaar (in the Kuiseb River) and the Hai//om San (at Tsinsabis).

4.2.1. Potential impacts on the livelihoods of the Topnaar

Natural environment
The Topnaar live in small settlements along the banks of the Kuiseb River in the hyper-arid, western part of the central Namib Desert – an area that has been arid or semi-arid for an estimated 80 million years. Over this extensive period, the plants and animals found here have been able to adapt to extremely harsh climatic conditions and, as a result, many are endemic.
The Kuiseb is typical of the many westward-flowing ephemeral rivers that characterise the Namib. Surface waterflow in these rivers is erratic and depends upon seasonal rainfall in their respective catchment areas. A permanent, subterranean waterflow occurs beneath the surface of these usually dry river beds – enough to maintain narrow strip of vegetation or westward flowing'linear oases'.

The Kuiseb River is flanked in the south by large sand dunes (a sea of sand extending for several hundred kilometres southwards), and in the north by gravel plains (flat stony areas that support an exceptionally low biomass of vegetation with a ground cover of 0.1 – 5%). These seemingly barren plains also support fog-dependent lichen fields and scattered herds of arid-adapted wildlife (springbok, oryx, ostrich and zebra, black-backed jackals and spotted hyena) (Mendelsohn *et al*. 2002)

Although the average annual rainfall for Gobabeb (the study site) is only 27 mm, the average annual precipitation derived from fog (which reaches the study site on average 37 days) is 31 mm (Lancaster *et al*., 1984).

When sufficient rain falls in the Kuiseb's catchment area to the east, the river is subject to 'flash' floods, which prevent the Namib dune sea from shifting north. The floods replenish the large trees and underground water reserves. Although the river has experienced large scale flooding in recent years (2010 and 2011), Masaaki (2005) states that instances of flood water reaching as far as the Kuiseb delta (at the coast) in the past 50 years, when compared to the previous 160 years, has become a rare event.

Much of the flora and fauna found in this area (including spiders, insects, and reptiles) are dependent on the coastal fog as a means of survival.

In extraordinary years, when high precipitation occurs in the Namib Desert, both the inter-dune valleys and the gravel plains become covered in high density stands of grass (predominantly *Stipagrostis sp*.) but this is not considered the norm.

Topnaar livelihoods

Traditionally the Topnaar were nomadic hunter-gatherers, entirely dependent on the seasonal harvesting of *!Nara* melons, other plants, fishing and hunting wildlife (Box 2). Reports from the 19th Century state that fish were caught in the vicinity of Walvis Bay (Koehler, in Dentlinger, 1977). In the 1890s, Palgrave (in Koehler) reports that Topnaar men were sometimes employed to help with the unloading of cargo at the Walvis Bay docks. Thus, the purely traditional lifestyle of the Topnaar has not been in evidence for at least 120 years and, since at least the 1960s, wages and small pensions from family members working in Walvis Bay or at the Desert Research Institute at Gobabeb, have played an important role in shaping the livelihoods of the Topnaar living in the Kuiseb basin over the past fifty years. Many Topnaar people also turn to the labour market for work on commercial farms and towns such as Walvis Bay where they are employed mostly in the fishing industry. Their opportunities for employment within the Erongo Region are limited without education and skills (Hoadley 2005). Opportunities for employment on farms in this mostly hyper-arid and arid region are also severely limited. An ever-increasing volume of tourism through the Region has occurred in recent decades but this too provides only limited jobs to people who are unskilled.

Box 2. Flooding of the Kuiseb River vital for *!Nara* and other vegetation survival

The livelihoods of the Topnaar living in the Kuiseb valley are closely linked to the annual flooding of the annual Kuiseb river which ensures that the water table is high enough to sustain its function as a linear oasis.

Van Damme *et al* (1992) report that the Topnaars make use of at least 50 different desert plant species for dietry and medicinal purposes but one plant, in particular - the !Nara (*Acanthosicyos horrida*), an endemic, arid-adapted plant which grows within the dune areas on the southern bank of the river - has served as a vital source of income and nutrition for the Topnaars since their arrival in the Kuiseb valley (Dentlinger,1977). This plant has an extensive tap root system that reaches to the water table. Water is stored in its melon-like fruits which produce large numbers of oil-rich seeds.

Annual flooding of the Kuiseb river is considered to be vital to the regeneration and survival of !Nara (Masaaki 2005) and the large trees that line the banks (Schactshneider and Edmunds 2010). Its seeds are used seasonally as a staple food and a source of cash income by the Topnaar during harvest time. In 2005 it was reported that 40% of Topnaar harvesters have no other source of income during the harvesting season (January – May) (Masaaki 2005).

The highest density of these plants is found at Nara valley (an inter-dune valley) situated 15km downstream from Soutrivier Village. Shilomboleni (1998) reports that conditions for !Nara growth have deteriorated over the decades , and crop yields have decreased in recent years . Changes to the flow of the Kuiseb due to building flood protection walls (in 1961) and lowering of the water table and altered climatic patterns could be to blame (Masaaki 2005).

Industrial activity in Erongo is limited and based on fish processing concentrated in Walvis bay. Small and Medium-sized Enterprises (SME) activity in the Erongo region has concentrated mainly in trade and services and to a lesser extent in manufacturing (which includes beer/liquor brewing) within the urban areas. It depends primarily on the buying power of those in the formal sector employment.

Today the Topnaar that are settled at Soutrivier, Natab and Homeb (in the nearby vicinity of the Desert Research Foundation at Gobabeb) keep chickens, small livestock (goats) and tend vegetable gardens. The trees of the Kuiseb provide extremely valuable shade and forage for wildlife and the Topnaar domestic livestock. Their diets, no longer 100% dependent on nature, are supplemented heavily by bought foods e.g. maizemeal, flour and oil.

Apart from the *!Nara* several plants, also dependent on the seasonal flooding of the river , still have significance for Topnaar livelihoods in the Kuiseb. *Acacia erioloba* (camel thorn) is a hardwood tree with profuse pods that thrives throughout Namibia in the ephemeral river beds. It provides an important source of shade, firewood and food for wildlife and goats. The gum, bark and roots are used medicinally (Wyk & Gericke, 2000) and the pulp of the pods, are eaten by the Topnaar during times of extreme drought (Mizuno & Yamagata, 2005). *Faidherbia albida* a large tree which sheds its leaves and pods annually. The leaf litter provides a vitally important food source for goats during the dry season.

Potential climate change impacts on Topnaar livelihoods

Using the information provided in Turpie *et al* (2010) together with baseline information presented in Mendelsohn *et al* 2002, the broad climatic and vegetation responses to climate change within the Kuiseb valley include:

- An estimated rise in the average maximum temperatures from 26° C to 28° C (for settlements closer to the coast) and from 30° C to 33° C (for more inland areas).
- A drop in the already extremely low (hyper-arid) average annual precipitation by +/-10 - 20% to < 40 mm/y (for settlements closer to the coast) and a decline to less than 50 mm/y (for the more inland areas).
- Increasing aridification and shift in hyper-arid desert eastwards, with a reduction in primary productivity and a corresponding decline in livestock carrying capacity during most years.
- Under expected climate change conditions, Namibia's ephemeral river systems, including the Kuiseb River, will be subject to decreasing rainfall, increasing temperatures and increasing rates of evaporation. Less frequent and lower magnitude flooding is predicted for these 'linear oases', but due to higher rainfall variability, the years with excessively high rainfall (as experienced in 2011) will cause high rates of run-off and excessive flooding (Turpie *et al* 2010).
- Schactsneider and Edmunds (2010) illustrate that the large trees (confined to the banks of ephemeral rivers) are reliant on a seasonally fluctuating combination of groundwater, shallow soil water and deep soil water), directly depend on Kuiseb aquifer recharge resulting from flood-water infiltration.
- If predictions for increased upstream water abstraction (due to increasing numbers of permanent water points and dams by farmers and other users) and global climate change are realized, then water levels of the Kuiseb aquifer will decline substantially. Ultimately water availability the vegetation structure along the river will be seriously

threatened. The implications for biodiversity and Topnaar survival along the Kuiseb river could be severe as large trees in riverbeds provide essential shade, fodder and habitat to many species of wildlife as well as fodder for the small herds of goats kept by the Topnaar.

- Turpie *et al* (2010) report that reductions in vegetation cover and declining surface water (small springs, seeps etc.) is likely to affect wildlife presence in the following way:-
  - the range of arid adapted species like springbok and gemsbok will decline slightly in the extreme western desert areas.
  - A noticeable decline in the range of Burchell's zebra throughout the Erongo region.
  - The reduced presence of wild ungulates will affect scavengers and predators (most notably black backed jackals and hyena). Their populations may eventually decline but there is a likelihood that the lower number of wild ungulates may mean that Topnaar goats will become more vulnerable to predation.
  - There may be changes to the quantities, quality and seasonality of all important *veldkos* plant species. In some cases (those plants well-adapted to hyper-arid conditions e.g the *!Nara plant* , *Acanthosclus horrida,* an important, seasonal staple of the Topnaar), no change or improvements in availability may occur due to higher temperatures although the lowering of the water table may affect them negatively.
- As sea-levels rise there will be (*inter alia*) increased risk of salt water inundation into coastal aquifers (Nicholls *et al* 2007]. This could affect the quality of water available to the Topnaar and to many of the plants they depend upon (the !Nara melon in particular with its dependence on deep ground water). The scale of salt-water intrusion of coastal aquifers will depend on the size of the aquifer, geological factors, groundwater withdrawals, surface water recharge and precipitation (Nicholls *et al* 2007]

- The impacts of climate change on Topnaar farm-based livelihoods are likely to include:-
  - a reduction in carrying capacity . Fewer goats will be able to be kept on the same area of land.
  - There may be a drive to increase the numbers of boreholes, which will increase overgrazing and rates of land degradation;
  - The high possibility of declining food security: increased competition and potential conflict over grazing, *veldkos* /indigenous natural products like *! Nara*, and increased likelihood of inter-community conflict;
  - Increased rates of illegal poaching in the Namib-Naukluft Park

4.2.2. Potential impacts on the livelihoods of the Hai//om San

Natural environment

The Hai//om San that have been resettled at Tsinsabis live on the western edge of the Kalahari Basin. To the east of the study area around Tsinsabis is the Mangetti Block an area of about 80,000 Ha which was originally set up by the previous South African Administration as a quarantine camp for livestock moving from the northern communal areas into the commercial farmlands to the south. Today, still fenced and out-of bounds, the Mangetti Block falls under the auspices of the Namibian Development Corporation and its fate is, as yet undecided. Areas to the north of Tsinsabis are traditional communal lands used by agro-pastoral Oshiwambo speaking communities. To the south, Tsinsibis is flanked by commercial farms (historically

owned by white settlers but increasingly represented by affirmative action or emerging black farmers).

Acacia savanna predominates the landscape. It is characterised by open expanses of grasslands dotted with mostly thorny *Acacia* trees but also includes areas where mopane (*Colophospermum mopane*) and other trees such as *Commiphora* dominate. *C.mopane* and *Dichrostachys cinerea* are indigenous trees which cause bush encroachment in this area. Bush encroachment is a form of land degradation that lowers land carrying capacity. It occurs in Namibia mostly on soils that have been extensively overgrazed by domestic cattle.

The Oshikoto region supports a fairly high plant diversity – with more than 400 species recorded (Mendelsohn *et al* 2002). It has a similarly moderately high natural diversity of birds and mammals. Large game species that still thrive here include ostrich, springbok, oryx Burchell's zebra and hartebeest but their densities in rural areas outside parks and conservencies is now likely to be very low due to illegal poaching. Elephant do break through the fences of Etosha periodically and these animals are capable of causing immense damage to infrastructure and subsistence crops.

Seasonal flooding sustains small seeps and *omurambas* the latter of which remain dry for most of the year but (like the ephemeral rivers in the Namib) do support areas of higher biodiversity and vegetation.

Hai//om **San livelihoods**

The Hai/kom, like all San people, were nomadic hunter-gatherers. These people are no longer able to roam and although communities, such as the one that is resettled at Tsinsabis, have access to a permanent water point and are expected to farm, they continue to depend directly on nature for their survival (albeit under highly compromised circumstances).

Traditionally, the gathering of wild products has contributed substantially to the nutrition and livelihoods of all indigenous communities in Namibia, especially during times of drought[4]. However, without a nomadic lifestyle, this practice eventually becomes unsustainable – causing the deforestation, the depletion of the most nutritious plants and local losses to biodiversity (wedlock, 1999; Barnes, 2005). The present day Hai||om maintain that they do not know as much about plants and their usages as their nomadic forefathers did and their forced sedentary life style has resulted in noticeable environmental degradation in just a few generations (Widlock 1999).

The most important natural products that are harvested include: firewood, wood for construction and woodcarvings; thatching grass; medicinal plants and foods (from nuts, fruits, leaves, roots and bark) as well as meat which, these days, is hunted illegally. Prosecution for illegal hunting does occur and penalties are strict but due to necessity most poor rural people in Namibia, including the Hai//om, do hunt.

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[4] In 1996 it was estimated that, at national level, 33% of total household consumption in rural areas came from wild foods. In parts of Caprivi rural communities relied on wild products for at least 50 % of their sustenance (Ashley and la Franchi 1997). This figure is likely to be considerably higher amongst severely poverty stricken communities like the Hai//om San settled at Tsinsabis .

Small animals such as duiker, steenbok, porcupine, tortoise and springhare are likely to be targeted (using traps and bows and arrows) more often than bigger game (Widlock, 1999). With domestic animals present in all areas surrounding the Tsinsabis settlement, some desperate Hai//om resort to stealing and slaughtering livestock.

Many of the plants they are dependent upon are very localized and seasonal in their occurrence. Mangetti nuts form an essential part of the staple diet of the Hai//kom but, when available, *!no* (*Strychnos cocculoides*), *|gui* (*Guibourtia coleosperma), ||go (Grewia falcistipula*), and *tsi'xa (Cucumis sp*.) are also used (Widlock, 1999). During the hot dry season impermanent waterholes dry up and availability of wild plant foods decline. Flying termites are briefly present and ||*Guo* and *xandaxan*e caterpillars are collected. Later in the season, termite mounds provide *nou-e*, a large edible mushroom.

The Hai||om appear to be losing their knowledge of bush craft very rapidly. Those receiving wages (mainly as farm labourers) or receive food for work, no longer eat some of the wild foods that used to sustain them. This is because they feel that eating insects and other small animals stigmatizes them in the eyes of other cultural groups.

Agriculture in the Tsinsabis area is limited by the hot, dry climate, sandy soils and lack of surface water. Like many other resettled farms in Namibia, the land that has been given to the San at Tsinsibis may be highly degraded and encroached. During severe drought periods (e.g the early 1990s) agricultural production becomes even more difficult. In the Tsinsabis area, all successful farming enterprises rely on external inputs such as machinery, drought security and an externally supported labour force.

In recent years the commercial value of some wild products (referred to as Indigenous Natural Products or INPs) has been recognized and developed by several NGOs in Namibia (e.g CRIEAA, IRDCN and WWF). It is not known whether the exploitation of INPs is occurring in and around Tsinsabis but this will be investigated during the field study. INP harvesters include some of the most cash-poor, marginalized people in Namibia, the majority of which are women (ARD 2008 (a)).

Potential climate change impacts on Hai//om San livelihoods

As the Hai//om's livelihood strategies become more threatened by difficult climatic conditions, their poverty is likely to increase. Using the information provided in Turpie *et al* (2010) together with baseline information presented in Mendelsohn *et al* (2006) and Mendelsohn *et al* (2002), the expected climatic and vegetation responses to climate change within Oshikoto Region can be summarised as follows:-

- An estimated rise in the average maximum temperatures by > 4° C from 34 ^{o}C to 38 ^{o}C.
- Increasing aridification will occur throughout the region with a corresponding reduction in primary productivity and agricultural potential. Rain fed cropping will become increasingly less viable by 2050 and cattle will have to be replaced by more arid-adapted goats and sheep. Commercial farms, which offer employment to some Hai//om San, will become less viable and opportunities to earn wages or food-for-work from the formal farming sector will become reduced.
- Some commercially valuable veldkos INPs (e.g.*Commiphora* sp., *Devil's Claw* and *Hoodia*) may benefit from climate change in Namibia and perhaps even expand their

range into new areas in response to the expected aridification (in SAIEA, 2010) but many other valuable plants (specifically the less arid-tolerant savanna species, e.g. marula) are likely to shift out of their current ranges. Overall there is likely to be a decline in the variety and availability of many plants and small animals currently encountered in the Oshikoto region. This will threaten food security, especially for those Hai//om San that depend heavily on *veldkos* for their survival.

- Despite lowered primary productivity, the increase in concentrations of atmospheric carbon dioxide could result in enhanced bush encroachment (e.g. *C .mopane* and *D. cinerea*) in the areas of Oshikoto that are susceptible to this form of land degradation.
- Reduced groundwater recharge, lower water tables and declining surface water (small seasonal springs, seeps and *omurambas*) will result in increasing water insecurity throughout the Oshikoto region.
- Turpie *et al* (2010) reports that reduced primary production and carrying capacity will lead to a decline of 11-22% in the numbers of the main grazing wildlife species throughout Namibia. This will reduce potential for hunting and tourism in the area and, indirectly, the opportunity for some Hai//om San to earn a living through this sector.
- Changing climates come with several health constraints – particularly those related to vector-borne diseases. There is the possible risk of increasing incidents of malaria in the Oshikoto region during wet years (Tarr, 1999).
- Declining food security throughout the region will result in increased competition and potential conflict over available grazing, *veldkos* and potentially valuable INPs with high commercial value. Increased incidence of illegal poaching in conservancies and parks is likely to occur.
- Turpie *et al* (2010) highlights the fact that incidents of human-wildlife conflict throughout the northern parts of Namibia are likely to increase in all areas near to Parks and conservation zones. Elephant damage of crops is an on-going problem for subsistence farmers throughout Namibia.

4.3. Contributing factors that minimize or increase impacts of climate change

4.3.1. Natural environment

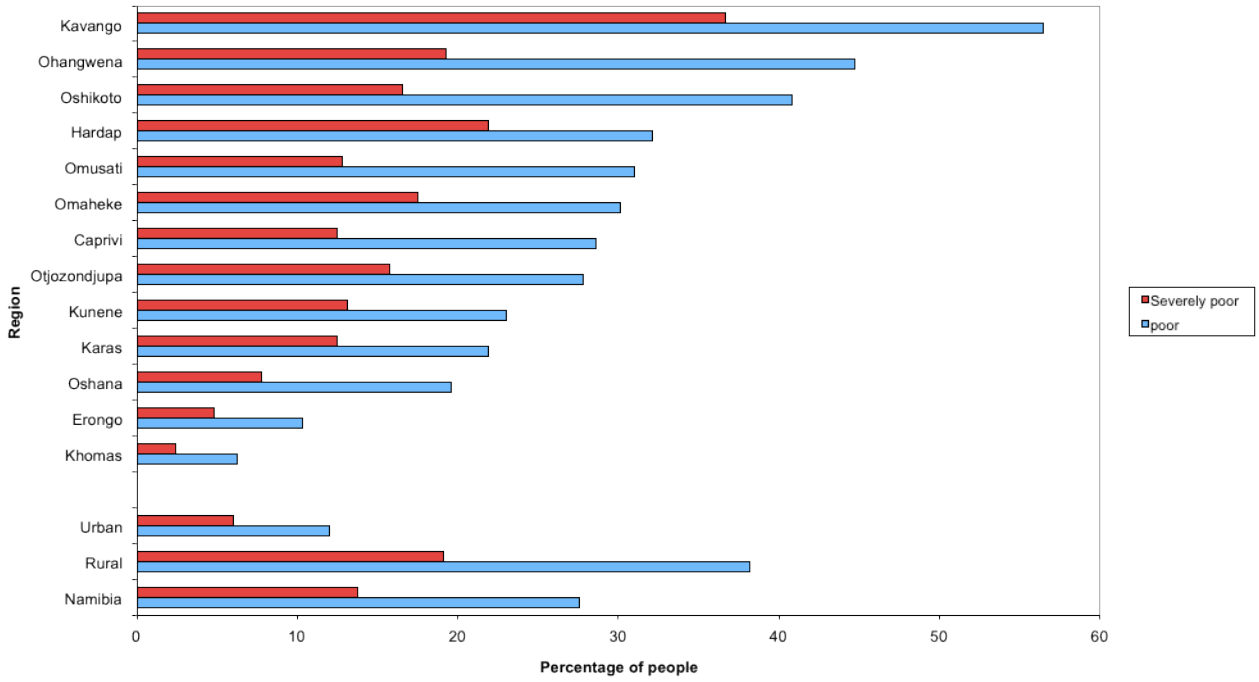
As highlighted in the previous section, Namibia, as a developing country located in an arid region where drought and high climatic variability is endemic, is considered to be particularly vulnerable to the impacts of climate change. Sedentarism amongst previously nomadic pastoralist and hunter gatherers (the Topnaar and Hai//om), poor soils and a history of land mismanagement (overstocking and overgrazing of cattle by commercial farmers during the colonial era) has encouraged land degradation (soil erosion and bush encroachment). These environmental issues, together with low water availability, exacerbate Namibia's vulnerability to the impacts of climate change (Tarr, 1999).

4.3.2. Socio-economic circumstances

Poverty

In 2003/2004 an estimated 41 per cent (750,000) of all Namibians[5] could be classified as either poor or severely poor (NPC, 2008). Nevertheless, the incidence of income poverty varies considerably between the administrative regions and between urban and rural areas Figure 11. shows that the Oshikoto region is the third poorest region in the country. Erongo Region is the second wealthiest region due to the towns of Swakopmund and Walvis Bay that provide employment opportunities

Figure 11: Incidence of Income poverty by Region in Namibia 2003/2004 (NPC 2008)



Poverty in Namibia is linked to unemployment. In 2004, about two-thirds of Namibia's unemployed fell into the most productive age group of 16-45 years (NPC, 2008). Unemployment continues to rise in Namibia and the Ministry of Labour and Social Security (MoLSS) most recent Labour Survey[6] states that by 2008 it had reached 51.2 percent.

Namibia is often reported as having the most unequal distribution of income in the world. The Gini Coefficient of 0.63 in 2003/04 placed it at the top of a selection of 30 countries. Explanations for this include the racist policies of the apartheid regime prior to Independence, which restricted the access of the majority of citizens to economic and social resources. In

[5] Namibia's population in 2003/2004 was estimated to be 1,830,000 (NPC,2006)
[6] Unpublished data reported in *Die Republikein* 8th February 2010.

addition, Namibia's traditional reliance on the extraction of natural resources such as diamonds has meant that production is highly capital intensive rather than labour intensive (Central Bureau of Statistics 2008: 37).

The Topnaar have been identified as the most marginalised group in the Erongo Region (in Hoadley 2005). In this Region, high levels of unemployment, due to poor education and low level of skills, is a major cause of poverty (NPC 2006). Poor education can be caused by a number of factors, but in rural areas where the Topnaar live, long distances to schools and limited education opportunities close to the homestead, often result in large number of school drop-outs.

The San are arguably Namibia's poorest people. Most San communities in Oshikoto do not participate in an agricultural-based economy and very few have access to on-farm employment. They consider themselves poor because they sleep in huts and have to depend directly on nature for their livelihoods. Although permanent water points have been established in most settlements, the poorest Hai//om in Oshikoto Region do not have the means to access sufficient water with which to irrigate small gardens. They also have very limited opportunities to earn cash and, as their environment degrades due to climatic factors and their own overexploitation of food plants and animals (Barnes 2005), they have to walk increasingly long distances to look for food. NPC (2007 (a)) records that many of the poorest people in the Oshikoto region feel impoverished because they feel that they are residing on someone else's land. This restricts their sense of freedom and movement. (NPC. 2007 (a)).

Health

The first few years following Namibia's Independence in 1990 saw a rise in the share of the budget allocated to health affairs and services (particularly for primary health care) but, although a share of ten percent or more was sustained for seven years, the allocation has declined since. The allocation has consistently fallen short of the 15 percent recommendation contained in the 2001 Abuja Declaration (Sherbourne 2009). This has come at a time when the country started to face the full costs associated with the HIV/AIDS crisis, which is considered one of the major drivers of falling life expectancy[7] and poverty in the country.

The 2008 National HIV Sentinel survey of prevalence rates in pregnant women aged 15 - 49 [8] reports that national prevalence of the disease in this group of Namibians was 17.8 percent. Communities in the Oshikoto Region suffer above average HIV/AIDS prevalence (22 percent). The incidence of orphans and vulnerable children (OVCs) – a major consequence of the HIV/AIDS epidemic - is highest in Namibia's rural areas with the lowest wealth quintiles (including Oshikoto, which has approximately 34 percent incidence).

In the Erongo Region, there are good hospitals in most major towns and centres. People in urban areas do not seem to have a problem regarding access to facilities, although some of them still believe that they are refused access to medicine and services if they cannot pay. This is in contradiction to policy of the government. In rural areas, communities are served through either static or mobile clinics. In Armstraat, which is a Topnaar community very close to the town of Walvis Bay, the service from clinics is considered excellent (NPC 2007). Access to

[7] Life expectancy fell by 11years (men) and 13 years (women) to 48 and 50 respectively between 1991 and 2001.
[8] MoHss, 2008 (a)

clinics to Topnaar communities living in Natab, Soutrivier and Homeb (all up river near Gobabeb) is unknown.

Not all villages have clinics and only two hospitals exist in the Oshikoto Region. Many people have to walk long distances to the nearest clinic. Due to budgetary constraints, the Regional Health Directorate was not able to implement its outreach programme as planned. Service delivery has also been criticized. Complaints range from long queues at hospitals and clinics, dissatisfaction with nursing staff, doctors too tired to examine patients properly, lack of hospital facilities and old people being too hesitant to go to hospital because they feared of being discharged before being cured. Especially San communities felt that they were excluded from health services (NPC 2007 (a)).

Education

Since independence, Education Affairs and Services has consistently received the highest share of resources from the national budget. Huge improvements for previously disadvantaged people in Namibia have occurred since independence. Nevertheless, large differences still exist regarding educational attainment between rural and urban populations: 23 percent in rural areas have no formal education as opposed to 7 percent in urban areas (NPC 2006).

Despite the improvements in school attendance and facilities and the high budgetary allocation for education in Namibia, this sector is constantly under criticism. One of the main issues is that a high percentage of teachers are not deemed proficient in the language of tuition (English)[9] and, as a result, standards in education remain low. This problem arose after independence when the new government suddenly shrugged off Afrikaans as the *lingua franca* for the country, without easing in English at a suitable pace for training the large numbers of new teachers.

As with health issues in the Oshikoto Region, the quality of education received criticism during the Region's Participatory Poverty Assessments (PPA), (NPC 2007; 2007(a)). According to many communities, more effort need to be put into the development of vocational training institutions and encouraging the unemployed youth to enroll for technical training at such institutions. It is reported that many children of poor households in Oshikoto stay away from school and a particular challenge exists with the San. The PPA makes the statement that for as long as the San communities remain dependent on gathering natural foods for subsistence, their children are likely to accompany their parents in search of food, particularly during the dry season (NPC 2007(a)).

Demographics

Namibia has an estimated 2.1 million habitants spread over an area of approximately 824,000 km² with an urbanised population of 31.3%. On average this means about 2 persons per square kilometre, making Namibia Southern Africa's most sparsely populated country.

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[9] Kisting,D. In the Namibian Newspaper ***Namibia: 98 Percent of Teachers Not Fluent in English***
9 NOVEMBER 2011

It should be noted that since the 1991 census, the ethnic identity of people is no longer taken into account as a criterion for classification. Because of this, it is difficult to get specific data on either the Topnaar or San as demographically separate ethnic groups. Table 1, however, highlights the fact that both the Topnaar Nama and the San are minority groups in Namibia.

The population of Topnaar people living in the Kuiseb valley have fluctuated over the years but records suggest their numbers have never been very large. In 1870, W.Palgrave estimated the existence of 750 Topnaars (of which 150 – 200 were settled in the nearest town , Walvis Bay). In 1966 Jenkens and Brain counted 130 Topnaars living along the Kuiseb, but they assumed that this was not the total population as many were reported to be living and working on road construction sites at the time.

In 1974, Dentlinger reported that six villages along the Kuiseb were inhabited with 32 inhabitants at Soutrivier.

4.4. History, culture and ethnography

There are more or less 12 different ethnic groups in Namibia. The relative sizes of the different ethnic groups can be illustrated as follows:

Table 1. Breakdown of the ethnic groups in Namibia (Malan, 1995)

Ethnic Group	**Percentage**
Owambo	49,8
Kavango	9,3
Damara	7,5
Herero	7,5
European origin	6,4
Nama	4,8
Coloureds	4,1
Caprivians	3,7
San	2,9
Rehoboth Basters	2,5
Others	0,9
Total	100%

The indigenous peoples relevant to this study are the Hai//om and Topnaar. The Hai//om is a subgroup of the San, also referred to as Bushman, while the Topnaar is a subgroup of the Nama, previously referred to as Hottentots.

There are approximately 5 subgroups of the San living in Namibia. The San are generally regarded as southern Africa's 'first people'. However, the arrival of the Bantu-speaking tribes from north and east Africa over a period of several hundred years and subsequent European settlers, forced them into an isolated form of existence in the arid parts of the Kalahari.

The Hai//om were traditionally nomadic hunter/gatherers. They roamed the area in the Oshikoto region now known as the districts of Tsumeb, Otavi and Outjo as well as the Etosha National Park and the southern and western parts of Owamboland.

Widlock (1999) argues that the way in which hunter-gatherers like the Hai//om San incorporate their ethnic identity into their social practices today remains largely hidden in historical accounts. Written or oral accounts of the past, especially when dealing with ethnicity, tend to privilege authoritative modes of dealing with the past. These accounts claim and justify the continuity and uniformity of ethnic identities. Characteristically, they comprise most documents written by Europeans. Other sources such as Hai//om folklore reveal a more valid perspective on ethnic identity. Hai//om storytelling does not disconnect representations of the past from the situational settings of the present. It is characterized by a socially conventional way of combining two registers of story-telling namely personal experience and shared folklore.

Historically, the indigenous collective named Khoi-khoin (today simply referred to as Khoi) or "Hottentots" comprised some of the earliest inhabitants of southern Africa of which the Nama form a part. There are at present 14 Nama tribes in Namibia. The Topnaar is one of Namibia's Nama tribes and they mainly live along the Kuiseb valley, in the Namib Desert, a hyper arid part of the Country. Around the beginning of the Christian era, the Khoi's pastoral cultural complex was gradually adopted by an ever-increasingly number of nomadic hunter-gathering communities (as a result of increasing contact and conflict with European colonials). During this unusual 'pastoral revolution', the physical and cultural differences between hunter-gatherers and pastoralist became intertwined. At present, the Nama retain a strong component of their ancient heritage of hunting and gathering of food.

The Topnaars are called #Aonin (People of the marginal area) or !Naranin (the Nara People) because they actively harvest (and seasonally subsist off) the *!Naras (Acanthosicyos horrida),* the wild melon that grows on the lower dune slopes in the Namib Desert. Traditionally the Topnaar acquired a substantial amount of their food from the shoreline.

In 1907, the Sperrgebiet was proclaimed, and the Topnaar were denied access to a large part of their traditional hunting areas. The proclamation of the Namib-Naukluft Park, and its expansion, between 1968 and 1990 further reduced the nomadic range of these people.
During the 1970s, in response to a request from the Topnaar, boreholes were drilled in the Kuiseb river valley, and permanent settlements became a way of life, ending the nomadic existence of most of the Topnaar. Many of the Topnaars have migrated to coastal towns.

In 1963 the Desert Research Institute at Gobabeb was established on the banks of the Kuiseb River, approximately 10 km upstream from the Topnaar settlement of Soutrivier and 10km downstream from Natab village. This institute has played an important role in the determining the development of these settlements as it has provided labour opportunities to the inhabitants of the Kuiseb.

4.4.1. Governance

The historically nomadic San societies were anti-hierarchical and, consequently, not predisposed to institutionalization of leadership positions to the same degree as the more dominant Bantu and European cultures in Namibia. Their primary reliance on hunting and gathering encouraged a system of relative egalitarian consensus politics, ensuring wide sharing and distribution of food and the endurance of band and kin structures.

However, during the last 200 years, the social and political dynamics of both black and white migration into Namibia, forced the development of different forms of political organization amongst the San communities. After a century of sustained dispossession and marginalization, San leaders now represent communities with very few central institutions, weak community structures and in some cases no real land base. Over a relatively short period of time, a number of distinct San groups became severely impoverished and to some extent formalized their leadership structures in response to pressure from other groups. When San communities do not have to deal with outsiders, these formal structures remain de-emphasized.

Dentlinger (1977) reports that very little is known about the social organization of the Topnaar but that they tend to be characterized by small family groups and, historically at least, their social structure is likely to have been similar to that of the other six Nama tribes. She states that each of these tribes was comprised of several patrilineal clans; one of which claimed chieftainship over the entire group. These small nomadic tribes and clans became scattered over Namibia – each mobile group comprised of between 200 and 300 members. Due to the harsh climatic conditions and limited availability of surface water that still characterise Namibia today, these small bands of Nama tended to travel not too far from a known watering place – over which they took ownership, based on their frequent and sole use.

Thus, in comparison with the San, most Nama tribes by the 19th century had developed permanent centres where a chief resided. This inclination towards centralisation which existed in pre-colonial times was further encouraged by missionary interests. Some of these independent governments established before the colonial era survive and still function today.

Namibia as a post-colonial African State celebrated independence from South African apartheid rule 22 years ago. It is still in the process of redressing past historical and legal inequalities that were premised on racial discrimination. In its post-colonial era, the Namibian government established itself as a sovereign, secular, democratic and unitary State founded upon the principles of democracy, the rule of law and justice for all. It ratified most regional and international human rights instruments. It continues to position itself politically, and possibly legislatively, as a government accommodating their indigenous communities in line with international expectations.

4.4.2. Legislation, policies, institutions and the recognition of IP rights

The following information has been gleaned from the annals of the Legal Assistance Centre (Odendaal and Jansen, 2011).

The Namibia Constitution does not officially recognize indigenous peoples' rights and, to date, the Namibian Government has not ratified ILO Convention 169 as a binding treaty for indigenous peoples. However, the Government does recognize the San as a marginalized community in terms of certain policies and practices. There also appear to be actions on the part of Government indicating that they recognize the San as an 'indigenous community', although they prefer the term 'marginalized communities'. Furthermore, there seems to be an acknowledgement, both politically and legislatively, of the San communities needing "special measures to ensure they enjoy all the human rights protections that the Namibian legislative framework offers.

The Namibian government actively participated in the adoption of the United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP) in 2007 at the UN General Assembly. It is open to possibly ratifying International Labour Organizations Convention 169. During February 2011, at the review of its human rights record at the United Nations Universal Peer review process, the Namibian government made huge commitments with regards to policy and its implementation with specific reference to the San community in the light of their obligations as set out in UNDRIP. They recently established a San Division within the Office of the Prime Minister that essentially resettles landless San communities in addition to *ad hoc* social projects it runs. The International Labour Organization also set up offices in Windhoek to offer technical assistance to the Namibian government on their indigenous peoples' issues.

The recognition of Traditional Authorities is based on Article 19 of the Namibian Constitution which states: "Every person shall be entitled to enjoy, practice, profess, maintain and promote any culture, language, tradition or religion subject to the terms of this [its] Constitution". Further to the constitution, Article 66 states: Customary law shall form part of Namibian law insofar as it's not conflicting with statutory laws. These rights are given effect through the Traditional Authorities Act (TAA) of 2000. This Act provides for the establishment of traditional authorities and the designation, election, appointment and recognition of traditional leaders; it defines the powers, duties and functions of traditional authorities and traditional leaders.

The TAA is the national instrument whereby all traditional communities in Namibia could have their traditional leaders elected. It is a standard framework for all traditional communities wanting to exercise authority over their land held communally/traditionally. The TAA defines a traditional community as an indigenous homogeneous, endogamous social grouping of persons comprising of families deriving from exogamous clans, which share a common ancestry, language, cultural heritage, customs and traditions, who recognizes a common traditional authority and inhabits a common communal area, and may include the members of that traditional community residing outside the common communal area.

The terms of recognition of traditional leadership is premised on at least two key assumptions; firstly, the TAA assumes that all traditional communities are automatically organized beneath a Chief (as a central politicized leader) along with an institutionalized leadership, structured as a council. This is highly problematic for the San as they are, historically, anti-hierarchical and, as such, had no chief or designated leaders.

During colonial times the legitimacy of leaders was a consensus issue and only in rare instances did they enjoy any special privileges in the form of tributes, taxes or summary powers. The more sustained presence of Bantu and whites on traditional San lands meant that around the beginning of the 20th century institutional leadership became deeply entrenched in some San societies. Unlike most of the other traditional authorities, most of the San traditional authorities had to start virtually from scratch at Namibian independence, when the government commenced the process of accepting applications for formal recognition of traditional authorities. At this time most San communities had no land base, few assets, very little administrative support, a scattered and extremely marginalized constituency and limited experience of leadership in a modern democratic state.

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