GUIDEBOOK

Addressing Climate Change Challenges in Africa:


A Practical Guide towards Sustainable Development

AMCEN

AFRICAN UNION

Tribute

To our friend and brother, the late Mama Konate who died on November 13, 2011, in the line of duty while attending a United Nations Framework Convention on Climate Change (UNFCCC) meeting in Bonn, Germany. Mr. Konate was the Chair of the Subsidiary Body for Scientific and Technological Advice (SBSTA) and Chair of the Experts Group of African Ministerial Conference on Environment (AMCEN) during the Fourth Special Session on Climate Change and Rio + 20.

ACKNOWLEDGMENTS

The AMCEN secretariat wishes to express its deep gratitude particularly to all the chapter lead authors, authors and reviewers who have taken their valuable time to write, provide information and review the chapters. These include: Anya Boyd, Fatma Ben Fadhl, Balgis Osman- Elasha, Ifejika Speranza Chinwe, Oliver Ruppel, Daniel Gwary, Fatou Gaye, Christopher Oludhe, Todd Ngara, Lawrence Agbemabiese, Bubu Jalloh, Babatunde Abiodun, Sunday Leonard, Sumaya Ahmed Zakieldeen, Andrew K. Githeko, Harald Winkler, Laban A. Ogallo, Shem Wandiga, Richard Odingo, John Nganga, Felix Ngana, Denis J. Sonwa, Pius Z. Yanda, Paul V. Desanker, George Manful, Emily Massawa, Salif Diop, Philip G. Oguntunde, Shuaib Lwasa, Dixon Waruinge, Julius Francis, E. Sware, Esmail Elgizouli, Desta Mebratu, Mounkaila Goumandakoye and Robert Wabunoha.

A special thank you to Emily Massawa, who, has worked tirelessly to coordinate the process of preparing this Guidebook.

We also wish to recognize the editor and designers and the competent and dedicated team at the UNEP Print shop.

The AMCEN Secretariat would like also to express its deep appreciation to UNEP for providing scientific and technical guidance.

Referencing this report

AMCEN, 2011: Addressing Climate Change Challenges in Africa; A Practical Guide Towards Sustainable Development.

FOREWORD

There is a consensus among scientists, policy makers and development practitioners that climate change poses complex challenges to the development of countries in Africa. Recent scientific information since the Inter-governmental Panel on Climate Change (IPCC) 4th Assessment Report confirms the world is on course for levels of warming that will be catastrophic for Africa. The United Nations Environment Programme (UNEP) Emission Gap Report confirms that the current mitigation pledges – unless strengthened – will set the world on course for global warming of between 2.5 to 5°C. Further to this, there is indication that temperature rises are likely to be progressively higher in Africa with other climate related effects such as variability in precipitation patterns and the frequency of extreme weather events placing considerable pressure on livelihoods and economies across the continent.

The adequate response to these challenges needs to be aligned with national and regional strategies for development, poverty alleviation, economic growth and the enhancement of human wellbeing, while increasing resilience to the physical impacts of climate change. The African Heads of State and Government meeting at the seventeenth session of the African Union Summit held in July in Malabo, Equatorial Guinea, the fourth session of the African Ministerial Conference on Environment held in September 2011 in Bamako, Mali, and most recently the Seventh Session of the Committee on Food Security and Sustainable Development and the Africa Regional Preparatory Conference on Sustainable Development(Rio+20) held in Addis Ababa, Ethiopia, in October 2011, all identified opportunities and challenges in the transition to green economy with links to the achievement of the MDGs, climate change and sustainable development.

In recognition of AMCEN's mandate which includes guidance in respect of key issues related to multilateral environmental agreements, African governments requested that AMCEN should facilitate the provision of information to countries that would assist them towards translating available climate science and current international climate policies in their effort to move towards practical implementation in the context of sustainable development.

This Guidebook has therefore been prepared towards this end and will inform on climate change matters including science, governance, technological, financial and capacity building needs as well as opportunities for effective actions towards sustainable development.

The Guidebook relies heavily on insights from UN agencies, national governments and African scholars from around the world, and we are grateful for this collaboration. The document has synthesized and integrated relevant material from IPCC and UN reports and other documentation on emerging issues on environment, climate change and development. It is written in a style suitable for policymakers and practitioners and seeks to provide guidance and practical advice on how to address climate change issues in the development and implementation of actions leading to sustainable development.

It is my hope that this Guidebook will meet the expectations of African countries contributing to their efforts to combat climate change.

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PREFACE

At the Seventh African Development Forum (ADF VII) which took place in Addis Ababa, Ethiopia in October 2010, policy-makers recognizing the need to move with urgency in preparing for the impacts of climate change, as the international negotiations continue on the reduction of Green House Gases (GHG) emissions, agreed on the urgent need for Africa to act on Climate Change for Sustainable Development. The AMCEN Bureau requested then its Secretariat to facilitate the preparation of a guidebook - Addressing Climate Change Challenges in Africa: A Practical Guide towards Sustainable Development.

The Guidebook aims to translate available climate science analysis and current international climate policies into practical implementation in Africa in the context of sustainable development. In this regard the guidebook focuses on analysis of potential climate change impacts in key sectors in Africa and appropriate adaptation and mitigation options. It informs on matters related to governance, technological, financial and capacity building needs and opportunities on the continent with relevance to sustainable development. It provides information that has been synthesized and integrated from relevant IPCC and UN reports and other documentation on emerging issues on environment, climate change and development. It provides guidance and practical advice on how to address climate change issues in the development and implementation of actions leading to sustainable development. The Guidebook is self-contained and stands alone, but provides guidance to intended users to other relevant materials in the form of links and annexes.

The primary audiences for the Guidebook are policymakers, decision makers, practitioners from public and private sector, Civil Society Organizations, environment and climate change negotiators and experts. However, it is recognized that others will also make use of the report.

The contents of the Guidebook include:

- Climate and climate change science from an African perspective.
- Impacts of climate change on systems and key sectors and their implication on sustainable development in Africa, elaborating on the links between climate change and sustainable development. Discussions will include case-studies. Impacts of different climate scenarios are discussed and presented under each sector.
- Suggested actions to mitigate and adapt to climate change; highlighting existing tools, methodologies and literature available to both assess the African and national situations in relation to adaptation and mitigation and furthermore to assist practitioners identify appropriate actions in relation to adapting to climate change and mitigating further contributions, where feasible, in the context of low carbon growth.
- Capacity building, technological and financial requirements to undertake the suggested mitigation and adaptation actions.

- Guidelines on the sources of financing particularly under the UNFCCC process
- Case studies on climate change mitigation and adaptation, on the green economy studies.

The Guidebook lays the groundwork in Africa for subsequent case studies of current actionable recommendations on climate change, covering both adaptation and mitigation which will enable the continent to achieve its full potential on adaptation and transition to green economy. It is an example of regional cooperation in Africa at its best. About 30 African scientists including those already engaged in the current work under Fifth Assessment Report of IPCC, policy makers and climate change negotiators participated in the writing, compilation and review, volunteering their time and expertise. We would like to thank them for their tremendous contribution.

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TABLE OF CONTENTS

Chapter 1: INTRODUCTION 1

1.1 Rationale 1

1.2 Framing the climate, Human Systems and Major Challenges for Africa 1

1.3 Summary of Recent Knowledge and Emerging Issues 2

1.4 Climate Change Science, Impacts and Responses by Africa 2

1.5 Climate Change and Development in Africa 3

Chapter 2: AFRICAN CLIMATE CHANGE: PAST AND FUTURE 4

2.0 Introduction 4

2.1 Global Climate Change 4

2.2 Climate Variability and Changes in Africa 5

2.3 Climate Changes 7

2.4. Causes of Climate Variability and Change 11

2.5. Future Climate Projections for Africa 12

Chapter 3: IMPACTS OF CLIMATE CHANGE ON SYSTEMS, KEY SECTORS AND IMPLICATIONS FOR SUSTAINABLE DEVELOPMENT IN AFRICA 21

3.0 Introduction 21

3.1 Methods and Tools of Assessment of Impacts of Climate Change 22

3.2 Observed and Projected Impacts of Climate Change on Africa 25

Chapter 4: ADAPTING TO CLIMATE CHANGE IN AFRICA 52

4.0 Introduction 52

4.1 Types of Adaptation 52

4.2 Adaptation Requirements 53

4.3 Adaptation Options 57

4.4 Insurance as Climate Change Adaptation Tool 74

4.5 A programmatic Approach to Adaptation 77

4.6 Mainstreaming Climate Change Adaptation 78

4.8 Research and Data Gaps 83

Chapter 5: THE ROLE OF MITIGATION 84

5.1 Introduction 84

5.2 Background of African Position in International Climate Change Mitigation Policy Debate 85

5.3 Mitigation Opportunities and Challenges 86

5.4 Identifying Mitigation Needs 92

5.5 Moving Mitigation Opportunities Closer to Implementation 98

5.6 Key benefits, opportunities and challenges and main actionable points 101

Chapter 6: OPPORTUNITIES FOR AFRICA TO PARTICIPATE AND BENEFIT FROM INVESTMENT IN ADAPTATION AND MITIGATION FOR SUSTAINABLE DEVELOPMENT 102

Introduction 102

6.1 Policy Overview: Climate Change Related National, Regional and International Policies 103

6.2 Approaches to Climate investments in Africa 105

6.3 Climate Change related Investment and financial trends: qualitative and quantitative assessments 109

6.4 Institutional Mechanisms, Tools and Instruments for climate Change Related Investments 119

6.5 The Investment Climate 123

Chapter 7: FINANCING FOR CLIMATE CHANGE IN AFRICA 127

7.1 Introduction 127

7.2 Opportunities to Support Climate Change Responses (Adaptation and Mitigation) in Africa 131

7.3 Cost of addressing climate change in Africa 135

7.4 Access to Financial and Technical Support for Climate Change Adaptation 140

7.5 Challenges and Opportunities in Funding for Adaptation in Africa 148

7.6 Case study: Support to LDCs for Adaptation 151

7.7. Access to Financial and Technical Support for Mitigation Actions 155

7.8 Access to Financial and Technical Support for Low Carbon Development Strategies 166

7.9 Funding Opportunities for Small-Scale Initiatives 169

Chapter 8: INSTITUTIONAL LEGAL AND POLICY FRAMEWORKS 170

8.1 Introduction 170

8.2 Policy and Legal Framework 175

Chapter 9: CONCLUSIONS AND RECOMMENDATIONS 203

9.1: Links between climate change, green growth and sustainable development 203

9.2: Reinforce the most important themes that emerge above. 204

ANNEXES 209

Annexe 1: Mitigation points: 209

Annex 2: International Financing mechanisms with an Africa focus 213

Annexe 3: List of Authors 223

REFERENCES 227

List of Tables

Table 2.1: Observed changes in climate by sub-region, summarized from IPCC Fourth Assessment Report 10

Table 2.2: List of some Institutions downscaling future climate projection over Africa 17

Table 3.1: Summary description of modules in the DSSAT - CSM 24

Table 4.1: Expected annual infrastructure investment needs, 2005-2010 56

Table 4.2a: MULTICRITERIA ANALYSIS (MCA) (UNFCCC, 2008) 58

Table 4.2b: Adaptation Decision Matrix (ADM) 59

Table 4.2c: Screening of Adaptation Options 60

Table 5.1: Some Examples of LCDS/LEDS /(NAMAs) Support Programs and Activities in Africa 94

Table 6.2: Annual costs of climate change in Africa, as an equivalent percentage of GDP 121

Table 7.1: Global Climate Change Funds 130

Table 7.2: Examples of the financial opportunities received from the Global Environment Facility 134

Table 7.3a: Total annual costs of adaptation for all sectors, by region and climate change scenario. 137

Table 7.3(b): Comparison od adaptation cost estimates by the UNFCC(2007), Parry and others (2009), 137

Table 7.4: Projected Cost of Climate Change Adaptation 138

Table 7.5: Summary of Developed Country Fast-Start Climate Finance Pledges February 18, 2010, 145

Table 7.6: World Bank Carbon Finance – Windows for Funding Mitigation 161

Table 8.1: AU Member States and their affiliations to Regional Economic Communities (RECs) 194

List of Boxes

Box 2.1: Definitions of Climate, Climate Variability and Climate Change 4

Box 2.2: Steps in the Development of Global Scenarios for use by IPCC and other communities 14

Box 2.3: Development of National Climate and Socio-economic Scenarios 16

Box 3.1: Climate Change Impacts Assessment for the Crops Production sub-Sector of Agriculture 22

Box 3.2: Climate, Water availability and Agriculture in Egypt 26

Box 3.3: Drought and food insecurity in Niger 32

Box 3.4 Climate Change in Malawi 34

Box 3.5: Climate Change and Tourism in Eastern and Southern Africa 39

Box 3.6: Impacts of the 1997-8 El Nino on human and animal health in the East African Region 41

Box 4.1: Demonstration and Promotion of Rainwater Harvesting as a viable climate change adaptation option in Seychelles 61

BOX 4.2 & 4.3: Rehabilitation of water reservoirs in the Savannas Region to enhance climate change resilience and livelihoods particularly for the benefit of women and youth groups 62

BOX 4.4: Rehabilitation of water reservoirs in the Savannas Region to enhance climate change resilience and livelihoods particularly for the benefit of women and youth groups 64

Box 4.5: Case study: Developing a Municipal Adaptation Plan in Cape Town 73

Box 4.6: Kenya index-based livestock insurance (IBLI) 75

Box **4.7:** Horn of Africa Risk Transfer for Adaptation (HARITA) 77

Box 4.8: Improving adaptation of cattle to climate change through introduction of genes obtained from drought and heat tolerant cattle. 81

Box 4.9: Enhancing Resilience of Communities through Provision of Tool and Policy Change in the Gishwati Area of Rwanda 82

Box 5.1: LTMS – Long Term Mitigation Scenarios (South African case study) 94

Box 5.2: Developing a national green economy strategy 96

Box 5.3: NAMAs – framing mitigation actions as investment opportunities? 99

Box 6.1: Public Finance Mechanism (PFM) 108

Box 6.2: NAMAs – framing mitigation actions as investment opportunities? 113

Box 6.4: Investment Climate Reform in Rwanda 125

Box 7.1: Methodology to estimate costs of adaptation for a country 136

Box 7.2: Economic Cost of Adaptation in Africa (AdaptCost) 138

Box 7.5. Funding Portals 148

Box 7.6: Case Study: Malawi country experience with the NAPA and the LDCF 151

Box 7.7: Case Study: Case Study: Malawi country experience with the NAPA and the LDCF (continued) 152

Box 7.8: Case Study: São Tomé and Príncipe Country Experience 153

Box 7.9: Case Study: São Tomé and Príncipe Country Experience(Continued) 154

List of figures

Fig 2.1: Decadal global average combined land-ocean surface temperature (°C), redrawn from WMO, 2011 5

Fig 2.2: Spatial distribution of annual mean temperature (left panel) and total annual rainfall in Africa (right panel), averaged over 1901 - 2010. (Data source: Met Office Hadley Centre, UK, and Climatic Research Unit, University of East Anglia, United Kingdom) 6

Fig 2.3 Mean linear trends in annual temperature (°C century–1) and annual rainfall (% century–1), calculated over the period 1901–2010. (Data source: Met Office Hadley Centre, UK, and Climatic Research Unit, University of East Anglia, United Kingdom). 7

Fig. 2.4: Observed Climate Change Impacts in Africa 9

Fig. 2.5: The number of days between May 1 and October 31 during which the maximum heat index occurring between 09Z and 15Z is in 19

Fig. 3.1 West African Coast 27

Fig. 3.2 East African Coast 27

Fig 3.3: Human development index 35

Fig 3.4: Living without electricity 36

Fig 4.1: Conceptual grouping of limits and barriers to adaptation 57

Fig 4.2: Elements of social barriers to adaptation 57

Fig 4.4: HARITA Conceptual Framework 76

Fig 4.5: Elements for a programmatic approach to adaptation 78

Fig 4.6: Mainstreaming adaptation at project level 80

Fig. 5.1: Carbon dioxide emissions by country 85

Fig 5.2: Global MAC curve beyond business as usual - 2030 93

Fig 5.3: Extract from Ghana Technology Needs Process 98

Fig 6.1 Trends in Investments in Irrigation and Drainage, 1961-2002 110

Fig 6.2: Annual costs from Climate change as a fraction of GDP in Africa in 2009 122

Fig 6.3: FDI Flows 2000 - 2010 24

Fig 7.1: Current and future climate change finance scheme 128

Fig 7.2: Climate Change Finance for response to Climate Change 129

Fig 7.3: The landscape of Climate Finance 129

Fig 7.4 The GEF Managed Funds under the Climate Change Conventions: 133

Fig 7.5 Schematic representation of the methodological approach used in the WB EACC Study in 2010. 136

Fig 7.6: Sources of Funding for Adaptation 140

Fig 8.1: Institutional Framework of the Climate Change Convention Process 171

Fig 8.2: Institutional Framework of the Kyoto Protocol of the Climate Change Convention 173

Fig 8.3: Future Potential Institutional Structure of the Climate Change Convention 174

Fig 8.4 UN-REDD Programme presence 184

Abbreviations- Antonyms:

ACF	Africa Carbon Facility
ADF-	African Development Forum
ADB	African Development Bank
AFF	African Forest Forum
AGF	African Green Fund
AWG	Ad Hoc Working Group
AMCEN	African Ministerial Conference on Environment
AREED	African Rural Energy Enterprise Development
AU	African Union
COMIFAC	Central African Forests Commission
CBFF	Congo Basin Forest Fund
CBFP	Congo Basin Forest Partnership
CAADP	Comprehensive Africa Agriculture Development Programme
CARPE	Central African Regional Program for Environment
CBNRM	Community Based Natural Resource Management
CCAP	Climate Change Action Plan
CCAA	Climate Change Adaptation in Africa
CDM	Clean Development Mechanism
CDIAC	Carbon Dioxide Information Analysis Center
COMESA	Common Market for Eastern and Southern Africa
COP	Conference of Parties
CDKN	Climate and Development Knowledge Network
CREDC	Community Research Development Centre
CTCN	Climate Technology Center and Network (CTCN)
CRiSTAL	Community-based Risk Screening Tool – Adaptation and Livelihoods
DSSAT-CSM	Decision Support System for Agrotechnology Transfer - Cropping System Model

DFID	Department for International Development
EBRD	European Bank for Reconstruction and Development
ECOWAS	Economic Community Of West African States
WAPP	West African Power Pool
FAO	Food and Agriculture Organization
GDP	Gross Domestic Product
GHG	Green House Gases
GCM	Global Climate Models (GCMs)
GCM	General Circulation Models
IBLI	Index Based Livestock Insurance
IRA	Institute Resource Assessment
AAS	African Academy of Sciences
IDRC	International Development Research Centre
IPPC	Intergovernmental Panel on Climate Change
ITCZ	Inter-Tropical Convergence Zone
IUCN	International Union of Conservation and Nature
IFAD	International Fund for Agricultural Development
SST	Sea-Surface Temperature
HARITAs	Horn of Africa Risk Transfer for Adaptation
LTMS-	Long Term Mitigation Scenarios
MDGs-	Millennium Development Goals
MAC	Mitigation Abatement Curve
NAMA	nationally Appropriate Mitigation Actions
NAPAs	National Adaptation Programmes of Action
MCA	Multi- Criteria Analysis
NEPAD	New Partnership for Africa's Development
LDCs	Less Developed Countries
OECD	Organisation for Economic Co-operation and Development
GEF	Global Environment Facility
LCDS	Low Carbon Development Strategies
LDCs	Least Developed Countries
RECs	Regional Economic Communities
REDD	Reducing Emissions from Deforestation and Forest Degradation in Developing Countries
REMA	Rwanda Environment Management Authority
RENGOF	Rwanda Environment NGO Forum
SBSTA-	Subsidiary Body for Scientific and Technological Advice

SEFA	Sustainable Energy Fund for Africa
UN	United Nations
UNDP	United Nations Development programme
UNCED	The United Nations Conference on Environment and Development
UNFCCC-	United Nations Framework Convention on Climate Change
UNEP-	United Nations Environment Progamme
UNIDO	United Nations Industrial Development Organization
USAID-	United States Agency for International Development
WMO-	World meteorological Organization
WB	World Bank
NOAA	National Oceanic,
NASA	National Aeronautics and Space Administration
WFP-	World Food Programme

Chapter 1:

INTRODUCTION

1.1 Rationale

The United Nations Conference on Environment and Development (UNCED), held in Rio de Janeiro in 1992, provided the vision and framework for the multilateral cooperation needed to achieve a sustainable future, particularly under a changing climate. Communities in Africa have developed various ways to cope with current climate variability, but these mechanisms may be insufficient to help communities adapt to future climate changes. Many African countries have assessed the effects of climate variability and climate change on their national economies. Based on their results, they have identified mitigation and adaptation measures in their National Communications, National Climate Change Strategies, National Adaptation Programmes of Action (NAPAs), Green Economy studies and other related studies, which provide opportunities for accelerating sustainable development in Africa. However, the implementation of these measures is constrained by inadequate financial, institutional and human capacities. Many stakeholders lack access to the skills, tools and information needed to make decisions on climate change.

This Guidebook aims to translate available climate science and current international climate policies into the tools for practical action in Africa, in the context of sustainable development. In this regard the guidebook focuses on the potential climate change impacts on key sectors in Africa and appropriate adaptation and mitigation options. It outlines the governance, technological, financial and capacity-building opportunities available to the continent to work effectively towards sustainable development. Experts and policymakers will be advised on where to look for additional information and tools to develop policies, programmes and plans to shape future sustainable development on the continent, under a changing climate.

1.2 Framing the climate, Human Systems and Major Challenges for Africa

Africa is a vast landmass and experiences a wide variety of climate regimes, which are determined by the location, size and shape of the continent. Poleward of 30^{O} North and South of the equator, winter conditions are experienced. Air mass subsidence between 15 and 30^{O} North and between 20 and 30^{O} South sustains the Sahara and the Kalahari deserts respectively. This air mass subsidence results from subtropical jets over those latitudes. Between 20^{O} South and 15^{O} North lies the most active weather zone of the continent, which is characterized by convective activity and precipitation. Both this convective activity and precipitation increase towards the equator.

The delineated ecological zones of the continent follow the same pattern as its climate. The extreme northern and southern latitudes of the continent experience winter ecology and support winter vegetation. The regions between 15 to 30^{O} North and 20 to 30^{O} South are occupied by desert ecology and marginal lands. Between 20^{O} South and 15^{O} North lie the Savannah, Rangeland and Forest ecologies.

1.3 Summary of Recent Knowledge and Emerging Issues

The National Oceanic and Atmospheric Administration (NOAA), the National Aeronautics and Space Administration (NASA), the United Kingdom Meteorological Office's Hadley Centre and the Japanese Meteorological Agency agree that 2010 and 1998 were the hottest of the 10 hottest years on record with 13 of the warmest years having occurred between 1997 and 2011. These data and findings for 2010 add weight to the common conclusion of all four agencies and most of the scientific community, that in spite of short-term spatial and temporal variability the clear long-term trend is one of global warming (NOAA, 2011; NASA, 2011; UK-Met Office, 2011; JMA, 2011; as reported in UNEP, 2011).

It should also be noted that the global climate for much of year 2011 was heavily influenced by one of the strongest La Nina events in history and was closely associated with many notable extreme regional events including drought in east Africa, central equatorial pacific and the southern United States, flooding in southern Africa, eastern Australia and southern Asia (WMO, 2011)

As the planet warms, the store of carbon held in permanently frozen organic matter (permafrost) gradually melts, emits greenhouse gases into the atmosphere and exacerbates climate change. When permafrost thaws, the decomposing organic matter contained therein emits carbon dioxide to the atmosphere; when thawing occurs under a lake in the absence of oxygen, it emits methane. The recent widespread loss of discontinuous permafrost has led to a change in hydrologic processes and triggered erosion or subsidence of ice-rich landscapes, increasing the threat of natural hazards for people, structures, roads and communication (Rekacewicz, 2000). See also http://www.global-greenhousewarming.com/permafrost.html

According to a United Nations Environment Programme's Global Environmental Alert Service (GEAS) report (UNEP, 2011), new research predicts that after the mid-2020s, the Arctic will shift from acting as a carbon sink to a carbon source. The impact of the emissions is irreversible and will be strong enough to offset 42 to 88 percent of the total amount of carbon stored in the global landmass (Schaefer et al., 2011).

Melting permafrost, resulting emissions and the potential effects on the climate system were not factored into the IPCC reports. For the first time, researchers have estimated the amount of carbon that could be released to the atmosphere from thawing permafrost and the expected impact on climate change. Their estimates result from calculations using three global climate models based on a scenario of moderate global warming, an emission scenario from the IPCC, and a land-surface model (Schaefer et al., 2011). With these emerging research results the international community must take this new information into account when calculating the amount of fossil fuel emission reductions needed to reach target atmospheric carbon dioxide concentrations. According to Schaefer et al., 2011; researchers estimate it will require an additional 14 percent reduction.

1.4 Climate Change Science, Impacts and Responses by Africa

According to the 4th IPCC Assessment Report, there is already evidence that Africa is warming faster than the global average, and this is likely to continue (IPCC, 2007). The warming occurs year-round. By 2100, temperature changes will fall into ranges of about 1.4 to almost 5.8°C increase in mean surface temperature compared to 1990 and about 10 to 90cm rise in mean sea level. This warming is greatest over the interior of semi-arid margins of the Sahara and central southern Africa. By the time the atmospheric concentration of carbon dioxide-equivalent has doubled, the global mean precipitation is projected to be about 1–5 per cent higher than in 1990. Under the lowest warming scenario, equatorial east Africa will

experience rainfall increases by 5-20 per cent in December, January and February(DJF) and decreases by 5-10 per cent in June, July and August (JJA).

Agricultural production and food security in many regions of African will likely be severely compromised by climate change and climate variability. Climate change will worsen the water stress currently faced by some countries, while some countries that are not at risk will become at risk of water stress. Changes in a variety of ecosystems are already being detected faster than anticipated, particularly in southern African ecosystems. Climate change and variability could also result in the inundation of low-lying lands, including coastal settlements. Human health could be further negatively impacted upon by climate change and climate variability, for example, there has been an increase in the prevalence of malaria in southern Africa and in the East African highlands. These adverse impacts, combined with poverty, poor policy and institutional frameworks, make Africa one of the most vulnerable continents to climate change and climate variability.

It should be noted that Global Climate Models (GCMs) are the most appropriate tool for addressing future climate change. However, in order to formulate adaptation policies and strategies in response to climate change impacts and vulnerability, reliable climate change information must be resolved at much finer spatial scales and these can be obtained from use a Regional Climate Models (RCMs). These models do provide finer spatial and temporal detail than the GCMs. There is however some uncertainty associated with the development of future climate change scenarios and these typically arise from the assumptions' made with regard to emission scenarios, socioeconomic emissions, GHG concentration projections, climate model projections among others. This Guidebook has made an attempt to present these uncertainties to some reasonable details.

1.5 Climate Change and Development in Africa

Climate change poses a big threat to Africa's economic growth (due to changes in natural systems and resources), long-term prosperity, as well as the survival of the already vulnerable populations. Climate change, variability and associated increased disaster risks are an additional burden to sustainable development in Africa, as well as a threat and impediment to achieving the Millennium Development Goals.

The development challenges for Africa will be significant as the continent faces complex economic, social and technological choices. This is compounded by the uncertainties in understanding future climate changes and their impact on key development sectors such as agriculture and food security, forests, health, water and energy. The overwhelming need for action on development in Africa must take place in the context of these challenges, with an understanding of and provision for the threats that climate change is likely to impose on economic and social systems. Moreover, global policies on finance and technology transfer provide a unique opportunity to transform climate challenges into development opportunities across Africa. The continent can 'leapfrog' the carbon-intensive phase of development and move directly to cleaner and more advanced transport, energy and land-use solutions. African governments and Regional Economic Communities (RECs) can proactively shape the development of their national infrastructures and services and avoid unsustainable technology 'lock-ins.'

The linkages between climate change and the many dimensions of equitable development and growth present both a crisis that must be tackled and an opportunity that must be seized. These linkages will be discussed in the various chapters of this guidebook for all sectors that have critical roles to play in the transformation process.

Chapter 2:

AFRICAN CLIMATE CHANGE: PAST AND FUTURE

2.0 Introduction

This chapter provides information on how African climate has changed in the past, and how it is projected to change in the future under global warming. Box 2.1 provides definitions of some terms that the reader will encounter in the text.

Questions:

- *Is climate change occurring in Africa? If so, why?*
- *What are the likely changes in climate that Africa faces in future?*
- *What method and tools are available to assess the changes?*
- *And what is the certainty level associated with future projections?*

Box 2.1: Definitions of Climate, Climate Variability and Climate Change

Climate: This is the long-term average weather conditions (usually taken over a period of more than 30 years as defined by the World Meteorological Organization, WMO) of a region including typical weather patterns such as the frequency and intensity of storms, cold spells, and heat waves.

Climate Variability: Variations in the mean state and other statistics (e.g. standard deviations or the occurrence of extreme events) of the climate on all temporal and spatial scales beyond that of individual weather events. Variability may be due to natural external processes outside the earth system, or to natural or anthropogenic internal forcing.

Climate Change from the IPCC point of view refers to any change in climate over time, whether due to natural variability or as a result of human activity.

This usage differs from that in the United Nations Framework Convention on Climate Change (UNFCCC), which defines climate change as: 'a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods'

2.1 Global Climate Change

It is well known that the global mean surface temperature has increased (by about 0.07°C per decade in the past 100 years (IPCC, 2007). However, the increase has been more rapid about 0.18°C per decade in last 25 years, with the last decade (2001–2010) being the warmest decade on record (Fig 2.1). The average temperatures over the decade is 0.46°C above the 1961–1990 mean, and 0.21°C warmer than the previous decade (1991–2000). In turn, 1991–2000 was warmer than previous decades, consistent with a long-term warming trend (WMO, 2011). The surface warming occurs everywhere (except in the eastern Pacific, Southern Ocean and parts of Antarctica), but the land is warming faster than the ocean (IPCC, 2007). The Intergovernmental Panel on Climate Change (IPCC) has projected that global mean temperatures may increase by between 1.4 and 5.8°C by the end of the 21st century (IPCC, 2007).

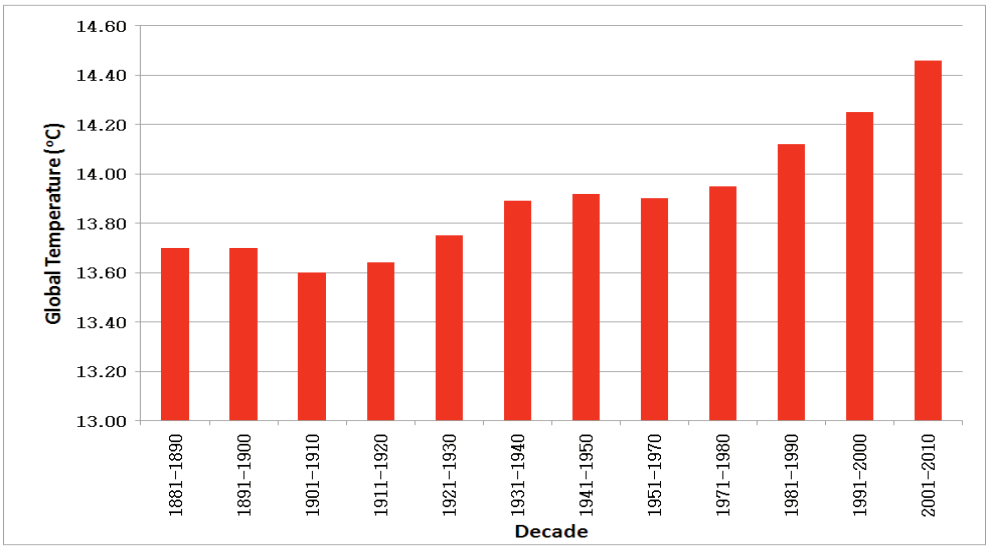


Figure 2.1: Decadal global average combined land-ocean surface temperature (°C), redrawn from WMO, 2011

Consistent with the global warming, mountain glaciers and snow cover have declined in both hemispheres. The global average sea level has risen since 1961 at an average rate of 1.8 mm per year and since 1993 at 3.1 mm per year, with contributions from thermal expansion and melting glaciers and ice caps, and the Greenland and Antarctic ice sheets. Significant increase in precipitation has been observed in the eastern parts of North and South America, northern Europe and northern and central Asia. The frequency of heavy precipitation events has increased over most land areas, which is consistent with warming and increases in atmospheric water vapour.

At the same time, there has been some drying in the Sahel, the Mediterranean, southern Africa and parts of southern Asia (IPCC, 2007). Widespread changes in extreme events have been observed. For example, cold days, cold nights and frost are less frequent, while hot days, hot nights, and heat waves are more frequent. More intense and longer droughts have been observed over wider areas since the 1970s, particularly in the tropics and sub-tropics. There is also evidence of increased intensity of tropical cyclone activity in the North Atlantic since about 1970 (Thornton et al., 2008).

2.2 Climate Variability and Changes in Africa

2.2.1 Spatial variability

Africa experiences a wide variety of climate regimes, in which its location, size, and shape play key roles. Rainfall amount, duration and seasonality are the most important factors in differentiating the African climate regimes, which vary from the Indian Ocean to Central Africa and from the North to the South, ranging from humid equatorial regimes, through seasonally-arid tropical regimes, to sub-tropical Mediterranean-type climate (Hulme et al., 2001). The poleward extremes of the continent experience winter rainfall associated with the passage of mid-latitude air masses. Northern Africa is made up of both arid and semi-arid climatic zones, with a wetter coastal strip (Fig. 2.2).

In West Africa, the climates range from humid equatorial conditions at the coast to arid conditions in the northern Sahelian countries and have a wide precipitation range decreasing from the coast towards inland. In the Sudano-Sahelian region, the climate is generally dry and characterized by two seasons while the Southern humid areas have one season. Central Africa's climate varies from tropical-dry to equatorial.

Rainfall is highly variable across Eastern Africa ranging from about 100 mm/year in northeastern Ethiopia to about 2500 mm/yr in parts of northern Tanzania, with an average annual precipitation of 920 mm/year (Fig 2.2). Large parts of Eastern Africa are arid or semi-arid, with annual rainfall below 500 mm. Southern Africa's climate also exhibits variation in climate zones, from warm desert to humid subtropical and high levels of variability exists within the zones (Tadross et al., 2009).

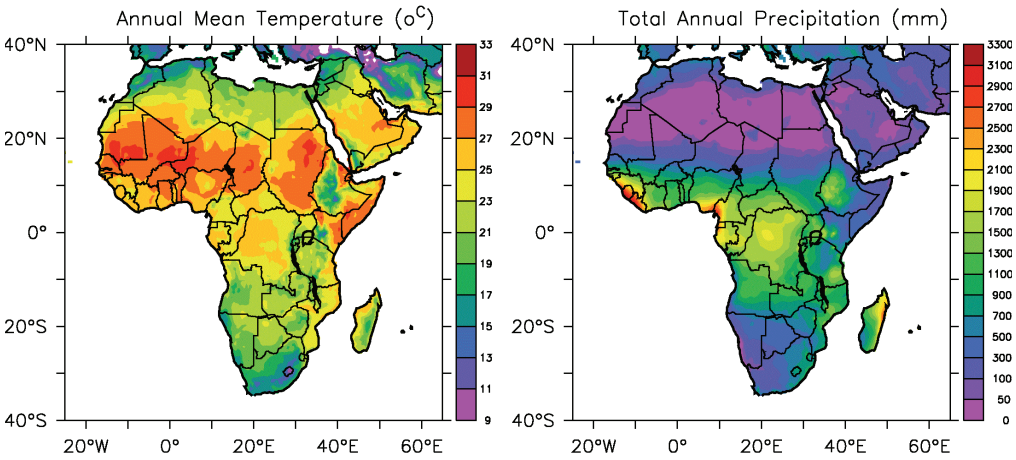


Figure 2.2: Spatial distribution of annual mean temperature (left panel) and total annual rainfall in Africa (right panel), averaged over 1901 - 2010. (Data source: Met Office Hadley Centre, UK, and Climatic Research Unit, University of East Anglia, United Kingdom).

African climate is influenced by planetary scale features such as the Hadley Circulation, the influences of the Atlantic and Indian Ocean monsoons, the Inter-Tropical Convergence Zone (ITCZ), Sea-Surface Temperature (SST), and El-Niño Southern Oscillation. For instance, across the Kalahari and Sahara deserts, precipitation is inhibited by downward motion in the Hadley Circulation throughout the year. In contrast, moderate to heavy precipitation associated with the Inter-Tropical Convergence Zone (ITCZ) characterizes equatorial and tropical areas. The spatial variability of African climate is also influenced by the presence of large contrasts in topography, and the existence of large lakes in some parts of the continent (Semazzi and Sun, 1995). Hence, the climate of the individual country county in Africa is influenced by latitude, atmospheric circulation diurnal position and by localized factors such as topography and the presence of large bodies of water.

2.2.2 Temporal variability

All African climates exhibit differing degrees of temporal variability, particularly with regard to rainfall. Variability can be seasonal, inter-annual, and decadal or in longer time scales (Lebel and Ali, 2009). High rainfall variability is a major determining feature of the African drier climates (arid and semi-arid). Rainfall is relatively high and reliable over the central and coastal parts of the sub-region but significant variation exists (e.g. Doula in Cameroon averages 3,850 mm and N'Djamena in Chad, 500 mm per year). Rainfall is more variable towards the north. Temperatures are high (24-26°C) in the low-lying coastal forests varying little due to persistent cloud, while in the high-relief mountainous areas, annual temperatures are lower and more variable (19°C and 24°C). The semi-arid zones experience a high temperature range between day and night.

2.3 Climate Changes

2.3.1 Trends in temperature

Most parts of Africa have experienced temperature increase (about 0.70°C) in the last century (IPCC, 2001). On regional scales, observation shows increases in temperature over the Sahel, tropical forests, southern Africa, eastern Africa and north Africa (Fig 2.3: Meehl et al., 2000; Boko et al., 2007). The temperature of African tropical forest increases by 0.29°C since 1960, and that of Sahel increased by 0.2°C-0.3°C during the 1990s (Hulme et al., 2005; Boko et al., 2007). Collins (2011) reported significant increasing temperature trends in all African regions during the past two decades (1995-2010). In southern Africa, increase in temperature between 0.1-2°C was reported for period 1900-1995 (Boko et al., 2007; Hulme et al., 2001). A temperature increase of between 0.2-0.3°C was reported for eastern Africa (Hulme et al., 2001). On local scales, temperature decreases have been observed in Cameroon and in parts of Malawi, Senegal and Nigeria (Hulme et al., 2001; Hulme et al., 2005). Hasanean (2001) found a temperature increase in Tripoli, Libya, but a temperature decrease in Alexandria, Egypt. Domroes and El-Tantawi (2005) observed temperature decrease in northern Egypt, but increase in the southern Egypt. Odjugo (2010) reported temperature increase of 1.2°C in Port Harcourt (a Coastal city) and 2°C in Nguru (a semi-arid city of Nigeria) between 1901 and 2005.

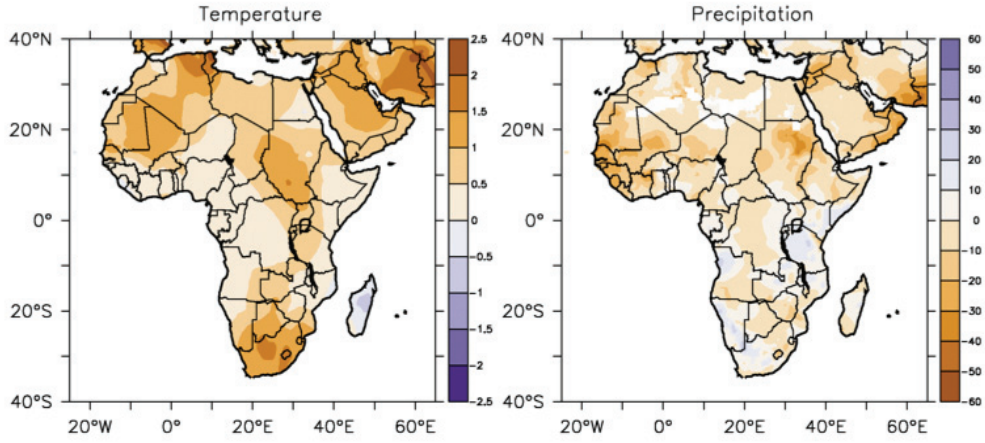


Figure 2.3 Mean linear trends in annual temperature (°C century–1) and annual rainfall (% century–1), calculated over the period 1901–2010. (Data source: Met Office Hadley Centre, UK, and Climatic Research Unit, University of East Anglia, United Kingdom).

More recently, WMO reported that 2010 was the warmest year on record in Africa, particularly, for West Africa, the Saharan/Arabian region, and the Mediterranean (WMO, 2011). The year was exceptionally warm in most of Africa. Temperatures averaged over Africa were 1.29°C above the long-term average, breaking the previous record by 0.35°C. Continental monthly anomalies exceeded +1.5°C in each of the five months from December 2009 to April 2010, peaking at +2.12°C in February; the previous largest monthly anomaly on record was +1.44°C in April 1998. All twelve months of 2010 were at least 0.7°C above normal. While temperatures were well above average throughout Africa, they were especially exceptional in the northern half of the continent (extending into the Arabian Peninsula), where the Saharan/Arabian region was 2.22°C above normal, 0.89°C above the previous record and the largest annual anomaly ever recorded for any sub-region outside the Arctic. The Mediterranean region also had its warmest year on record with Tunisia equaling its previous warmest year.

2.3.2 Trends in rainfall

In general, Africa has been drier in the last few decades (Nicholson, 2001; L'Hóte et al., 2002; Oguntunde et al., 2006), however, while some regions have experienced a decrease in rainfall, some have experience an increase in rainfall. For instance rainfall has decreased in the Horn of Africa (Fischer et al., 2005), in Botswana, Zimbabwe, the Transvaal, and in the Sahel during the period from 1961 to 1990 (Hulme et al., 2005), but significant increase in rainfall is reported for South Africa (Mason et al., 1999). In the Volta Basin encompassing six countries in West Africa, rainfall increased at the rate of 0.7 mm/yr^2 or 49 mm/yr between 1901 and 1969, whereas a decrease of 0.2 mm/yr^2 (6 mm/yr) was estimated for 1970-2002 sub-series (Oguntunde et al., 2006). In central Africa (Congo basin), precipitation reduced slightly (2-3%) but heavy rainfall events increased over Angola, Namibia, Mozambique, Malawi and Zambia between 1931 and 1990 (Sivakumar et al., 2005; Boko et al., 2007). The Sahel has experienced a decrease in rainfall from 1970 to 2000, with recurrent droughts; a major drought lasted from 1972-1984 (UNEP, 2002). Rainfall in the Sahel has increased since the end of the 1990s, although the annual average rainfall is still as low as during the drought of the 1970s (Mahe and Paturel, 2009).

2.3.3 Trends in extreme climate events

While decreases in precipitation may lead to drought, increases in precipitation can lead to floods. In Africa, the frequency and severity of droughts and floods have increased over the past 30 years. Droughts have increased in frequency and intensity in Eastern Africa (FAOSTAT, 2000; UNEP, 2002), where frequent droughts have occurred in each decade over the past 50 years in the region (FAOSTAT, 2000). The East African drought of 2011 is proving to be one of the worst that Ethiopia has faced in 50 years. In the Central Africa and Sahel, droughts have become more frequent since the late 1960s. An increase in rainfall extremes has been observed for southern Africa and the Guinean coast. Increase in frequency of rain days, heavy rains often accompanied by severe floods (as in 1999/2000 in Mozambique). Devastating flooding events in southern Nigeria has been linked with the progressive increase in August rainfall over the region in the last five decades (Adefolalu, 2001). The various changes, increases and decreases in climate variables within a location and between locations, increases the challenges already posed by climate variability in Africa (Fig 2.4; Table 2.1).

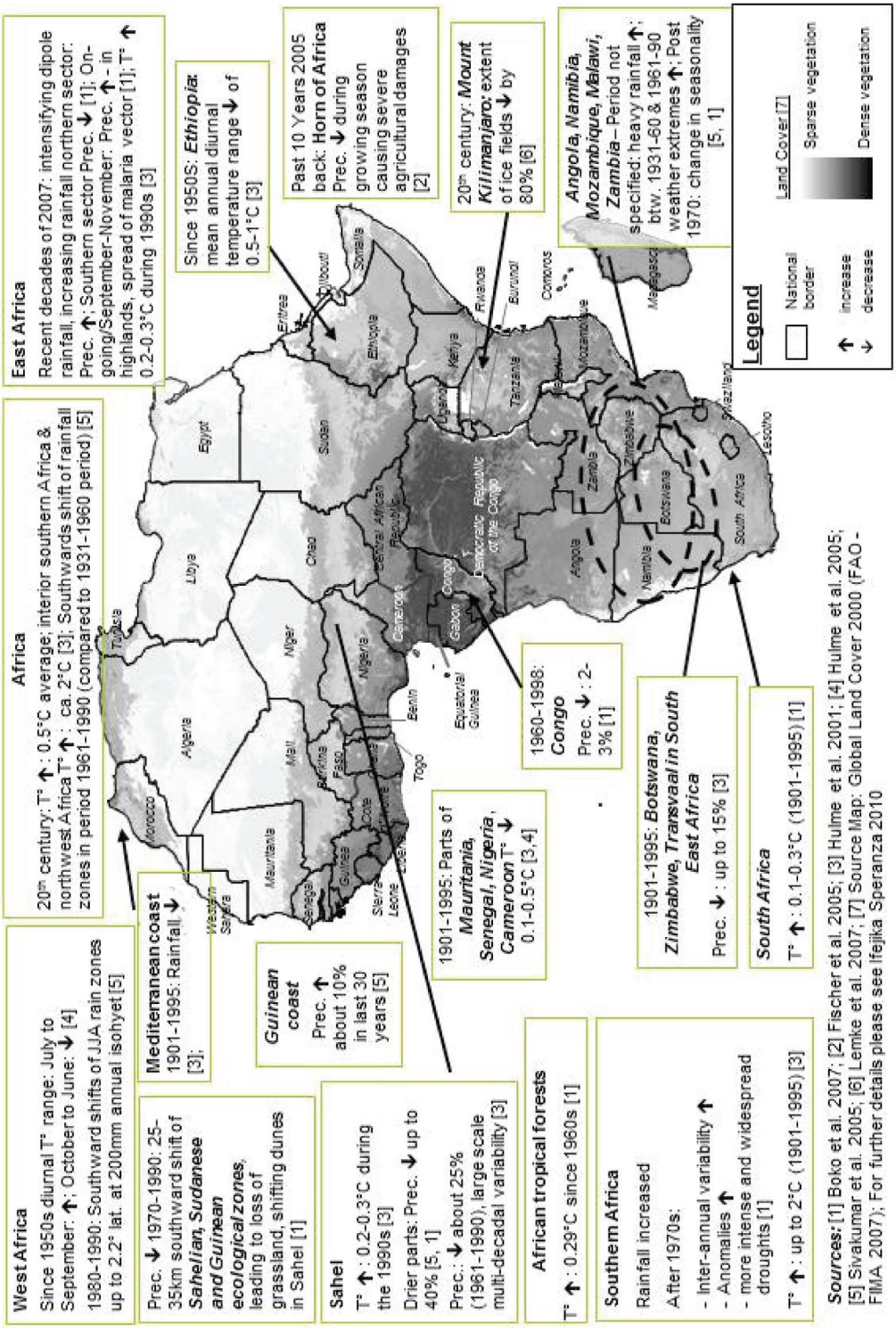


Fig. 2.4: Observed Climate Change Impacts in Africa (source: Chinwe Ifejika Speranza, 2010)

Table 2.1: Observed changes in climate by sub-region, summarized from IPCC Fourth Assessment Report

Region	Observed Trends	Extremes
West Africa	• Greater warming trend since 1960s (changes not uniform) • Increase in number of warm spells (1961-2000) • Decrease in the number of extremely cold days (1961-2000) • Decline in annual rainfall since end of 1960s (e.g. decrease of 20 to 40% noted between 1968-1990,), with an increase again since 1990, but still significantly below 1960s levels • Inter-annual variability has become larger since 1980 • Decline in mean annual precipitation of around 4% in tropical rain-forest zone (1960-1998)	• Increased incidence of drought 1900-2002
Central Africa	• Greater warming trend since 1960s (changes not uniform e.g. decadal warming rates of 0.29°C in the African tropical forests) • Declines in mean annual precipitation in the tropical rain-forest zone for period 1960 to 1998 (e.g. around 3% in North Congo and 2% in South Congo) • 10% increase in annual rainfall along the Guinean coast during the last 30 years	
East Africa	• Greater warming trend since 1960s (changes not uniform) • Decreasing trends in temperature from weather stations located close to the coast or to major inland lakes • Intensifying dipole rainfall pattern on the decadal time-scale, characterized by increasing rainfall over the northern sector and declining amounts over the southern sector	• 1997/98 El Nino • 1999/2001 La Nina Drought • 2009/2010 Drought
Southern Africa	• Greater warming trend since 1960s (changes not uniform e.g. 0.1 to 0.3°C in South Africa) • Increase in number of warm spells (1961-2000) • Decrease in the number of extremely cold days (1961-2000) • No long-term trend in annual rainfall has been noted, but increased inter-annual rainfall variability has been observed in the post-1970 period • In certain parts (e.g. Angola, Namibia, Mozambique, Malawi, Zambia) there is evidence of changes in seasonality	• More intense and widespread droughts reported • In certain parts (e.g. Angola, Namibia, Mozambique, Malawi, Zambia) a significant increase in heavy rainfall events has been observed associated with flooding

2.4. Causes of Climate Variability and Change

Climate variability and change is driven by natural and anthropogenic factors. Here we distinguish between these factors, and discuss the African contribution to the anthropogenic factors.

2.4.1 Natural versus anthropogenic climate forcing

The climate system is driven by the sun's energy and regulated by natural processes and cycles in the Earth system. These include the carbon cycle and greenhouse effect, orbital cycles, ocean currents that distribute warmer and colder water around the globe, and atmosphere-ocean interactions that moderate temperature. The natural processes include variations in solar sunspot activities, the earth-sun geometrics, volcanic eruption, ocean-atmosphere interaction integration, and continental drift. The signature of these natural forcing is evince on inter-annual variability of global and regional atmospheric features like the El-Nino/La Nina Southern Oscillation (ENSO), the African jet streams, the tropical Easterly jet, the North Atlantic Oscillation, the southern annular mode, monsoons, cyclones and subtropical anticyclones, and the easterly/westerly wave perturbations - they all influence regional weather patterns and climate variability in Africa (Knippertz et al., 2003; Bowden and Semazzi, 2007; Christensen et al., 2007; Paeth and Thamm, 2007; Patricola and Cook, 2009).

However, the influence of these atmospheric features on African climate varies from one region to the other. In Eastern Africa, the ENSO is a major feature in the sub-region's climate variability, causing floods and droughts (UNEP, 2002). In southern Africa, rainfall is strongly influenced by the Inter-Tropical Convergence Zone (ITCZ), the Southern Oscillation Index (SOI), the Antarctic Oscillation (AAO) and also the ENSO. In West Africa the climate is influenced by atmospheric jets, monsoon, and is very sensitive to global SST and regional land surface processes. The climate of northern Africa is also distinguished by an especially strong coupling between the atmosphere and the land surface (e.g., Xue and Shukla, 1993; Xue and Shukla, 1996; Koster et al., 2004; Patricola and Cook, 2007).

It is generally accepted that the anthropogenic climate forcing is the main cause of the climate change (IPCC, 2007). This includes greenhouse gases, aerosols, and land surface changes. Studies have shown that while increase in the concentration of the greenhouse gasses would increase the global temperature (global warming), an increase in atmospheric aerosol would decrease it (global dimming and global cooling), but changes in the land cover could either increase or decrease the local temperature.

The increase in the GHG (i.e. CO_2, Methane, etc) since industrialization in the 1900s is the major cause of the ongoing global warming. The increase has been attributed to a rise in the burning of fossil fuels, high population growth rates, increasing reliance on fossil fuel-driven growth technologies, and land use effects (particularly urbanization, agriculture and deforestation). Further increases in GHG levels are expected in future, particularly as developing countries also become more industrialized. However, any increase in GHG enhances the "greenhouse" properties of the earth's atmosphere. These gasses allow solar radiation from the sun to travel through the atmosphere but prevent the reflected heat from escaping back into space which causes the earth's temperature to rise.

2.4.2 African contribution to the anthropogenic climate forcing

2.4.2.1 Greenhouse Gases (GHGs)

While the developed countries are responsible for increase in GHGs, there are various activities in Africa that could contribute to the increase. For instance deforestation would increase the amount of CO_2 in the atmosphere, because when forests (which act as major carbon store) are cleared and the trees are either burnt or rot, the stored carbon is released as CO_2 into the atmosphere (Houghton, 2005; Stern, 2006). Other anthropogenic ways through which Africa contributes to increase in GHGs include the release of black carbon (including gas flaring and bush burning), methane from waste (poor waste management), and many industrial activities. However, studies have shown that African contribution to the increase in GHGs is very small when compared to that of other more developed continents.

2.4.2.2 Landuse changes

Land-use changes (such as deforestation, desertification, and urbanization) also increase the atmospheric temperature. These land use changes remove the vegetative cover that absorbs the shortwave radiation, thereby, leading to global warming (Glasdottir and Stocking, 2005). Development is a main cause of these land-use changes in Africa. For instance, people cut down trees for economic purpose: to expand cities, build houses, and create large-scale farming. The band of West African forests that once extended from Guinea to Cameroon is virtually gone. Deforestation has been most severe in Nigeria, where more than 410,000 hectares of forest are lost to desertification annually. The annual deforestation rate has increased from 2.7 percent of the country's land from 1990-2000 to 3.3 percent in 2000-2005; and currently, less than 12.2 percent of the country land is forested (FAO, 2009). Within 2000 and 2005, Ghana lost an average of 115,000 hectares of forest per year, which amount to 2.0 percent of the country's land. In general, over the last 15 years, West Africa has lost almost 12 million hectares (two times the size of Togo) of tropical forest (FAO, 2009); the annual deforestation rate is 1.17 percent of the total land per annum. Even though, African forests constitute only 16 percent of the world's total, the deforestation rate in Africa is more than six times the world's average (FAO, 2009). Abiodun et al., (2007) used regional climate model to show that changes in land-use may be major contributors to the persistence of the observed drought over the West African sub-region.

2.5. Future Climate Projections for Africa

Various future climate projections are available over Africa. This section presents methods and sources of climate projection before discussing the future climate projected over the continent.

2.5.1 Tools for future climate projections

Climate studies use different climate models to project the future climates, but the most acceptable tools, used in IPCC reports, are Global Climate Models (GCMs) and Regional Climate Models (to downscale results of GCMs). Distinguish from General Circulation Models. It should be noted that a General Circulation Models (GCMs) are mathematical equations to represent the general circulation of the planetary atmosphere or the oceans. These equations are the basis for complex computer programs commonly used for simulating the atmosphere or ocean of the Earth. Atmospheric and Oceanic GCMs (AGCM and OGCM) are key components of Global Climate Models along with sea ice and land-surface components. GCMs and global climate models are widely applied for weather forecasting, understanding the climate, and projecting climate change.

2.5.1.1 Global Climate Models (GCMs)

GCMs are the primary tools for simulating past climate and projecting the future climate using different climate forcing scenarios. They are complex computer models that represent interactions between the different components of climate such as the land surface, the atmosphere and the oceans. GCMs solve various complex equations and adopt parameterization schemes to represent atmospheric processes, and provide physically self-consistent explanations of observed climate variations on various time scales (IPCC, 2007; WGI, Chapter 8). Various studies have demonstrated that the models are capable of providing reliable climate projections for the future (IPCC, 2007). In making projections of climate change, several GCMs and scenarios of future emissions of greenhouse gasses are used to predict the future. This process generates a suite of possible future scenarios, each valid but some scenarios can be considered more likely than others.

2.5.1.2 Downscaling GCM output for regional and local impacts assessments

There is a need to downscale GCM outputs before using them for regional and local impact assessments. This is because GCMs typically work at a spatial resolution of 200-300 km, which is useful for projected future climate at a global scale. However, at a regional scale GCMs are less useful because they cannot

resolve local scale features (for example, sea-breeze, lake-breeze, or mountain-induced flows) which play an important role in regional climate. This limits the application of GCM projections for assessments of change at the local or regional scales. Therefore, the technique of downscaling is typically used to produce projections at a finer spatial scale. Downscaling is effective because the GCMs are generally good at projecting changes in atmospheric circulation (high and low pressure) but do a poor job of translating that information into changes in rainfall.

There are two possible approaches for downscaling, namely: statistical and dynamical regional climate models. The statistical model uses statistical/empirical equations to represent the relationship between the large features and local climate variables at stations, while dynamical models use physically based laws (similar to those in GCMs) to represent the relationship. Each method has advantages and disadvantages, and both are used in IPCC assessments.

Development of projections of climate change involves the development of both climate and socioeconomic scenarios. "SCENARIO" is defined as a plausible and often simplified description of how the future may develop based on a coherent and internally consistent set of assumptions about driving forces and key relationships. Scenarios may be derived from projections, but are often based on additional information from other sources, sometimes combined with a "narrative storyline" (IPCC, 2007a).

Scenarios of future conditions relevant to analyzing different aspects of the climate change issue have always been an important component of the work of the Intergovernmental Panel on Climate Change (IPCC) because of their utility for representing uncertainties associated with anthropogenic climate change. For the first, second, third and fourth assessments reports, the IPCC provided the terms of reference, reviewed the scenarios, and ultimately approved them, while modeling teams around the world prepared the scenarios. Previous sets of IPCC scenarios were published in 1990, 1992, and 2000. In 2006, the IPCC decided that new scenarios would be developed for their future assessment reports by the scientific community and these scenarios should include adaptation, economic growth, demographic, and other societal variables that lead to emission scenarios. Rather than having the IPCC directly coordinate and approve new scenarios, the research community itself now coordinates the process of scenario development. The role of the IPCC is to "catalyze" the timely production of new scenarios by others.

In this new process, a small number of "benchmark" emissions scenarios (referred to as "representative concentration pathways" (RCPs) are identified for potential use by climate modeling groups. The process considers:

- Comparability to serve the various user communities;
- Results of scenario activities undertaken by the World Bank, the Food and Agriculture Organization (FAO), the Organization for Economic Cooperation and Development (OECD), the International Energy Agency (IEA), the World Meteorological Organization (WMO), and the UN Environment Programme (UNEP), and the possible future involvement of these organizations in scenario development;
- Transparency and openness of the scenario development process; and
- Increased involvement in the scenario development process of experts from developing countries and countries with economies in transition.

Development of Global Climate Scenarios

Box 2.2 below provides the steps in development of global scenarios.

Box 2.2: Steps in the Development of Global Scenarios for use by IPCC and other communities
(ref: IPCC, 2008 IPCC-XXVIII/Doc.8, Twenty-Eighth Session Agenda item: 11.3, Budapest, 9-10 April 2008)

Step 1: Hold Expert Meeting to

- Proposed set of "benchmark concentration pathways" that will be used in initial climate model runs to provide simulated climate outputs;
- Describe key scientific and technical issues for coordinated development of new integrated scenarios;
- Plan for the relevant research communities to coordinate, organize, and communicate further actions towards the development of new integrated scenarios; and
- Develop a plan for increasing involvement of experts from developing countries and countries with economies in transition in the development of new scenarios, including funding and organizational aspects.

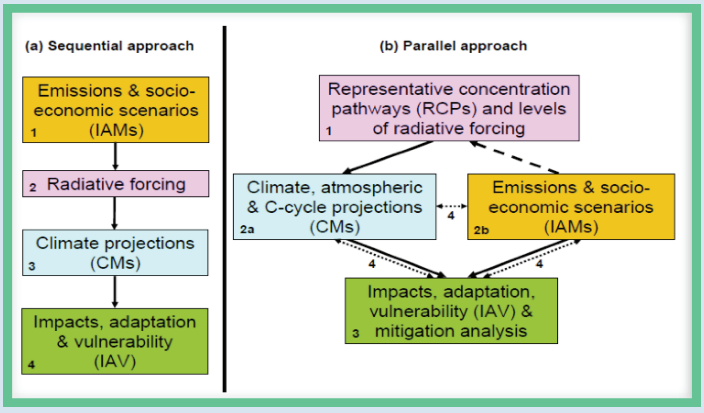
Step 2: Develop an integrated perspective for decision support and assessment by identifying and developing consistent scenarios to allow for:

- Assessments of impacts, adaptation, and vulnerability that are consistent with views of the evolution of climate change, which in turn should be consistent with views of emissions trajectories;
- Assessments of emissions that are consistent with views of socioeconomic drivers and landuse change and account for feedbacks from climate change impacts and policies to reduce both emissions and adverse impacts; and
- Impacts, adaptation, and vulnerability are assessed in a way that uses consistent information about socioeconomic drivers, technology, and land use change.

Step 3: Determine scenario characteristics and needs from an end-user perspective

- The characteristics and types of scenarios required must be determined in light of the needs of users of those scenarios. Users are categorized as "end users," policy- and decision makers who use scenario outputs and insights in various decision processes; and "intermediate users," researchers who use scenarios from a segment of the research community other than their own as inputs into their work;
- Time frame is important to users and requirements vary. Global scenarios for the IPCC has two time periods:
    - ◊ "near-term" scenarios that cover the period to about 2035 and are useful for better projections of regional climate change and associated impacts, evaluation of potential adaptation options; and exploration of opportunities and constraints on mitigation by taking account of economic, technological, and institutional factors; and
    - ◊ "long-term" scenarios that cover the period to 2100 and, in a more stylized way, can be extended to 2300 focus on considering options for the stabilization of anthropogenic influences on climate or the consequences of not doing so. They are often used for comparative analysis of the long-term climate, economic, environmental, and policy implications of different mitigation scenarios or pathways. They consider the role of feedbacks between climate and biogeochemistry, and nonlinearities in the climate system as well as in affected systems;

Step 4: Development of Representative Concentration Pathways (RCPs) to support a parallel process to expedite the development of integrated scenarios by enabling modeling the response of the climate system to human activities to proceed in parallel to emissions scenario development. (see Figure below: Approaches to the development of global scenarios: (a) previous sequential approach; (b) proposed parallel approach)



Step 5: Implement the parallel process for scenario development

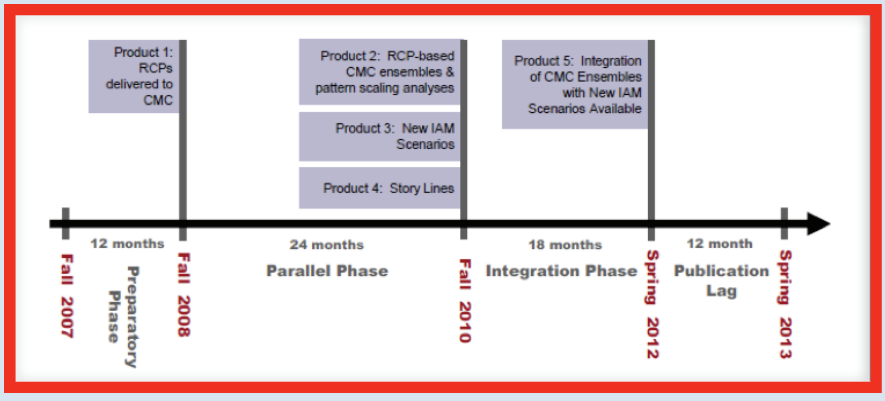
- As the identification of RCPs proceeds, the Climate Modeling community proceeds in parallel with new climate change projections by the IAM and IAV communities.
- The RCPs serve a limited role as inputs to various classes of CMs.
- The IAM community will simultaneously develop a range of completely new socioeconomic and emissions scenarios.
- Production of some new scenarios that are consistent with the RCPs will enable different teams of integrated assessment modelers to explore alternative technological, socioeconomic, and policy futures that are consistent with a given stabilization level,
- The IAV community conducts Impacts, adaptation, and vulnerability studies results become available from both the CM and IAM communities.

Step 6: Incorporating perspectives from developing and transition-economy countries

- Develop regional information for both IAV and mitigation analysis that touch on the special needs of developing and EIT countries in these areas.
- Identify barriers required to deepen, broaden and sustain DC/EIT participation in the scenario development process and in climate change assessments
- Develop a strategy for fundable opportunities to address these barriers in particular:
- The need for the expansion of expert and institutional scientific capacity in lower-income DCs, which lag behind both industrialized countries and larger DCs.
- In DCs that have more extensive scientific and modeling capacity proposed financial and technical support should be directed to enabling opportunities for downscaling of global models and up-scaling of regional/ national models;
- Concerted outreach and integration initiatives on the part of the broader international research and policy communities in address capacity and funding limitations to enhance DC/EIT participation

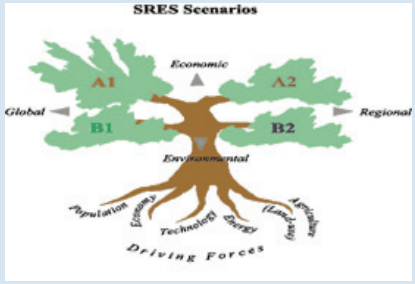
Following these steps in the coming years leading up to a possible IPCC Fifth Assessment Report (AR5), the following five principal scenario products are anticipated to be developed.

1. Representative concentration pathways (RCPs) and their associated emissions, produced by IAM teams and taken from the existing literature, discussed in Section III and anticipated to be completed by the fall of 2008;
2. Ensemble climate projections and pattern scaling anticipated to be available in the fall of 2010; these scenarios will be used for pattern scaling;
3. New scenarios developed by the IAM community anticipated to be available in the fall of 2010;
4. Global narrative storylines developed by the IAM and IAV communities anticipated to be available in the fall of 2010; and
5. Integrated new IAM scenarios consistent with the storylines with associated pattern-scaled climate scenarios anticipated to be available in spring 2012.



Box 2.3: Development of National Climate and Socio-economic Scenarios

To assess climate change impacts, the IPCC has developed family scenarios and storylines A1, A2, A3 and A4 (see figure) that describe demographic, social, economic, technological, environmental, and policy future for each one of these scenario families. Within each family, different scenarios explore variations of global and regional developments and their implications for trace gas emissions.



Schematic illustration of SRES scenarios

All four storylines and scenario families describe future worlds that are generally more affluent compared to the current situation. Each storyline assumes a distinctly different direction for future developments. They cover a wide range of key "future" characteristics such as demographic change, economic development, and technological change. Climate Change Impacts Assessors use a combination of the families to come up with scenarios for use in the climate change impacts assessment for their study site.

Having chosen the story lines appropriate for the country, the climate change scenarios for the country are developed by building a good data set of current climate extending for a period of not less than 30 years and then determining and accessing a Scenario Generator Model (e.g., MAGGICC-SENGEN or GRADs). MAGICC/SCENGEN, for example, is a coupled gas-cycle/climate model (MAGICC) that drives a spatial climate-change scenario generator (SCENGEN). It has built-in current and future climate data sets for the different regions of the world and General Circulation Model outputs (temperature, rainfall, etc) into the future (e.g., up to 2100). MAGICC has been the primary model used by IPCC to produce projections of future global-mean temperature and sea level rise. The flowchart below shows the directory structure of the MAGICC/SCENGEN software and useful information can be found in Wigley and Raper, (1992, 2001, 2002); Raper et al., 1996; Wigley, 1993, 2000 and Wigley et al., 2002

SCENGEN uses the scaling method of Santer et al., (1990) to produce spatial patterns of change from an extensive data base of atmosphere/ocean GCM (AOGCM) data. The scaling method is based on the separation of the global-mean and spatial-pattern components of future climate change, and the further separation of the latter into greenhouse-gas and aerosol components. Spatial patterns in the data base are 'normalized' and expressed as changes per 1oC change in global-mean temperature. These normalized greenhouse-gas and aerosol components are appropriately weighted, added, and scaled up to the global-mean temperature defined by MAGICC for a given year, emissions scenario and set of climate model parameters. For the SCENGEN scaling component, the user can select from a number of different AOGCMs for the patterns of greenhouse-gas-induced climate.

Climate Change scenarios of a region or a country are developed by combining current climate data with outputs from General Circulation Models extracted from the MAGGICC-SENGEN Model. The methodology requires first to run MAGICC in which one begins by selecting a pair of emissions scenarios, labeled as a reference scenario (R) and a policy scenario (P). Information in BOX 1 above guided the selection of reference and policy scenarios to use in this study. The user then selects a set of gas-cycle and climate model parameters and for these the default ('best guess') was chosen which is then carried through to SCENGEN. Running MAGICC then produces four output files to drive SCENGEN where the spatial consequences are explored.

Running the SCENGEN component of the software enables access to many GCM outputs (14 Models in the MAGGICC-SENGEN SG41 software) and the country's 30-year current or baseline climate data. The 30-year monthly baseline data is averaged. The averaged country temperature data is correlated with the GCM Model output of current temperatures and the correlation coefficient is determined. The 3 GCMs with the highest correlation coefficients are the ones that have closely estimated the baseline climate of the country and these are the Models recommended for use in the development of climate change scenarios for use in Impacts Assessment for the country. The climate change scenarios for the period 2000 to 2100 are then calculated by the combination of baseline climate parameters with the GCM Outputs for the period 2000 to 2100.

2.5.1.3 Identification of institutions undertaking downscaling of climate change scenarios

Table 3 provides the list of institutions that have downscaled climate change over the whole or regions of Africa. Note that only two of the institutions are in Africa, and both institutions are in South Africa. This underscores the need for capacity building on climate science in Africa**.** However, recently, an international project, called: "Coordinated Regional Downscaling Experiment (CORDEX)", was established to provide a coordinated high-resolution regional Climate projections for most land-regions of the world, with special focus on Africa (Giorgi et al., 2009). The project (CORDEX), which involves over 20 Regional Climate Modelling and Statistical Downscaling groups, would be implemented in two phases. The first phase would evaluate the performance of the downscaling methods for the regions, while the second phase would produce regionally downscaled climate projections for various regions at resolutions in the range of 50km-10km. The success of CORDEX means that, in future, a lot of information and data on regional climate change will be available online for impact assessment, adaptation and mitigation studies. Presently the Climate Research Group (CSAG) has a climate web-porter (ref), where downscaled regional climate data (using Statistical approach) can be downloaded over major cities in Africa.

Table 2.2: List of some Institutions downscaling future climate projection over Africa

Institution	Type of Downscaling	Reference (sample)
Climate System and Analysis Group (CSAG) University of Cape Town, South Africa www.csag.uct.ac.za	Statistical and Dynamical	Hewitson and Crane (2006) Tadross et al., (2005)
Department of Geography, Geoinformatics and Meteorology, University of Pretoria, South Africa	Dynamical	Engelbrecht et al., 2009
Earth System Physics Section International Centre for Theoretical Physics, Italy http://www.ictp.trieste.it/research/esp.aspx	Dynamical	Sylla et al., 2010
Department of Civil and Environmental Engineering, University of Connecticut, USA www.engr.uconn.edu	Dynamical	Alo and Wang, 2010
Department of Earth and Atmospheric Sciences, Cornell University, USA www.cornell.edu	Dynamical	Paricola and Cook, 2010
Geographical Institute, University of Wurzburg,Germany www.uni-wuerzburg.de	Dynamical	Paeth et al., 2008

2.5.1.4: How good are the tools over Africa?

Different models (both GCMs and RCMs) show different skills in simulating present-day climate. Evaluating a model against another is not an easy task; one model may better simulate monthly mean rainfall and temperature but it may not better simulate the daily frequency or diurnal cycle of rainfall (Collier and Bowman, 2004; Bergman and Salby, 1997). Some preliminary results from CORDEX indicate

that most regional models capture the magnitude and timing of precipitation over Africa well, and the ensemble mean precipitation agrees with the observations very well. However, while some models are better than others at simulating the present-day observed African climate, this does not necessarily mean that they are better at simulating future change.

2.5.2: Projected future climate changes over Africa

Various studies have shown that the future climate change would hit Africa hard, but with different degrees over different parts of the continent. The IPCC (2007) provides a broad assessment of changes expected to 2100 in Africa for all climate scenarios, and the main message is that the entire African continent is very likely to warm during this 21st century. The warming is very likely to be above the global average in all seasons, with drier subtropical regions warming more than the moister tropics IPCC, 2007. In addition, the annual rainfall is likely to decrease in Mediterranean Africa, Northern Sahara, Southern Africa, but increase in East Africa IPCC, 2007.

Many downscaled regional climate projections have confirmed or refined the IPCC assessment over different regions of Africa. Over northern Africa, there is no consensus among the GCMs about how the elevated GHGs would change the rainfall during the summer in the late 21st century, but projections using regional climate models provide more robust information (Patricola and Cook, 2007, 2009, 2010; Sylla, 2010; and Alo and Wang, 2010). For West Africa, Patricola and Cook (2010) project wetter conditions (with possibility of about 50% increase in rainfall) in spring, drying in early summer (June and July), and wetter conditions again (except over Guinean Coast) in the late summer, with possibility of more flooding (Fig 2.5). These projections are consistent with those in other regional climate studies over the region. Patricola and Cook (2010) also predict wetter conditions over eastern Central Africa (i.e. Cameroon, Central African Republic, Congo, and Democratic Republic of Congo) in June, but drying during August through September, and drying over East Africa in later summer, but wetter in October. A general increase in heat stroke risk is projected over all northern Africa throughout May-October (Fig 2.5). The people in the Sahel region would be most vulnerable, with possibility of 160 days of heat stoke per year in the twenty first century. The next highest risk is with the people in central equatorial Africa, Somalia, Kenya, Uganda, Gabon, and the Guinean Coast.

Over southern Africa, Tadross et al., (2005) project drier conditions across the tropical western side of the subcontinent in summer, and wetter conditions towards the east in January-March. Hewitson and Crane (2006) predict that South Africa would experience increased summer rainfall over the central and eastern plateau, and to the east of the eastern escarpment, but the south-western Cape will experience drying in both summer and winter. Olwoch et al., (2007) predict drier conditions over South Africa in winter, due to a displacement of frontal rain-bands towards the south, but wetter conditions over the western to central interior of South Africa mid-summer. Engelbrecht et al., (2009) project less than 10% changes in the annual rainfall over South Africa, except in the south-western Cape of South Africa, where the annual rainfall would considerable decrease. The projection also shows that the Eastern South Africa would become drier despite the projected increase in summer rainfall, and that the central interior of South Africa is the only part of the country that would become wetter in the future climate.

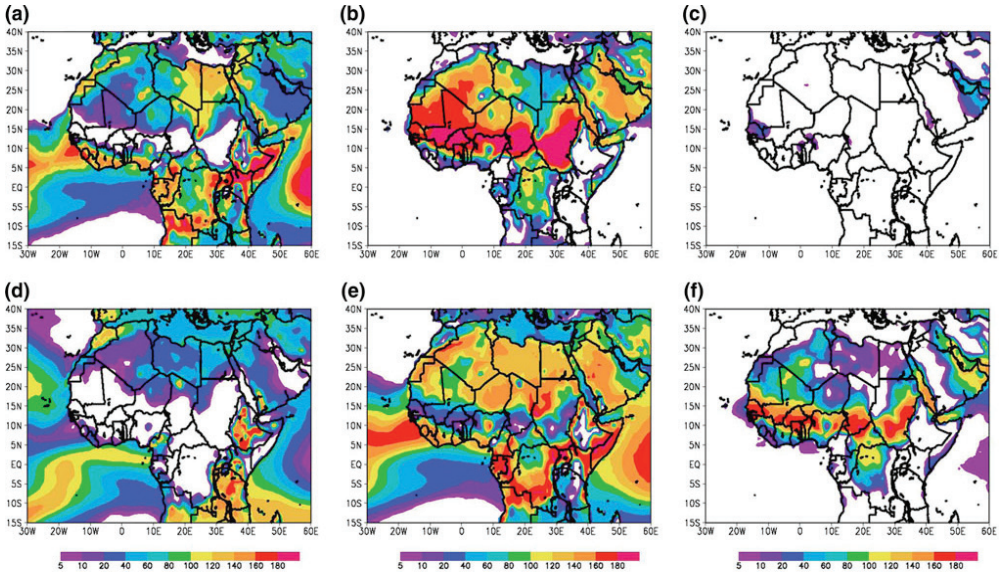


*Fig. 2.5: The number of days between May 1 and October 31 during which the maximum heat index occurring between 09Z and 15Z is in (**a**) low, (**b**) medium, and (**c**) high risk category in the twentieth century simulation, and the twenty-first century ensemble average number of days between May 1 and October 31 during which the maximum heat index occurring between 09Z and 15Z is in (**d**) low, (**e**) medium, and (**f**) high risk category (Patricola and Cook, 2010).*

2.5.3: How to handle the uncertainties in the future climate projections.

The issue of uncertainty is crucial to understanding past and future climatic change, especially when designing adaptation strategies that will benefit both present and future social, economic and ecological conditions. All climate projections, including seasonal forecasts, are presented in terms of the probability of particular climate conditions occurring in the future. Despite this uncertainty, this approach provides a framework which allows for assessing future risks, e.g. consideration of financial and other investment opportunities. To be able to assess risk, one needs to consider all sources of information. It is therefore essential that a probability framework is used to develop projections which incorporate different sources of information. The IPCC define four sources of uncertainty that currently limit the detail of the regional projections (IPCC, 2007):

1. **Natural variability:** Due to the challenges of observations (both in time and space), there is a limited understanding of natural variability. It is difficult to characterise this variability and the degree to which it may exacerbate or mitigate the expected background change in climate. This variability itself may change due to anthropogenic factors, e.g. increases in the frequency of droughts and floods;

2. **Future emissions:** Much of future projected change, at least in terms of the magnitude of change, is dependent on how society will change its future activities and emissions of greenhouse gases. Even so, the course is already set for a degree of change based on past emissions (at least another 0.6°C warming in the global mean temperature). Human responses to managing emissions may result in a projected global mean temperature change of between 1.5° and 5.6°C;

3. **Uncertainty in the science:** This is further complicated within Africa because of limited understanding of the regional dynamics of the climate of the continent. There may be aspects of the regional climate system which could interact with globally forced changes to either exacerbate

or mitigate expected change, for example land-use change. One consequence is the possibility of rapid nonlinear change, with unforeseen and sudden increases in regional impacts;

4. **Downscaling:** This term defines the development of regional scale projections of change from the Global Climate Models. Downscaling tools can introduce additional uncertainty, for example between downscaling using regional climate models and statistical techniques. This uncertainty limits the confidence in the magnitude of change, not the patterns of change, which are predicted with more certainty.

A challenge when using a single model is that only a limited number of future scenarios can be generated which can create the impression of a narrowly determined future that may not fully span the range of potential future change. It is therefore recommended that future change is expressed either as a range of future scenarios or as an average statistic (e.g. median) with some measure or recognition of the spread of possible future scenarios. The multi-model approach is essential in quantifying uncertainties for impact studies.

Chapter 3:

IMPACTS OF CLIMATE CHANGE ON SYSTEMS, KEY SECTORS AND IMPLICATIONS FOR SUSTAINABLE DEVELOPMENT IN AFRICA

The questions the chapter seeks to answer are as follows

- *What are the methodologies and tools to identify and assess sensitivity, adaptive capacity, and risk to climate change impacts) – i.e., conduct a vulnerability assessment and a risk assessment?*
- *What are the observed and likely impacts*
- *Where can we find information on impacts on different sectors*
- *How to measure the implications of climate change impacts across sectors on sustainable development? What indicators?*

3.0 Introduction

Climate change is the key factor defining human development issue of our generation. All development is ultimately about expanding human potential and enlarging human freedom. It is about people developing the capabilities that empower them to make choices and to lead lives that they value. There is compelling evidence that the effects on the environment from the totality of humankind's development activities are heating up the planet towards levels dangerous for life. This demonstrates unequivocally that current global development practices taken all together are fundamentally unsustainable at planetary scale. Added together, the impacts of climate change are potentially disastrous for Africa, as they become increasingly severe through the rest of this century, always exacerbating existing pressure points and creating new ones. Climate change has already set development efforts back, and made achievement of the Millennium Development Goals (MDGs) significantly more difficult. In order to address this planet-wide crisis, there must be rapid global transformation to a development pathway in which sustaining the planet – ourselves and our life environment - is paramount. The ideas for long-term sustainable planetary development are embodied in the concept of a "Green Economy". It is vitally important that Africa and the world seize and develop the many opportunities in a green economy and evolve a genuinely sustainable development pathway.

The overall threat from climate change on development in Africa is severe. Many of the changes are expected to occur earlier and are likely to be more serious in Africa than elsewhere. In addition, Africa is highly vulnerable to climate change on account of its large rural population that remains highly dependent on rain-fed agriculture for food, its natural resource-based economy, and constraints on internal trade. Wealthy communities have more resources and hence more choices when it comes to adapting to change.

3.1 Methods and Tools of Assessment of Impacts of Climate Change

As already presented in Chapter 2, projections of climate change are based on socioeconomic and climate change scenarios. In chapter 2 methodologies and tools for development of climate change scenarios are presented under section 2.5.

Approaches used to assess the impacts of climate change on economic sectors of Africa have typically been scenario-driven. These **scenario-driven** approaches have been widely used to determine the key long-term impacts of climate change and the efforts required to reduce the adverse effects of climate change through adaptation. Key methods and tools used in this approach include various downscaling techniques for developing scenarios of future climate and socio-economic conditions, sectoral biophysical impact models, and sometimes tools for assessing and prioritizing adaptation options. The approach and tools are strong in biophysical aspects of impacts and certain types of dynamic interactions, but do not do well in representing human interactions and local abilities to adapt. For example, crop impact modelling can yield information on the magnitude of potential impacts but sheds little light on the distribution of these impacts among local communities (UNFCCC, 2004)

In the following sub-sections, the methodologies and tools for assessment of impacts of climate change on sectors and national economy are presented and discussed. The tools presented are Sectoral Biophysical Models (Box 3.1) which use socio-economic and climate change scenarios as input to assess and determine the impacts of climate change on the sector. An integrated assessment based on the sectoral impacts results produces an interpolation of the impacts of climate change on the national economy. Integrated Assessment Models are also available and these are discussed briefly as their applications in Africa are limited due to availability in the market and also expertise of the impacts assessment technicians.

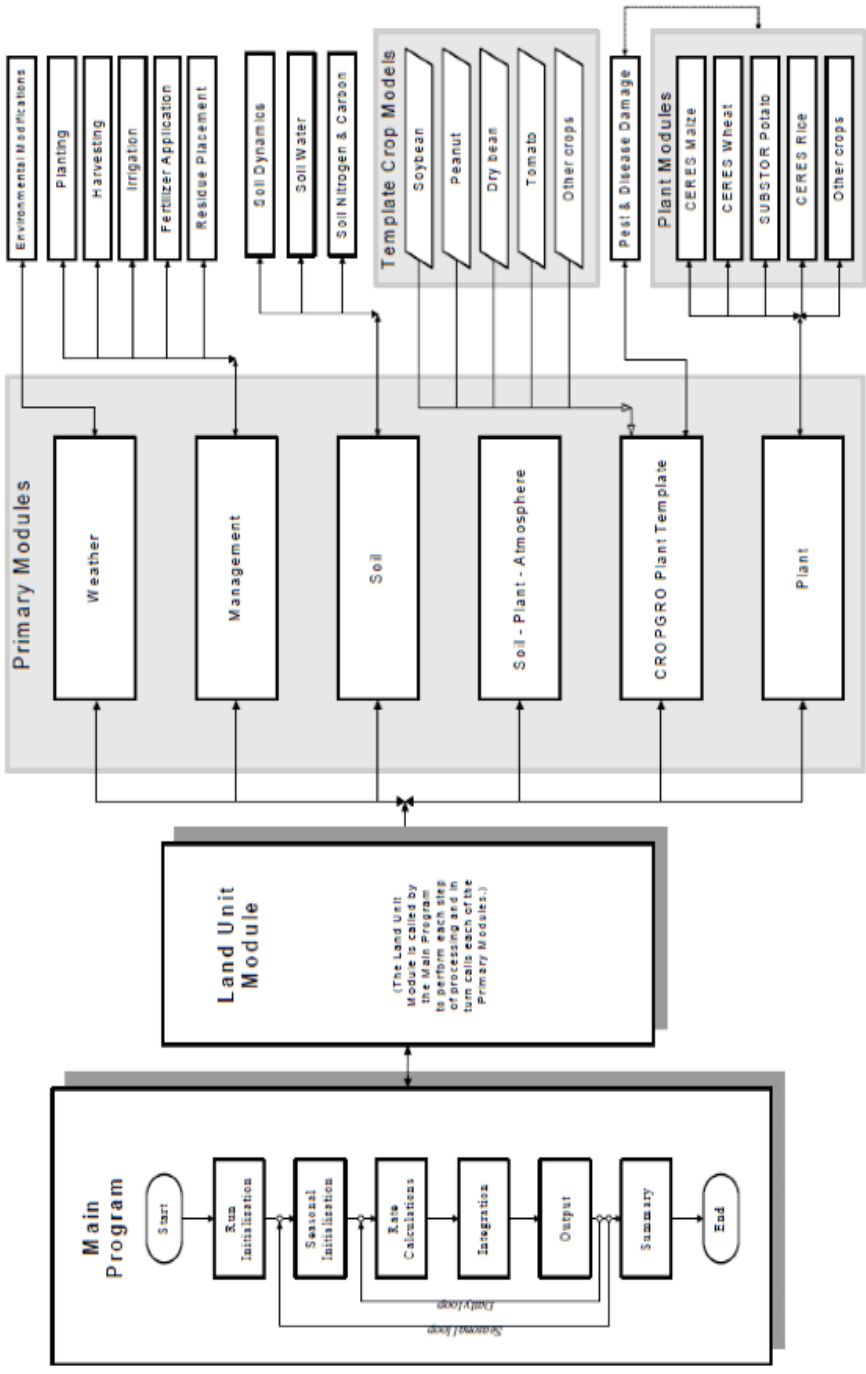
Box 3.1: Climate Change Impacts Assessment for the Crops Production sub-Sector of Agriculture

Two major Biophysical Models used extensively in Africa are the Decision Support System for Agro-technology Transfer - Cropping System Model (DSSAT - CSM) and CROPWAT software.

The DSSAT model simulates growth and development of a crop over time, as well as the soil water, carbon and nitrogen processes and management practices (G. Hoogenboom et al., 2003). The figure below shows the main components of CSM. These include:

- A main driver program, which controls timing for each simulation,
- A Land unit module, which manages all simulation processes which affect a unit of land
- Primary modules that individually simulate the various processes that affect the land unit including weather, plant growth, soil processes, soil-plant-atmosphere interface and management practices.

Collectively, these components simulate the changes over time in the soil and plants that occur on a single land unit in response to weather and management practices. The DSSAT-CSM incorporates models of all crops within a single set of code. This design feature greatly simplifies the simulation of crop rotations since soil processes operate continuously, and different crops are planted, managed, and harvested according to cropping system information provided as inputs to the model. Table 3.1 below lists the primary and sub modules that are currently used in the cropping system model with a summary of their functions.



Overview of the components and modules structure of DSSAT - CSM (Ref: G. Hooganboom, J.W., Jones et al., 2003

Table 3.1: Summary description of modules in the DSSAT - CSM

Primary Modules	Sub Modules	Behavior
Main Program (DSSAT-CSM)		Controls time loops, determines which modules to call based on user input switches, controls print timing for all modules. Calls the input module (MINPT030.EXE) to read FILEX, soil file, and cultivar file and write the appropriate output information to a temporary input file (DSSAT40.INP).
Land Unit		Provides a single interface between cropping system behavior and applications that control the use of the cropping system. It serves as a collection point for all components that interact on a homogenous area of land.
Weather		Reads or generates daily weather parameters used by the model. Adjusts daily values if required, and computes hourly values
Soil	Soil Dynamics	Computes soil structure characteristics by layer. This module currently reads values from a file, but future versions can modify soil properties in response to tillage, etc.
	Soil Water Module	Computes soil water processes including snow accumulation and melt, runoff, infiltration, saturated flow and water table depth. Volumetric soil water content is updated daily for all soil layers. Tipping bucket approach is used.
	Soil Nitrogen and Carbon Module	Computes soil nitrogen and carbon processes, including organic and inorganic fertilizer and residue placement, decomposition rates, nutrient fluxes between various pools and soil layers. Soil nitrate and ammonium concentrations are updated on a daily basis for each layer.
Soil – Plant – Atmosphere (SPAM)		Resolves competition for resources in soil-plant-atmosphere system. Current version computes partitioning of energy and resolves energy balance processes for soil evaporation, transpiration, and root water extraction.
	Soil Temperature Module	Computes soil temperature by layer.
CROPGRO Crop Template Module		Computes crop growth processes including phenology, photosynthesis, plant nitrogen and carbon demand, growth partitioning, and pest and disease damage for crops modeled using the CROPGRO model crop Template (soybean, peanut, dry bean, chickpea, cowpea, faba bean, tomato, Macuna, Brachiaria, Bahiagrass).
Individual Plant Growth Modules	CERES-Maize	Modules that simulate growth and yield for individual species. Each is a separate module that simulates phenology, daily growth and partitioning, plant nitrogen and carbon demands, senescence of plant material, etc.
	CERES-Wheat / Barley	
	CERES-Rice	
	CERES-Sorghum	
	CERES-Millet	
	SUBSTOR-Potato	
	Other (future) plant models	
Management Operations Module	Planting	Determines planting date based on read-in value or simulated using an input planting window and soil, weather conditions.
	Harvesting	Determines harvest date, based on maturity, read-in value or on a harvesting window along with soil, weather conditions.
	Irrigation	Determines daily irrigation, based on read-in values or automatic applications based on soil water depletion.
	Fertilizer	Determines fertilizer additions, based on read-in values or automatic conditions.
	Residue	Application of residues and other organic material (plant, animal) as read-in values or simulated in crop rotations.

The DSSAT4 Shell program provides a user-friendly working environment in which various standalone tools and applications (Crop Management Data Editing Program, Soil Data Editing Program, Weather Data Editing Program, Experimental Data Editing Program, Graphical Display Program, Seasonal Analysis Program and Rotational Analysis Program) are seamlessly integrated with the DSSAT4 crop models. Within the shell, the user can launch applications for creating and modifying data files, running the crop models, and analyzing the results. Each of the component applications of the DSSAT4 system are installed separately so that the user can customize the DSSAT4 setup and the shell program recognizes the components which are present.

3.2 Observed and Projected Impacts of Climate Change on Africa

In chapter 2 global and national climate change scenarios have been presented and projected climate change has been discussed. In the following sub-sections of this chapter, some of the climate change impacts on major sectors in Africa are presented. The main impacts of climate change on people and society are likely to be through increased vulnerability, as climate-induced hazards exacerbate a wide range of underlying risk conditions aggravating environmental stresses already evident. This explains the current and projected impacts of climate change on the following key sectors and their linkage to sustainable development and human security in Africa.

3.2.1 Impact on water resources

It is estimated that nearly 51 per cent of the population in sub-Saharan countries lack access to a supply of safe water and 41 per cent lack adequate sanitation. Nearly 330 million of these people live in rural areas. Consequently, rural populations are burdened to a greater extent by preventable water and sanitation-related diseases and suffer greater deprivation from women and children not attending school or engaging in economic activities due to the time and effort needed to fetch water." In almost all rural communities in Africa, it is primarily women and girls who collect water, protect water sources, maintain water systems, and store water. Women spend a significant amount of time with these activities and they also determine the use of water. Without access to sufficient and reliable water for productive uses in and around the household, people are excluded from a range of options that would otherwise enable them to secure their sources of food and income.

The water sector is strongly influenced by, and sensitive to, changes in climate (including periods of prolonged climate variability). About 25% of the contemporary African population experiences high water stress while 69% of the population lives under conditions of relative water abundance ((Vörösmarty et al., 2005; IPCC, 2007). However, this relative abundance does not take into account other equally important factors such as access to clean drinking water and sanitation, which effectively reduces the quantity of freshwater available for human use. The quantitative and qualitative manifestations of this are emerging as major development challenges for many countries (ECA, 2006). Specifically, 14 countries in Africa are already experiencing water stress; another 11 are expected to join them by 2025, at which time nearly 50 per cent of Africa's predicted population of 1.45 billion people will face water stress or scarcity. This situation is shown by the case study of water situation in Egypt (Box 3.1).

The impacts of climate change including changes in temperature, precipitation and sea levels are expected to have severe consequences for the availability of water in Africa (IPCC, 2007). This is of particular concern to Africa, where much of the population relies on surface water for their different livelihoods activities (De Wit, 2006). Currently, more than 30% of the people in Africa live in drought prone areas mainly in the Sahel, the Horn of Africa and southern Africa (Brooks, 2004). A 3°C temperature increase could lead to 0.4 – 1.8 billion more people at the risk of water stress (Boko et al., 2007). Reduction in water quantity will lead to a reduction in water quality and associated impacts on health, biodiversity etc

Rainfall variability is expected to increase in semi-arid and arid areas in Africa (Brooks, 2004) , coupled with increasing temperature this is expected to negatively impact the water supply in many parts of Africa.

Box 3.2: Climate, Water availability and Agriculture in Egypt

Egypt is one of the African countries that could be vulnerable to water stress under climate change. The water used in 2000 was estimated at about 70 km3 which is already far in excess of the available resources. A major challenge is to close the rapidly increasing gap between the limited water availability and the escalating demand for water from various economic sectors. The rate of water utilisation has already reached its maximum for Egypt, and climate change will exacerbate this vulnerability. Agriculture consumes about 85% of the annual total water resource and plays a significant role in the Egyptian national economy, contributing about 20% of GDP. More than 70% of the cultivated area depends on low-efficiency surface irrigation systems, which cause high water losses, a decline in land productivity, water logging and salinity problems. Moreover, unsustainable agricultural practices and improper irrigation management affect the quality of the country's water resources. Reductions in irrigation water quality have, in their turn, harmful effects on irrigated soils and crops. Institutional water bodies in Egypt are working to achieve the following targets by 2017 through the National Improvement Plan, improving water sanitation coverage for urban and rural areas,

- Wastewater management,
- Optimizing the use of water resources by improving irrigation efficiency and agriculture drainage-water reuse.
- However, with climate change, an array of serious threats is apparent. • Sea-level rise could impact on the Nile Delta and on people living in the delta and other coastal areas.
- Temperature rises will be likely to reduce the productivity of major crops and increase their water requirements, thereby directly decreasing crop water-use efficiency.
- There will probably be a general increase in irrigation demand.
- There will also be a high degree of uncertainty about the flow of the Nile.
- Based on SRES scenarios, Egypt will be likely to experience an increase in water stress, with a projected decline in precipitation and a projected population of between 115 and 179 million by 2050. This will increase water stress in all sectors.
- Ongoing expansion of irrigated areas will reduce the capacity of Egypt to cope with future fluctuations in flow.

Source: IPCC 2007

3.2.2 Coastal zones

3.2.2.1 Introduction

The coastal areas of Africa stretch over 30,490 km and are divided between the Mediterranean coast, Atlantic (Fig. 3.1), Indian (Fig. 3.2) and the Suez Canal. These areas play a very important economic role in the development of the entire continent in general and a place for import and export for the supply of some of its most remote countries. Population growth and urban level is very high compared to coastal countries to the interior. This human pressure is due to the fact that coastal areas focus on important economic activities ranging from fishing to port activities to generate employment.

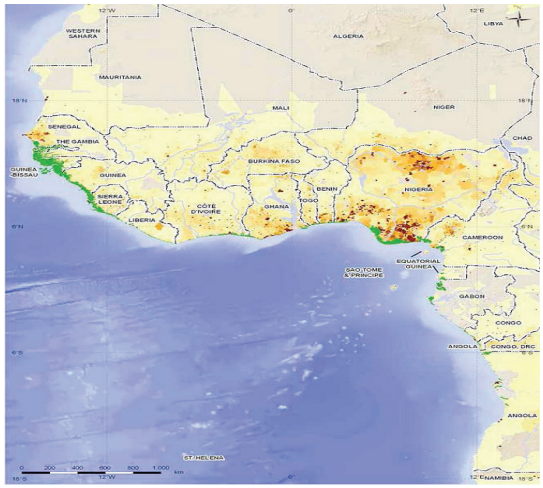


Fig. 3.1 West African Coast

Photo: NASA, Earth Observatory, 2003

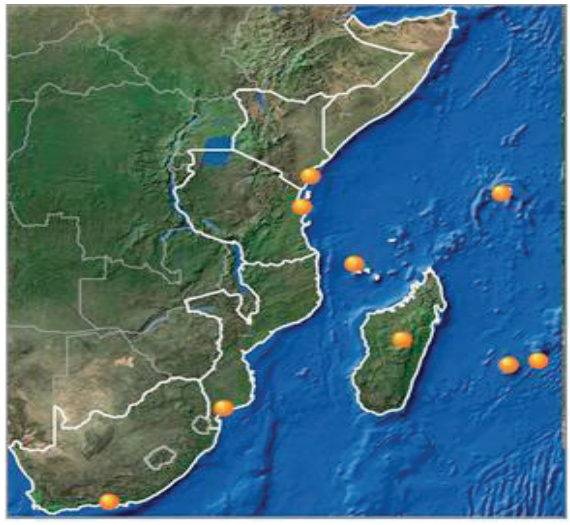


Fig. 3.2 East African Coast

Photo: NASA, Earth Observatory, 2003

Photo: ProGero, n° 12, 2010

IUCN (2008), using the example of the coasts of north Africa, noted that coastal areas "have a multitude of landscapes and diverse backgrounds with rich biodiversity in terms of flora and fauna. They contain many types of ecosystems: coastal, island, mountains, deserts, oases and wetlands. These ecosystems are particularly threatened by several anthropogenic factors and climate. The impacts of climate change on coastal areas in Africa manifest themselves in several ways. .Africa's oceans, coastal zone and islands are experiencing climate change impacts with most of them being attributed to the outcomes of ocean warming and increased sea levels. The most notable of these perceived impacts are the increase in coral bleaching and mortality; the reduction of rainfall in eastern and southern Africa; the alteration in stratification and circulation patterns of ocean currents including the Agulhas Current (Beal et al., 2011);

and the increased frequency and intensity in extreme weather events.

The current and potential outcome that these impacts may have for coastal communities and key economic sectors is highly significant and includes areas such as tourism, agriculture and fisheries. In particular the small island developing states in Africa are highly vulnerable to the impacts of climate change.

3.2.2.2 Rising sea levels and flooding the coast of Africa

In Egypt, about 38% of the people live in coastal areas between 0 and 10 meters from sea level and are at risk of flooding. In Djibouti and Gambia the population under such risks is 41%, and 38% respectively.(IIED, 2008-2010). From the ecological point of view, salt water intrusion would change a critical ecosystem of the flooded areas. This is the case of the Mandorové pumping station in Gabon, which provides drinking water to much of the population of Port-Gentil in Gabon. Saltwater intrusion has resulted in changes in the landscape, as certain plants and some fish stocks will not be supported by the changes in salt content. They need to move away from their former breeding areas, and therefore this could disrupt the activities of fishermen (UNDP, 2008).

Boko et al., (2007) have indicated that three of the five regions shown to be at risk of flooding in coastal and deltaic areas are those located in Africa. Coastal agriculture (e.g. plantations of palm oil and coconuts in Benin and Côte d'Ivoire, shallots in Ghana) could be at risk of inundation and soil salinisation. In Kenya, losses for mangoes, cashew nuts and coconuts could cost almost US$500 million for a 1 m sea-level rise (Republic of Kenya, 2002). In Guinea, between 130 and 235 Km^2 of rice fields (17% and 30% of the existing rice field area) could be lost as a result of permanent flooding, depending on the inundation level considered (between 5 and 6 m) by 2050 (République de Guinée, 2002). In Eritrea, a 1 m rise in sea level is estimated to cause damage of over US$250 million as a result of the submergence of infrastructure and other economic installations in Massawa, one of the country's two port cities (State of Eritrea, 2001).

3.2.2.3 Erosion and silting of the African coast

Major rivers in Africa like Senegal, Volta, Niger, Congo, and the Nile drain the back country, each with various dams for agricultural irrigation and hydropower, altering the nature of water and sediment discharge to the coast. Rising surface temperatures cause intense storms and surface runoff and there is therefore the degradation and the rapid erosion of the coastal environment. In addition, the intense energy of ocean currents on the coast continues to accelerate the phenomenon of coastal erosion in recent years constituting a serious problem in most African coastlines (UNEP, 1999). Some parts of shorelines are constantly exposed to erosion while others experience accretion Winds during the dry season are moving large quantities of sand that is deposited in areas near basins and coasts. During the rainy season this sand is transported by the rivers down to the coast causing huge sand deposits at certain ports and beaches used for tourism. In South Africa, changes in estuaries are expected mainly as a result of reductions in river runoff and inundation of salt marshes following sea-level rise (Clark, 2006).

3.2.2.4 The vulnerability of the coastal and marine biodiversity

Climate change has impacts on the composition and structure of fauna and flora in relation to the benthic change in sediment dynamics. The increase in water temperature has detrimental effects on the physiology of marine organisms and promotes the establishment of thermophilic species. These effects are especially noticeable on the breeding habits of certain species. The rise in water temperature causes disturbances on the ecology of sensitive populations, particularly in terms of distribution and resistance to changes in physical-chemical processes of the original medium. The range of species stenothermal are then modified (UNEP, 2009).

Coastal flooding affects the habitat of species such as caves or houses that can accommodate monk seals. The risks also relate to the Mediterranean littoral forest and all of the space occupied by the

mangrove forest with many endemic species threatened with extinction. Shoreline vegetation will be faced with the rise in temperature causing thermal stress or an increased risk of fire. The fringes of most of these coastal forests may disappear due to a significant rise in sea level chemistry and structure of the soil at risk of change that will affect the associated biodiversity, irrigated crops grown on the coastal plain, also be affected by the effects of climate change precisely rising sea levels, storms and high winds (UNEP, 2009).

3.2.3 Terrestrial ecosystems and biodiversity

The past and present climate trends in temperature and rainfall as well as occurance of extreme events in Africa have been explained in chapter two (section 2.2) of this book. Under the changing climate in Africa, observed and expected climate change impacts in terrestrial ecosystems and biodiversity are examplified below;

Mountain ecosystems in africa appear to be undergoing significant observed changes likely due to complex climate-land interactions and the climate change (IPCC, 2007a). According to Boko et al., (2007), the ice cap on Mt. Kilimanjaro could disappear by 2020. The mountains of Cameroon, and the island-like Afromontane habitats that stretch from Ethiopia to South Africa at altitudes above about 2,000 meters are also threatened by increase in temperature (Mace et al., 1998). According to WWF, montane centers of biodiversity are particularly threatened by increases in temperature because many contain isolated plant populations with no possibility of migration. Under 1.5°C, 2°C and 4°C global mean temperature rise scenarios Glaciers on Mount Kilamanjaro, Mount Kenya and Ruwenzori could be lost by 2015 (Thompson et al., 2002).

Climate change is also likely to result in species range shifts, as well as in changes in tree productivity, adding further stress to forest ecosystems (UNEP, 2004). Endangered species associated with mangrove and coral ecosystems, including manatees and marine turtles, could also be at risk, along with migratory birds (Government of Seychelles, 2000; Republic of Ghana, 2000; République Démocratique du Congo, 2000). Mangroves could also colonize coastal lagoons because of sea-level rise (République du Congo, 2001; Rocha et al., 2005).

The proliferation of algae and dinoflagellates during these warming events could increase the number of people affected by toxins (such as ciguatera) due to the consumption of marine food sources (Union des Comores, 2002). In the long term, all these impacts will have negative effects on fisheries and tourism.

Climate change can cause changes in ecosystem composition and function and lead to increased vulnerability of ecosystems to natural and anthropogenic disturbances. In Africa, studies have shown that around 5,000 African plant species and over 50% of bird and mammal species will be seriously affected or even lost by the end of this century (Fischlin et al., 2007). Changes in ecosystem composition and function could result in further species diversity reductions (Malcolm et al., 2002) and possible collapse or change in the state of ecosystems, as well as shift of species range (UNEP, 2004). Under 1.5°C, 2°C and 4°C global mean temperature rise scenarios, 10-15% of sub-Saharan species will be at risk of extinction (IPCC, 2007), at least 40% of sub-Saharan species at risk of extinction (IPCC, 2007), and; up to 66% of species expected to be lost from Kruger National Park in South Africa and four endangered species: the termite genus, canthonine; dung beetle, golden mole and armoured lizard become totally extinct (Erasmus et al., 2002). Predicted climate change century could alter the range of African antelope species (Hulme, 1996).

Climate change is likely to trigger species migration and lead to habitat reduction. Reduced habitat and other human-induced pressures put up to 50 per cent of Africa's total biodiversity at risk (Boko et al., 2007). Typical large mammal migrations are sensitive to climate change, they involve regular movement between dry-season and wet-season grazing areas. Persistent drought due to increase in temperature and unreliable rainfall pattern in Tanzania, for example is expected to affect the lifestyles of most of the

migratory wild species, in particular the wildebeest (in the Serengeti area of Tanzania and the Masai-Mara region of Kenya) and some bird species (URT, 2007). Reduced large-mammal migratory systems persist in the Kalahari (Botswana, South Africa, and Namibia) and Etosha (Namibia) areas of southern Africa (IPCC, 2001).

Thuiller et al., (2006) applied a simple IUCN Red List assessment of potential range loss on animals in 141 national parks in sub-Saharan Africa. Assuming no migration of species, 10-15% of the species were projected to fall within the IUCN Critically Endangered or Extinct categories by 2050, increasing to 25-40% of species by 2080. Assuming unlimited species migration, the results were less extreme with these proportions dropping to approximately 10-20% by 2080. In this assessment spatial patterns of loss and gain showed contrasting latitudinal patterns with a westward range shift of species around the species-rich equatorial transition zone in central Africa, and an eastward shift in southern Africa.

According to Hockey (2000) about one-fifth of African bird species migrate on a seasonal basis within Africa while one-tenth migrate annually between Africa and the rest of the world. Significant losses of bird's biodiversity could result if climatic conditions or specific habitat conditions at either end of these migratory routes change beyond the tolerance of the species involved.

As the climate changes, plants will naturally attempt to adapt by migrating, assuming the landscape is not too fragmented, but not all species will be able to migrate. However in regions such as the fynbos, which is at the edge of the continent migrations are limited. Dry woodlands and savannas in semi-arid and sub-humid areas will be increasingly subjected to drying in the next century (Desanker et al., 1997). Modeling of the distribution of forest species on the basis of the Holdridge (1967) life zone classification has projected changes from mesic vegetation to xeric vegetation in Tanzania and The Gambia (Jallow and Danso, 1997) but a shift from arid vegetation to moist vegetation in Mozambique (Bila, 1999 cited in IPCC, 2001).

In the desert/semi-arid fringe in southern Africa and the Sahelian region, locust outbreak phenomenon is strongly linked to climate, particularly the pattern of soil moisture and temperature (Hanrahan et al., 1992). Outbreaks are reported to occur when a dry period is followed by good rains. Under future changing climates, invasive alien species infestations will pose a significant threat to ecosystems and biodiversity (Sala et al., 2000; Gaston et al, 2003). Increases in winter rainfall in the Sahel could provide better breeding conditions for the desert locust, with catastrophic impacts on crop and livestock production in the Sahel region (FAO, 2008b; cited in PACJA, 2009).

Climate change might exacerbate desertification through alteration of spatial and temporal patterns in temperature, rainfall, solar insolation, and winds. The Sahara and central southern Africa are expected to experience hotter conditions (IPCC, 2007). Potential increases in the frequency and severity of drought are likely to exacerbate desertification. Under 1.5°C, 2°C and 4°C global mean temperature rise scenarios, flora and fauna are likely to disappear in the Sahel due to drought and shifting sands (ECF, 2004) while warmer temperatures may lead to expansion of dunes in the Kalahari (Thompson et al., 2005 in Stern 2006).

It is important to note that observed changes in ecosystems are not solely attributable to climate variability and change. Additional factors, such as fire, invasive species and landuse change, interact and also produce change in several African locations (Muriuki et al., 2005; cited in IPCC, 2007). An Ecosystem approach in enhancing adaptation and mitigation of climate change impacts remains important in enhancing the continuity of terrestrial ecosystem and biodiversity as well as provision of ecosystem services and goods.

3.2.4 Impact of Climate Change on Forestry and Wildlife

Forests and woodlands cover an area of about 675 million hectares, or 23% of Africa's land area and about 17% of global forest area (FAO, 2011).Tropical moist forests in Central and parts of West Africa and woodlands in southern Africa are the dominant formations. The proportion of the land area covered by forests in the various sub-regions is: Central Africa (43.6%), Southern Africa (31%), East Africa (20.8%), West Africa (14.3%) and North Africa (7.2%) (FAO, 2003). Forests underpin the economies of many African countries, while enhancing the quality of the environment. Over 70% of the continent's population depends on forest resources for their survival (AfDB, 2003).

There is growing evidence that climate change is impacting on forests and forest ecosystems in Africa, and therefore on the livelihoods of forest dependent communities as well as on national economic activities that depend on forest and tree products and services. Africa is one of the most vulnerable regions in the world to climate change. This vulnerability is expected to have considerable negative impacts on the agricultural sector and could render useless significant regions of marginal agricultural land (Kowero, 2011).

Currently little is known about the potential of African forests and trees to adapt to climate change. IPCC reports indicate that climate change will cause shifts in the ranges of many vegetation communities, but its also accepted that different species respond differently to climate factors. As such, understanding the responses to climate change of individual species, especially the dominant and ecosystem critical species, is of paramount importance to the development of forest-based adaptation strategies and measures, as well as to the assessment of the ability of forests and trees in Africa to mitigate climate change. Thus both climate response and mitigation by forests and trees need to be carefully assessed so that informed strategies and measures (taking on socio-economic, ecological, gender, tenure and rights aspects) can be put in place to promote the role of forests and trees in climate change programmes.

3.2.4.1 Impacts of climate change and variability on wildlife resources

The climate of West Africa is subjected to recurrent variations of significant magnitude. Severe declines in rainfall were registered between 1968 and 1972. Because of this, major watercourses have registered a decline with a significant reduction in the surface area of main natural wetlands (the case of Lake Chad where the surface area has shrunk from 20,000 km2 during wet years before 1970 to less than 7,000 km2 since the early 1990s) (UICN-BRAC, 2007). Many studies have demonstrated how environmental factors (mainly climate) influence animal populations. But data focusing on West and Central Africa area. There are scientific reports indicating that increasing temperatures, in combination with changes in rainfall and humidity, may have significant impacts on wildlife, domestic animals and human diseases (Hofmeister et al., 2010).

Drought and extreme temperatures pose potential risks to wildlife that include decrease in surface water for mammals and birds. Given the high level of climate variability in large parts of Africa, impacts of climate change could be regarded as under-estimations. It is probable that increases in mortality of many species may be due to climate warming. Climate change, climate variability and extreme events may also be responsible for changes in seasonal life cycles of many species. Other impacts of climate change on wildlife include changes in phenology and wildlife host-pathogen interactions and disease patterns in wildlife species.

Common effects of climate change on species and ecosystems in East and Southern Africa include: 1) changes in the timing of life-history events or phenology, 2) effects on demographic rates, such as survival and fecundity,3) reductions in population size, and 4) shifts in species distribution ranges. In the case of wildlife, food availability and ambient temperature determine energy balance and variation in

energy balance is the ultimate cause of seasonal breeding in all mammals and the proximate cause in many (Bronson, 2009).

3.2.5 Impact of Climate Change on Agriculture, fisheries and Food security

The agricultural sector accounts for over one third of export earnings in around 50 developing countries and for almost half of employment in the developing world (World Bank, 2003). In sub-Saharan Africa in particular, economic growth rates are closely tied to rainfall, as demonstrated by the experience of Ethiopia. Moreover, every US$1 generated in agriculture in sub-Saharan Africa is estimated to generate up to US$3 in the non-agricultural sector (Delgado et al., 1998).

Climate change will affect rainfall, temperature and water availability for agriculture in vulnerable areas. For example, drought affected areas in sub-Saharan Africa could expand by 60–90 million hectares, with dry land zones suffering losses of US$26 billion by 2060 (2003 prices), a figure in excess of bilateral aid to the region in 2005 (HDR 2007-2008). Based on various climate models it is estimated that, by 2100, parts of the Sahara are likely to show agricultural losses of between 2 and 7% of GDP. This is evident from the situation report on Niger (Box 3.3). Western and Central Africa are also vulnerable, with impacts ranging from 2 to 4%. Northern and southern Africa, however, are expected to have losses of 0.4 to 1.3% (Mendelsohn et al., 2000).

Box 3.3: Drought and food insecurity in Niger

Niger is one of the poorest countries in the world. It ranks close to bottom of the HDI, with a life expectancy of nearly 56 years, 40 percent of children having low weight for their age in an average year, and more than one in five children dying before their fifth birthday. Vulnerability to climate shocks in Niger is linked to several factors, including widespread poverty, high levels of malnutrition, precarious food security in 'normal' years, limited health coverage and agricultural production systems that have to cope with uncertain rainfall. During 2004 and 2005 the implications of these underlying vulnerabilities were powerfully demonstrated by a climate shock, with an early end to rains and widespread locust damage. Agricultural production was immediately affected. Output fell sharply, creating a cereals deficit of 223,000 tonnes. Prices of sorghum and millet rose 80 percent above the 5-year average. In addition to high cereal prices, deteriorating livestock conditions deprived household of a key source of income and risk insurance. The loss of pasture and nearly 40 percent of the fodder crop, along with rising animal feed prices and 'distress sales', pushed down livestock prices, depriving households of a key source of income and risk insurance. With vulnerable households trying to sell under-nourished animals for income to buy cereals, the drop in prices adversely affected their food security and terms of trade. By the middle of 2005 around 56 zones across the country were facing food security risks. Some 2.5 million people—around a fifth of the country's population—required emergency food assistance. Twelve zones in regions such as Maradi, Tahou and Zinder were categorized as 'extremely critical', meaning that people were reducing the number of meals eaten each day, consuming wild roots and berries, and selling female cattle and production equipment. The crisis in agriculture led to severe human costs, including:

- Migration to neighbouring countries and less critically affected zones.
- In 2005 Médecins Sans Frontières (MSF) re-reported an acute malnutrition rate of 19 percent among children aged 6–59 months in Maradi and Tahoua, representing a significant deterioration over average levels. MSF also reported a fourfold increase in the number of children suffering from severe malnutrition in therapeutic feeding centres.
- USAID survey team reported women spending entire days collecting anza, a wild food. In some respects, Niger's low level of human development makes the country an extreme case. However, developments during 2005 demonstrated in stark fashion the mechanisms through which increased climate-related risk can disrupt coping strategies and create extensive vulnerabilities.

Source: Chen and Meisel, 2006; Mousseau and Mittal, 2006; MSF, 2005; Seck, 2007a

According to Abdou Karim Diarra (2010), climate change will lead to a 50% drop in agricultural production in Africa by 2030. This decrease results from the degradation of arable soils losing their fertility due to high exposure to climatic stress and human pressure on forests and other vegetation cover.. The loss of forest cover causes a reduction in the fertility of soils and a big decline in agricultural production.

Climate change, population growth and poverty are at the base of the overexploitation of forest products such as consumable plants (Nguimalet, 2008). The degradation and deforestation of forest ecosystems constitute a loss for the pharmacopoeia, one of the virtues in Africa. Local communities become therefore vulnerable to new outbreaks of some little known diseases. Since the Congo Basin forests represent an embodiment of a whole civilization (past and present), its reduction is inevitably accompanied by a cultural vacuum that the current world cannot fill.

In sub-Saharan Africa 10 million people were affected by drought and 2 million by flooding, in many cases with near simultaneous episodes. Increased exposure to drought is of particular concern in sub-Saharan Africa. .Agricultural production is likely to suffer in these regions, especially those dominated by rainfed production. In sub-Saharan Africa, the areas suitable for agriculture, the length of growing seasons and the yield potential of food staples are all projected to decline. By 2020, between 75 million and 250 million more people in sub-Saharan Africa could have their livelihoods and human development prospects compromised by a combination of drought, rising temperature and increased water stress (Arnell, 2004, Box 3.2).

As the world's poorest and most rainfall-dependent region, sub-Saharan Africa is a cause for special concern. Across the region, agricultural producers are operating with limited resources in fragile environments sensitive to even minor shifts in temperature and rainfall patterns. In dryland areas sophisticated intercropping systems—maize and beans, cowpea and sorghum, and millet and groundnut, for example—have been developed to manage risk and sustain livelihoods. Climate change poses a direct threat to these systems and to the livelihoods that they sustain. Part of that threat comes from expansion of the area vulnerable to drought, as projected by the Hadley Centre for Climate Change. Arid and semi-arid areas are projected to increase by 60–90 million hectares. By 2090, in some regions, climate change has the potential to cause extreme damage. Southern Africa faces especially acute threats: yields from rain-fed agriculture could be reduced by up to 50 percent between 2000 and 2020, according to IPCC (2007b). Dryland agricultural systems will register some of the most damaging impacts from climate change. One study has looked at the potential implications for dryland areas in sub-Saharan Africa of a 2.9°C increase in temperature, coupled with a 4 percent reduction in rainfall by 2060. The result is a reduction in revenue per hectare of about 25 percent by 2060. In 2003 prices, overall revenue losses would represent around US$26 billion in 2060 54—a figure in excess of bilateral aid to the region in 2005. More broadly, the danger is that extreme food insecurity episodes, such as those that have frequently affected countries like Malawi, will become more common (Box 3.3). Cash crop production in many countries could be compromised by climate change. With an increase of 2°C in average temperatures, it is projected that the land area available for growing coffee in Uganda will shrink. In Kenya it would be possible to maintain tea production—but not in current locations. Production on Mount Kenya would have to move up to higher slopes currently occupied by forests, suggesting that environmental damage could be a corollary of sustained production.

Climate change on the scale projected for sub-Saharan Africa will have consequences that extend far beyond agriculture. In some countries, there are very real dangers that changed climate patterns will become drivers for conflict. For example, climate models for Northern Kordofan in Sudan indicate that temperatures will rise by 1.5°C between 2030 and 2060, with rainfall declining by 5 percent. Possible impacts on agriculture include a 70 percent drop in yields of sorghum. This is against the backdrop of a long-term decline in rainfall that, coupled with overgrazing, has seen deserts encroach in some regions of Sudan by 100 kilometres over the past 40 years. The interaction of climate change with ongoing environmental degradation has the potential to exacerbate a wide range of conflicts, undermining efforts to build a basis for long-term peace and human security (UNEP, 2007a).

Box 3.4 Climate Change in Malawi

Climate change models paint a bleak picture for Malawi. Global warming is projected to increase temperatures by 2–3ºC by 2050, with a decline in rainfall and reduced water availability. The combination of higher temperatures and less rain will translate into a marked reduction in soil moisture, affecting the 90 percent of smallholder farmers who depend on rainfed production. Production potential for maize, the main smallholder food crop, which in a normal year is the source of three-quarters of calorie consumption, is projected to fall by over 10 percent. It is hard to overstate the implications for human development. Climate change impacts will be superimposed on a country marked by high levels of vulnerability, including poor nutrition and among the world's most intense HIV/AIDS crisis: almost one million people are living with the disease. Poverty is endemic. Two in every three Malawians live below the national poverty line. The country ranks 164 out of the 177 countries measured in the HDI. Life expectancy has fallen to about 46 years. Successive droughts and floods in recent years have demonstrated the added pressures that climate change could generate. In 2001/2002, the country suffered one of the worst famines in recent living memory as localized floods cut maize output by one-third. Between 500 and 1,000 people in the central and southern part of the country died during the disaster or in the immediate aftermath. Up to 20,000 are estimated to have died as an indirect result of associated malnutrition and disease. As maize prices rose, malnutrition increased: from 9 percent to 19 percent between December 2001 and March 2002 in the district of Salima. The 2001/2002 drought undermined coping strategies. People were forced not just to cut back on meals, withdraw children from school, sell household goods and increase casual labour, but also to eat seeds that would have been planted and exchange productive assets for food. As a result, many farmers had no seed to plant in 2002. In 2005, the country was again in the grip of a crisis caused by drought, with more than 4.7 million people out of a population of over 13 million experiencing food shortages. Climate change threatens to reinforce the already powerful cycles of deprivation created by drought and flood. Incremental risks will be superimposed upon a society marked by deep vulnerabilities. In a 'normal' year, two-thirds of households are unable to produce enough maize to cover household needs. Declining soil fertility, associated with limited access to fertilizer, credit and other inputs, has reduced maize production from 2.0 tonnes per hectare to 0.8 tonnes over the past two decades. Productivity losses linked to reduced rainfall will make a bad situation far worse. Apart from its immediate consequences for health, HIV/AIDS has created new categories of vulnerable groups. These include households lacking adult labour or headed by elderly people or children, and households with sick family members unable to maintain production. Women are faced with the triple burden of agricultural production, caring for HIV/AID victims and orphans, and collecting water and firewood. Almost all HIV/AIDS-affected households covered in a survey of the Central region reported reduced agricultural production. HIV/AIDS-affected groups will be in the front line facing incremental climate change risks. For a country like Malawi climate change has the potential to produce extreme setbacks for human development. Even very small increments to risk through climate change can be expected to create rapid downwards spirals. Some of the risks can be mitigated through better information, flood management infrastructure and drought-response measures. Social resilience has to be developed through social provision, welfare transfers and safety nets that raise the productivity of the most vulnerable households, empowering them to manage risk more effectively.

Source: Devereux,2002, 2006; Menon, 2007a; Phiri, 2006; Republic of Malawi, 2006

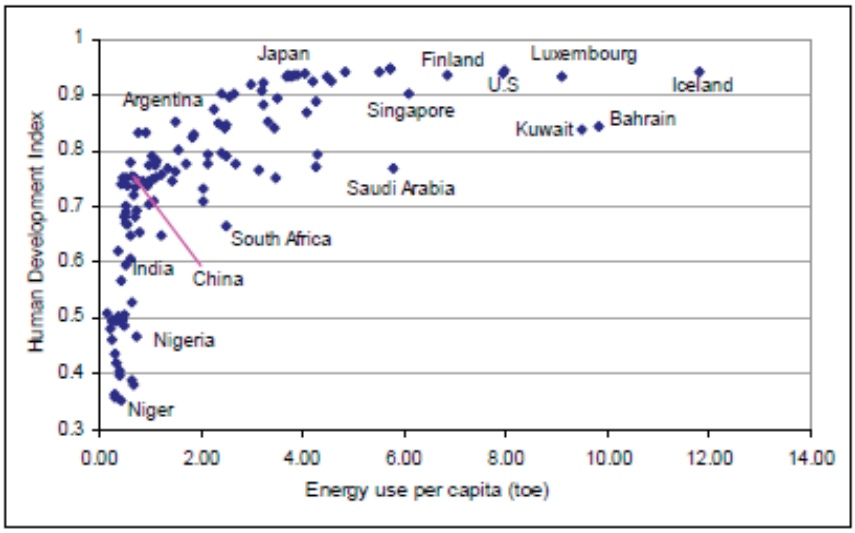
3.2.6 Climate Change impacts on energy security in Africa

Africa consumes the lowest energy amount of all the continents (only 3% of global energy consumption whilst contributing only 3.8% to global greenhouse gas emissions (World Bank, 2008). More than five hundred million people in sub-Saharan Africa have no access to electricity(World Energy Council, 2010); only 4% of Africa's full hydropower potential has been exploited; Africa's huge solar, wind, and geothermal resources are untapped; and, 23 of the 48 countries in sub-Saharan Africa are vulnerable

to energy shocks (Vijay, 2006). Furthermore, Africa needs to diversify energy supplies, enhance energy efficiency measures and private investment in order to cushion against energy shocks. Approximately 80% of African households use biomass fuels (e.g. wood and vegetation) for cooking and water heating. Electrification rate in Africa lies at only 31%(IEA, UNDP, UNIDO, 2010). Unsustainable harvesting of forests coupled with climate change and variability threatens biomass users with dwindling supplies.

For Africa , expanding and modernizing the energy sector is important since limited availability of energy impedes human and economic development. When countries become richer, energy consumption per capita rises to satisfy increasing energy demands thus raising the living standards (Fig 3.3) below.

Fig 3.3: Human development index

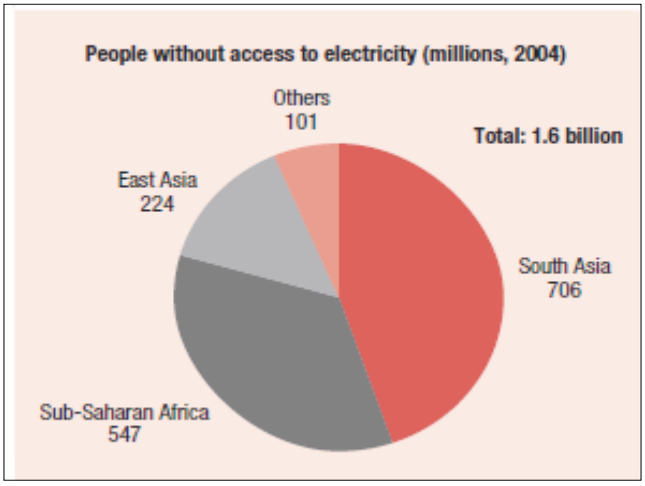


Source: World Bank, *World Development indicators,* United Nations Developing Program, *Human Development Report 2004.*

Over the past few decades the number of people impoverished through lack of modern energy services has remained unchanged (UNDP: http://www.undp.org/energy/, 2005). Today, almost 1.6 billion people in developing countries live without electricity in their homes, while nearly 2 billion people depend on dung, firewood, and agricultural residues for cooking and heating. The availability of energy services has a distinct impact on the lives of poor people, in particular women. For women and their families, dependence on traditional fuels and fuel technologies barely allows fulfillment of the basic human needs of nutrition, warmth and lighting, let alone the opportunity for more productive activities (UNDP, 2007).

The UNDP human development report (2007) stated that provision of affordable energy services to the world's poor stands as one of the challenges of this century. Living without electricity affects many dimensions of human development. Energy services play a critical role not just in supporting economic growth and generating employment, but also in enhancing the quality of people's live in sub-Saharan Africa, where only around one-quarter of people use modern energy services.

Figure 3.4: Living without electricity



Source: UNDP (2007)

Biomass as a major energy source for households in Africa is highly vulnerable to negative impacts of climate change (see the African NAPAs). The resilience and regeneration capacity of forests resources are negatively affected by extreme climate conditions. On the other hand, the hydroelectric generation which represents the promising source of energy faces a lot of challenges apart from the fact that less than 4% of Africa's hydropower potential is currently utilized. It has been repeatedly stated in the NAPAs that hydro-electric power generation has been negatively affected by droughts and floods (Gambia, 2007; Lesotho, 2007; Malawi, 2006; Zambia, 2007 – UNFCCC NAPAs).

Africa: Energy security perspectives

However, energy shocks in Africa have been experienced through declining energy stocks, supply disruptions, poor infrastructure, political instability, high commodity prices as well as natural disasters. This may result in local, regional, and international competition for energy supplies (e.g. forest-based hard woods and water). Increased climate variability and change can also impact on the functioning of key energy infrastructures (e.g. refineries, rigs, hydro-electric plants) within countries (Access Vulnerability Report, 2010). Biofuel usage also impinges on land-use patterns thus affecting food production, and consequently increase in agricultural commodity prices.

Energy security hotspots

In this section three hot spot countries in Eastern and central Africa (as examples only) that are at risk from climate change and energy insecurity are discussed. The selection of the countries was based on risk and geographical criteria (Access: Vulnerability Report, 2010) i.e geographical spread, continental representativeness together with environmental and socioeconomic indicators. The energy risk criteria was used in singling out the following countries as energy security hotspots: Democratic Republic of Congo, Kenya, and Zambia. The following briefs touch on energy security issues in the selected countries:

1. **Democratic Republic of Congo (DRC):** With a population of about 68 million people, a reliable supply of energy is essential for the country's development. Although DRC has a high potential for renewable energy sources less than 20% of the population have access to electricity. It has a relatively low level of energy production, coupled with low electrification, of the country.(IEA, 2010). The country has plenty stocks of hard wood associated with the world's second largest rain forest. In addition to that, Eastern DRC derives a substantial amount of its electricity from a sub-regional hydroelectric plant on the Ruzizi River, which is shared with Burundi and Rwanda.

2. **Kenya**: Climate change and variability constitute a considerable energy security risk for Kenya. This risk is exacerbated by the fact the country faces a population pressure of about 40 million people with a annual growth rate of about 3%. With approximately 60% of its hydro-electric power sourced from the Tana River located in drought-prone area, Kenya experiences frequent energy crises. Major exploitation of biomass by the country's rural population increases in tandem with population growth and consequent energy demand. While Kenya has invested in a greater degree of energy diversification, it fails to meet its energy needs.
3. **Zambia:** Approximately 70% of Zambia's 13 million population are poor hence the urgent need to provide equitable access to energy under affordable prices. The country is currently dependent on wood, imported petroleum, and hydropower for its energy supplies. although rural areas are not adequately connected to the national electricity grid. Erratic and low rainfall has a negative impact on the energy production potential (UNDP, CDM opportunities, 2010). In addition, climate change and variability negatively affect the country's forest areas, which cover 60% of Zambia's landmass. An increasing population and recurrent droughts impact on Zambia's energy security. Low rainfall levels also affect the country's ability to generate enough electricity for the nation. The 1991–92 drought, for example, reduced hydropower energy produced at the Kariba Dam on the Zambezi River by about 30% (Watson et al., 1998).

International initiatives to enhance energy security in Africa

The Clean Energy and Development Investment Framework plays a significant role in helping developing countries increase access to energy services, control GHG, as well as adapting to climate risk. The World Bank, together with the African Development Bank, the Africa Infrastructure Consortium and the European Investment Bank are working with other partners to raise Africa's energy access from the current 25 to 35% by 2015 and to 47% by 2030, especially the following areas: household electrification; generation capacity (including regional projects), energy services for key public facilities; stand-alone lighting packages for households and access to clean cooking, heating and lighting fuels. Furthermore, the framework is also designed to increase private sector participation in each of these areas. (World Bank: Investment Framework for Clean Energy Development, 2006)

Conclusions

Energy security remains a grave problem for African countries. The energy sector faces a number of challenges, climate change being one of them. Confronting these challenges is a complex task and requires an innovative integrated approach to energy policy. The wide spectrum and ramifications of the energy sector has often led to uncoordinated approaches that make the integration difficult.

Furthermore, Governments ought to focus their efforts towards developing the required efficiency of transport and delivery; this will require improved technical capacity and regulation. Training and investment is also required to increase energy efficiency. In-depth statistical data is required so as to forecast potential supply disruptions and to tackle alleviation efforts at an early stage of energy insecurity in these countries. Such data should be made available on national and regional levels.

3.2.7 Climate change impacts on tourism

With its close connections to the environment and climate itself, tourism is considered to be a highly climate-sensitive economic sector similar to agriculture, insurance, energy, and transportation. Indeed, climate change is not a remote future event for tourism, as the varied impacts of a changing climate are

even now becoming evident at tourists destinations around the world and climate change is already influencing decision-making in the tourism sector. There are four broad categories of climate change impacts that will affect tourism destinations, their competitiveness and sustainability.

3.2.7.1 Direct climatic impacts

Climate is a principal resource for tourism, as it codetermines the suitability of locations for a wide range of tourist activities; is a principal driver of global seasonality in tourism demand, and has an important influence on operating costs, such as heating-cooling, snowmaking, irrigation, food and water supply, and insurance costs. Thus, changes in the length and quality of climate-dependent tourism seasons (e.g., sun-and-sea or winter sports holidays) will negatively impact the sector. The IPCC has concluded that increases in the frequency or magnitude of certain weather and climate extremes (e.g. heat waves, droughts, floods, tropical cyclones) are likely as a result of projected climate change (IPCC, 2007a). Such changes will affect the tourism industry through increased infrastructure damage, additional emergency preparedness requirements, and higher operating expenses.

3.2.7.2 Indirect environmental change impacts

Because environmental conditions are such a critical resource for tourism, a wide-range of climate-induced environmental changes will have profound effects on tourism at the local and regional destination level. Changes in water availability, biodiversity loss, reduced landscape aesthetic, altered agricultural production (e.g., food and wine tourism), increased natural hazards, coastal erosion and inundation, damage to infrastructure and the increasing incidence of vector-borne diseases will all impact tourism to varying degrees. In contrast to the varied impacts of a changed climate on tourism, the indirect effects of climate induced environmental change are likely to be largely negative.

3.2.7.3 Impacts of mitigation policies on tourist mobility

National or international mitigation policies – that is policies that seek to reduce GHG emissions – may have an impact on tourist flows. They are likely to lead to an increase in transport costs and may foster environmental attitudes that lead tourists to change their travel patterns (e.g., shift transport mode or destination choices).

3.2.7.4 Indirect societal change impacts

Climate change is thought to pose a risk to future economic growth and to the political stability of some nations. Any such reduction of global GDP due to climate change would reduce the discretionary wealth available to consumers for tourism and have negative implications for anticipated future growth in tourism.

Box 3.5: Climate Change and Tourism in Eastern and Southern Africa

Climate change models paint a bleak picture for Malawi. Global warming is projected to increase temperatures by 2–3ºC by 2050, with a decline in rainfall and reduced water availability. The combination of higher temperatures and less rain will translate into a marked reduction in soil moisture, affecting the 90 percent of smallholder farmers who depend on rainfed production. Production potential for maize, the main smallholder food crop, which in a normal year is the source of three-quarters of calorie consumption, is projected to fall by over 10 percent. It is hard to overstate the implications for human development. Climate change impacts will be superimposed on a country marked by high levels of vulnerability, including poor nutrition and among the world's most intense HIV/AIDS crisis: almost one million people are living with the disease. Poverty is endemic. Two in every three Malawians live below the national poverty line. The country ranks 164 out of the 177 countries measured in the HDI. Life expectancy has fallen to about 46 years. Successive droughts and floods in recent years have demonstrated the added pressures that climate change could generate. In 2001/2002, the country suffered one of the worst famines in recent living memory as localized floods cut maize output by one-third. Between 500 and 1,000 people in the central and southern part of the country died during the disaster or in the immediate aftermath. Up to 20,000 are estimated to have died as an indirect result of associated malnutrition and disease. As maize prices rose, malnutrition increased: from 9 percent to 19 percent between December 2001 and March 2002 in the district of Salima. The 2001/2002 drought undermined coping strategies. People were forced not just to cut back on meals, withdraw children from school, sell household goods and increase casual labour, but also to eat seeds that would have been planted and exchange productive assets for food. As a result, many farmers had no seed to plant in 2002. In 2005, the country was again in the grip of a crisis caused by drought, with more than 4.7 million people out of a population of over 13 million experiencing food shortages. Climate change threatens to reinforce the already powerful cycles of deprivation created by drought and flood. Incremental risks will be superimposed upon a society marked by deep vulnerabilities. In a 'normal' year, two-thirds of households are unable to produce enough maize to cover household needs. Declining soil fertility, associated with limited access to fertilizer, credit and other inputs, has reduced maize production from 2.0 tonnes per hectare to 0.8 tonnes over the past two decades. Productivity losses linked to reduced rainfall will make a bad situation far worse .Apart from its immediate consequences for health, HIV/AIDS has created new categories of vulnerable groups. These include households lacking adult labour or headed by elderly people or children, and households with sick family members unable to maintain production. Women are faced with the triple burden of agricultural production, caring for HIV/AID victims and orphans, and collecting water and firewood. Almost all HIV/AIDS-affected households covered in a survey of the Central region reported reduced agricultural production. HIV/AIDS-affected groups will be in the front line facing incremental climate change risks. For a country like Malawi climate change has the potential to produce extreme setbacks for human development. Even very small increments to risk through climate change can be expected to create rapid downwards spirals. Some of the risks can be mitigated through better information, flood management infrastructure and drought-response measures. Social resilience has to be developed through social provision, welfare transfers and safety nets that raise the productivity of the most vulnerable households, empowering them to manage risk more effectively.

Source: Devereux, 2002, 2006; Menon, 2007a; Phiri, 2006; Republic of Malawi, 2006

3.2.8 Human and animal diseases

Diseases that affect mankind are classified into infectious and non-infectious diseases. Infectious diseases which comprise parasites, bacteria and viruses are transmitted from infected persons to non-infected persons by insects, through water, food and air. Zoonotic diseases are animal diseases that can also infect humans through transmitting agents and also by direct contact with infected animals. Epizootics are the equivalent of epidemics in animal disease outbreaks. Climate sensitive non-infectious diseases are directly affected by meteorological parameters such as temperature and humidity on cardiovascular diseases.

Most infectious diseases have seasonal cycles that include spatial and temporal changes in prevalence. The seasonality of the diseases is driven by changes in rainfall, temperature and humidity. Although the relationship between disease prevalence and meteorological parameters may not be linear and direct,

there is a proportional relationship within certain meteorological thresholds. For example most mosquito borne diseases cannot be transmitted below 14°C because the larval stages die and parasites cease to develop. On the other hand total thermal mortality of the adult mosquitoes occurs at 40°C (Githeko et al., 2000). In the case of malaria the mosquitoes can develop at temperatures above 16°C however below 18°C the malaria parasite development time exceed the lifespan of the female mosquitoes thus transmission is not possible at this temperature. Climate change and variability can drive the temperature above the threshold (18°C) and enable transmission. This situation is the main cause of malaria epidemic in the Eastern African highlands (Lindsay and Martens, 1989; Githeko and Ndegwa, 2001). About 20% of the human populations living in East Africa are at a risk of malaria epidemics. Other countries in the Eastern Africa region at risk are Rwanda Burundi, Ethiopia and Eritrea.

Cholera is caused by vibrio cholera bacteria that live in water bodies. Temperature, salinity, rainfall and plankton have been shown to be important factors in the ecology of V. cholerae (Magny et al., 2008). Large scale epidemics occurred in Eastern Africa in 1983 and 1997 during strong El Niño events associate with significant temperature anomalies and rainfall (Olago et al., 2007). To date major regional cholera epidemics in Africa have been associated with climate variability events such as strong El Niños. Climate change will increase marine temperature and alter the ecology in ways that may favor the reproduction of vibrio. It is still not clear whether the frequency of anomalous weather is increasing. However some models predict that this may be the case. Such a trend will increase the risk of cholera around large water bodies unless public health and hygiene is improved.

Meningococcal disease is an air-borne disease and about 50% of the global cases of the disease occur in the Sahelian belt in Africa (Maïnassara et al., 2008). The risk of the disease is associated with high temperatures and low humidity (Yaka et al., 2008) although other non-climatic factors are involved. There is uncertainty about the future of the Sahelian climate. Notwithstanding vaccine development may alleviate the impacts of meningitis.

Rift Valley Fever is a viral disease transmitted by mosquitoes mainly affecting livestock but also humans. The virus survives in the eggs during the dry period of Aedes mosquitoes and proceed to the larval stage and finally into the adult female. When the female bites, the host gets infected. The virus is also transmitted by Culex, Mansonia and Anopheles species during the rainy or flooded season (Seufi and Galal 2010). The disease is strongly associated with flooding and the immunity of the host. In Eastern Africa where Rift Valley Fever epidemic have become frequent, flooding is driven by the interaction between the El Nino Southern Oscillation (ENSO) and the Indian Ocean Dipole Moment (IOD).

3.2.9 Climate change on famine and human health

Drought leads to famine, malnutrition and under nutrition. These events lead to micro-nutrients, energy-protein deficiencies with subsequent impacts on child growth and development. Famine can also lead to mass migration of affected populations, competition for scarce resources and violent conflict. Socioeconomic conditions of the population will affect the resilience of the populations to the impacts of the drought and famine. While not all famines are a direct result of climate change, the great majority of famines have their roots in climate variability. Inter-annual seasonal changes in rainfall in Eastern and Southern Africa is a function of the El Nino Sothern Oscillation (ENSO) phenomenon. In the East African region drought occurs during the La Nina years when below normal rainfall is experienced. In Southern Africa, droughts are associated with El Nino events. In the Sahel, droughts started in the late 1960 and have lasted for more than 30 years. The Sahel climate variability is modulated by the Atlantic multi-decadal scale oscillation and also the ENSO at an inter-annual scale oscillation (Rowell, 2001).

Droughts are characterized by precipitation deficit, loss of crop and fodder, high livestock mortality and subsequently nutritional deficit in the human population and high child mortality. Long term effects of famine on human health include stunted physical and mental growth.

3.2.10 Source of information about climate change and health

Most of the published research carried out on climate and health can be found in the United States National Library of Medicine (PubMed) and these publications are available on the website (http://www.ncbi.nlm.nih.gov/pubmed/). All abstract of the papers on the website are freely available. Some full papers are also available free of charge from the website. Many of the papers available on PubMed can also be accessed through Google Scholar Search engine. They may be available as abstracts or full pdf papers.

The United Nations' Intergovernmental Panel on Climate Change (IPCC http://www.ipcc.ch/) carries out sectoral and region assessment every five years and publishes policy relevant reports. Information on climate and Health is available in the sector and regional chapters.

3.2.11 Methodologies and tools for detection of impacts

3.2.11.1 Health- temporal change in incidence

Public health services maintain records of disease data and carry out continuous trend analysis. Most climate driven diseases exhibit seasonal trends that are dependent on the major driver of the disease. For example malaria cases increase during the rainy season and decrease during the dry season. In some ecosystems such as the highlands of east Africa the numbers of malaria cases are also co-dependent on temperature. In any given locality there is an established normal range of disease statistics. If these statistics are exceeded then a outbreak or an epidemic is declared. As a rough guide a 50-100% increase in malaria cases can be considered an outbreak, case 100-200% a moderate epidemic and >200% is a sever epidemic which the medical facilities may not be able to cope with. A distinction is also made on the severity of the cases. Some cases may be uncomplicated while others are complicated requiring higher level intervention. The frequency of a disease my increase beyond long term trends and the underlying driver of such an event needs to be investigated.

Box 3.6: Impacts of the 1997-8 El Nino on human and animal health in the East African Region

Recent records indicate two strong (1972-3 and 1987-8) and two very strong (1982-3) El Niño events. These events are associated with enormously high temperatures and flooding. In Kenya rainfall exceeded 1000 mm between October 97 and February 98 in some parts of the country resulting in severe flooding (Kovats et al., 1999). Maximum temperatures of 50C above normal were recorded in western Kenya (Githeko & Ndegwa, 2001). This event resulted in severe malaria, cholera and Rift Valley fever epidemics in Eastern Africa culminating in high morbidity and mortality. Rift Valley Fever enzootic caused high livestock mortality. In Rwanda, malaria incidence increased by 337% in late 1987. The increase was greatest in groups with little acquired immunity--children under 2 years (564%) and people in high-altitude areas (501%). High temperatures and rainfall occurred in the country in 1987 and these variables explained 80% of the variance in monthly malaria incidence (Loevinsohn 1994). In 1997 a cholera epidemic spread along the East African coast affecting Somalia, Kenya and Tanzania. In addition the populations living along the Lake Victoria were severely affected (Legros et al., 2000). In the 2002-2003 epidemic s coinciding with the El Nino the case fatality rate was 10.3% (Alajo et al., 2007). A time series analysis of cholera cases and climate in East Africa and Zanzibar indicates that a 1°C increase in temperature at 4 months lag resulted in a 2-fold increase of cholera cases, and an increase of 200 mm of rainfall at 2 months lag resulted in a 1.6-fold increase of cholera cases (Reyburn et al., 2011). The 2006-7 Rift Valley Fever epidemic in North Eastern Kenya affected 180,000 people with 700 suspected cases and there was high fatality among hospitalized people (Nguku et al., 2008)

Source: Devereux, 2002, 2006; Menon, 2007a; Phiri, 2006; Republic of Malawi, 2006

3.2.11.2 Range expansion

A disease may spread into new geographic areas where it did not previously occur as a result of climate change and increase ecological suitability for transmission. Vectors may become established in a ecological zone due to climate change and improved survival and reproductive capacity. In Kenya malaria has spread to the Central highlands where it did not exist before (Githeko, 2009). Schistosomiasis has spread to higher altitudes in western Uganda (John et al., 2008).

3.2.12 Human settlements and urbanization

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. Africa's major economic sectors are vulnerable to current climate sensitivity, with huge economic impacts, and this vulnerability is exacerbated by existing developmental challenges such as endemic poverty, limited access to capital, including markets, infrastructure and technology; ecosystem degradation; and complex disasters and conflicts. These in turn have contributed to Africa's weak adaptive capacity, increasing the continent's vulnerability to projected climate change (IPCC, 2007). The Intergovernmental Panel on Climate Change has warned that by the year 2020 up to 250 million people in Africa could be exposed to increased water stress and that food production could be halved (IPCC, 2007). Climate change is already affecting agriculture and water availability, especially in costal regions; it causes extreme weather events and diseases. It may increase livelihood vulnerability, which is greater in areas more environmentally and socially marginalized. Some climate-driven outcomes are long term and chronic, such as declining productivity of agricultural land; others such as floods; are episodic (Wakhungu & Nyukuri, 2008).

It has been stated that the decreasing rainfall and devastating droughts in the African Sahel region during the last three decades of the 20th century are among the most undisputed and largest recent climate changes recognized by the climate research community (Aiguo et al., 2004). The African Sahelian zone is a home to millions of traditional agriculturalists (both pastoralists and farmers) who depend on livestock herding and subsistence farming for survival. In recent decades the Sahel's climate became even drier, resulting in repeated droughts and spread of desert. The United Nations Environment Programme (UNEP, 2007) stated that climatic changes have greatly stressed Sahelian countries such as Sudan. Climate change is expected to further shrink the rangelands which are important for livestock keeping communities. Shrinkage of rangelands is likely to exacerbate conflicts between livestock keepers and farmers in many areas. Vulnerability Assessment of Tanzania indicated that civil conflicts have been occurring between livestock keeper and farmers over grass and water for the animals in Morogoro, Mara and Kilimanjaro regions (Tanzania NAPA, 2007). The National Adaptation Programme of Action (NAPA) prepared under the guidance of the United Nations Framework Convention on Climate change (UNFCCC) clearly showed that climate change extreme events particularly drought and flood have impacted the livelihoods in Africa (Ethiopia NAPA, 2007; Malawi NAPA, 2006; Uganda NAPA, 2007; Sudan NAPA, 2007; Sierra Leone NAPA, 2007; Tanzania NAPA, 2007; and Zambia NAPA, 2007). The adverse impacts on livelihoods did not only cause suffering of vulnerable communities but it also triggered migration of tribes. In Uganda various forms of incursion into the Protected Areas are experienced because of drought. Pastoralists drive their cattle into the Protected Areas in search of pasture and water. In Lake Mburo National Park, over 300,000 cattle entered the park to access water from river Rwihizi, thus degrading over 100sq km of park (Uganda NAPA, 2007). In the pastoral communities where livestock is the major source of food, migration of the men (family leaders) with the livestock herds in search of water and pasture often leaves the family behind more vulnerable to famine (Uganda NAPA).

In many African countries such as Sudan extreme years (either good or bad) are more common than average years. The unreliable nature of the rainfall, together with its concentration into short growing seasons, heightens the vulnerability of rainfed agricultural systems. Recent studies showed that for the

period 1971-2000, the rainfall amount was found to decrease and rainfall isohyets (200 and 500 mm) were found to shift southward. Over the same period of time the coefficient of rainfall variability (or the percentage deviation from the norm) was found to increase. Declining and uncertain rainfall makes life very difficult for traditional farmers and herders and severely affects their livelihoods (Sudan NAPA, 2007).

Studies in Darfur found that climate change not only forces migration but can also trigger conflict. The latter was found to be the result of environmental pressures together with the breakdown of native administration designed to mitigate traditional resource conflict (Scott, 2008). Climate change, drought and desertification altered rural livelihoods of both sedentary and pastoralist communities e.g. the migration patterns of pastoralist tribes into new areas. The altered livelihoods systems, combined with more permanent migration by people in North Darfur looking for viable land for subsistence, led to conflict (Scott, 2008). It has been found that Drought had led to displacement of some groups from northern central and southern part of the state. The migrating groups were looking for drinking water and agricultural lands in areas that have more rainfall.

The Intergovernmental Panel on Climate Change (2007) showed that during the period 1950 to 2005, the urban population in Africa grew by an average annual rate of 4.3% from 33 million to 353 million. Complex migration patterns, which are usually undertaken to ensure income via remittance and which often occur in response to stress-induced movements linked to conflict and/or resource constraints, can further trigger a range of environmental and socio-economic changes. Drought occurs anywhere in the world but its damage is not as severe as in Africa in general and Sahel in particular. Recurrent drought events in the past have resulted in huge loss of life and property as well as migration of people. The worse is yet to come the IPCC (2007) anticipated that the Sahel is likely to be drier in the future, a 25% reduction in the rainfall is expected by the year 2100. Negative impacts of climate change could create a new set of refugees, who may migrate into new settlements, seek new livelihoods and place additional demands on infrastructure. A variety of migration patterns could thus emerge, e.g. repetitive migrants (as part of ongoing adaptation to climate change) and short-term shock migrants (responding to a particular climate event).

Many African countries stated that the communities that are vulnerable to the adverse impacts of climate change are practicing wide range of traditional and contemporary coping mechanisms to climate variability and extremes (such as changes in cropping and planting practices, reduction of consumption levels, collection of wild foods, use of inter-household transfers and loans, introduction of drought resistant plants, practicing of traditional water harvesting, credit from merchants and money lenders, use of early warning system, etc (Ethiopia NAPA, 2007; Sudan NAPA, 2007). Many countries mentioned that both temporary and permanent migrations are used as coping mechanisms to climate change (Ethiopia NAPA, 2007; Gambia NAPA, 2007; Sudan NAPA, 2007). It has been argued that the high cost of living and inadequate opportunities for income diversification are likely to remain major factors behind permanent migration of youth to urban areas (Gambia NAPA, 2007). However, it has also been argued that migration as a result of climate change is a reflection of the lack of ability of people and communities to adapt (Scott, 2008). Certain countries beside migration of groups are also exposed to shifts of rainfall isohyets which is causing shift in the agro ecological zones induced which is causing and likely to induce remarkable forced displacement not only of individuals and tribes but also of traditional patterns and systems (Sudan NAPA, 2007).

The massive population displacement has always been accompanied by significant human suffering and environmental damage. Areas around the larger camps are severely degraded. The environmental degradation is considered to weaken opportunities of combating poverty. In fact environmental degradation is also a contributing cause of displacement in Sudan, accordingly halting displacement will require concurrent action to halt environmental degradation (UNEP, 2007).

Migration is also associated with the spread of HIV/AIDS and other diseases. Increases in population also exert stresses on natural resources. Agricultural intensification and/or expansion into marginal lands can trigger additional conflicts, cause crop failure, exacerbate environmental degradation and reduce biodiversity (IPCC, 2007). The causes of such conflicts include structural inequalities, resource mismanagement and some instances land distribution and land scarcity have promoted conflict, often exacerbated by environmental degradation. Marginalization is also often a key driving force behind conflict. Climate change may become a contributing factor to conflicts in the future, particularly those concerning resource scarcity, for example, scarcity of water (IPCC, 2007).

Climate change is expected to bring more frequent and longer droughts to the region (Boko et al., 2007). Drought in rural areas may be a major trigger for in-migration to urban areas, further stressing urban infrastructure (Ramin, 2009). Falling agricultural productivity in the region could place increased strain on local food markets, thus increasing rates of malnutrition in slums. Urbanization in Africa is linked to poverty (Ramin, 2009). The United Nations Human Settlements Programme (UNHABITAT) defines a slum as an urban area with a lack of basic services (sanitation, potable water, electricity), substandard housing, overcrowding, unhealthy and hazardous locations, insecure tenure and social exclusion (UNHABITAT, 2003). In sub-Saharan Africa, 71.8% of urban dwellers live in slums, the highest proportion in the world (UNHABITAT, 2006). Slums are often located in marginal lands near factories and busy roadways thus rendering their inhabitants to different sort of vulnerabilities (exposure to pollution, flooding, diseases etc) (Ramin, 2009).

The urban poor build houses of weak, inadequate materials, often against hillsides that are subject to landslides during heavy rains (Boko et al., 2007). Over the coming decades, the effects of climate change will also be progressively felt across the African continent. Climate change and urbanization will interact, with unpredictable effects. The Fourth Assessment Report of the Intergovernmental Panel on Climate Change stated that “urbanization and climate change may work synergistically to increase disease burdens

Across Africa, 45% of the urban population lacked access to improved sanitation in 2000 (UNHABITAT, 2006). In eastern Africa in 2006, open defecation was the only sanitation practice available to 33% of the population UNHABITAT (2008). This contributes to the contamination of water and land within cities as well as to many of the waterborne diseases prevalent in slums (Ramin, 2009).

Because climate change is associated with more extreme precipitation events and rising sea-levels, African cities will also experience more severe and more frequent flooding (Douglas et al., 2008). Flooded areas and ditches, latrines and septic tanks are key reservoirs that perpetuate cholera, malaria, dengue and yellow fever in urban areas.

3.2.13 Social impacts (poverty, employment, gender) of climate change

The vulnerability of ecosystems in Africa following the adverse effects of climate change is accompanied by human vulnerability. The reduction of natural resources and declining agricultural production increase poverty, especially people who rely on nature to meet the basic needs of their existence. The reduction of logging and the crisis in the industry for lack of raw materials lead to increased unemployment in Africa. Women, children and the elderly are most affected by the impact of changes shift. The implementation of the Millennium Development Goals (MDGs) is accompanied by more pressure on natural resources and therefore makes the severe climatic stress. The damage affects the loss of cultural identity in certain sensitive people will disappear.

By changing their habitat, forest populations change culture. The Pygmies in the Congo Basin forests are an example of a strong interbreeding when they move towards large villages. The deforestation witnessed today is due to the collective loss of cultural identity to the benefit of modernization (Ngana, 2004). Since the safeguarding of the forest is accompanied by the safeguarding of the culture

of marginalized populations, the absence of one will impede the existence of the other. The risks of the disappearance of a culture and the destruction of the forest are inevitable- "From one point to another, one period to another, social attitudes, ways of speaking and codes changes. Cultural realities do not represent any more the same face" (Claval, 1995). "An ethnic group which disappears is a culture that goes away" (UNESCO). The disappearance of a culture is the loss of a community's identity. The protection of biological diversity is therefore a vital strategy of safeguarding the culture. However, due to climate change, the forest protecting the Pygmies is shifting every year (Bahuchet, 1978).

"All the authors agree on these premises that is, the possibility of comparing the communities which we would call today primitive with Western civilization" (Lévi-Strauss, 1996; p365). The reduction in the vegetation cover in the face of urbanization, slash-and-burn agriculture, logging and mining and climate change undermine the culture of those who live there (PNUD, 2007).

The Aka, Baka, Twa, CWA, Efe, Bongo, Gyeli (Fig. 1) are the ethnic groups in the Congo Basin will lose their cultural identity because of climate change. The vulnerability of forest ecosystems following the negative impacts of climate change causes the reduction of resources upon which these populations. Rendered as vulnerable, they are forced to migrate to large towns and cities to enjoy the support of humanitarian agencies in health, nutrition and human right. Pygmies in Central African Republic who lived only gathering in their cultural habits are required for example to convert to farmers (Ngana, 2004). Climate change with declining rainfall and increasing temperature caused the drying up of Lake Chad. Indeed, the migration of farmers who depend on the lake has increased in recent years. The Congo Basin forest is beginning to be occupied by farmers from the savanna areas of Africa such as Sudan, Chad and Niger. Land conflicts resulting impoverishment and accentuate the risk of survival of indigenous peoples such as the Pygmies.

3.2.14 Climate change and human security

3.2.14.1 The concept of human security

The purpose of the concept 'human security' is to protect the vital core of all human lives in ways that enhance human freedoms and human fulfilment (CHS, 2003). The issue of human security has already been addressed by the founders of the United Nations; however, a milestone of the development of today's concept of human security was the Human Development Report of UNDP in 1994, which formulated new dimensions of the idea of human security. The concept of human security is established on two pillars: The 'freedom from fear' factor focuses on protecting individuals from violent conflicts and from denial of civil liberties and ensures freedom of expression and belief. The 'freedom from want' factor emphasises satisfying the basic needs of individuals for food, shelter and clothing (Kumssa and Jones, 2010; UNDP 1994). Seven broad categories have been identified, which are interdependent components of human security: Economic security, food security, health security, environmental security, personal security, community security and political security (UNDP, 1994). In addressing the root problem of insecurity in Africa, violence, poverty and inequality, be it social or economic; do play a core role (Kumssa and Jones, 2010). In this section, possible impacts of climate change on the various components of human security in Africa will be outlined by summarizing issues which have been discussed above such as the impacts on agriculture and food security, and health security, while focusing on the impacts of climate change on violent conflicts and migration.

3.2.14.2 Interrelation between climate change and human security: Impacts of climate change on different components of human security in Africa

Despite Africa's relatively low contribution to the world's total GHG emissions, Africa is one of the most vulnerable continents to climate change and climate variability (Boko et al., 2007). Climate change and variability have the potential to impose additional pressures on human security along with many socioeconomic factors and to overwhelm adaptive capacities of societies in many world regions. Interrelating issues between climate change and human security include water stress, land use and food security, natural disasters and environmental migration (Scheffran and Battaglini, 2011).

3.2.14.3 Aspects of environmental, economic, food and health security

The most direct link between climate change and threats to human security is probably the aspect of environmental security, which aims to protect people from the short- and long-term ravages of nature, man-made threats in nature, and deterioration of the natural environment. Access to clean water resources and air pollution are considered to be the greatest environmental threats. Another important environmental security issue is global warming, caused by the emission of greenhouse gases. The nature of impacts on economic security as one aspect of human security is manifold. Economic security requires an assured basic income for individuals, usually from productive and remunerative work or, as a last resort, from a publicly financed safety net' (UNDP, 1994). The impacts of global warming on the agricultural sector in Africa are probably of most direct and profound nature. Water scarcity for example has a direct impact on many economic development initiatives on the agricultural sector which is of undoubtedly the most important sector in the economies of Africa, at least for those, which are not oil-exporting. In particular, climate change has economic impacts on crop and livestock farming systems; warmer and drier climates adversely affect net farm revenues translating into worsening food security situation in the region (see e.g. Nhemachena et al., 2010). The ultimate damages of climate change may significantly affect economic growth (Lecocq and Shalizi, 2007).

Although agricultural productivity might increase in the short run in some regions as a result of global warming, many African countries and regions are likely to be severely affected by climate change and climate variability (Boko et al., 2007). Impacts of climate change will particularly affect agricultural and food systems (Brown and Funk, 2008). Increasing temperatures and declining precipitation in Africa resulting from climate change are likely to reduce yields for primary crops in the next two decades, changes, which will have a substantial impact on food security in Africa, although the extent and nature is uncertain (Boko et al., 2007). Periods of droughts and floods will have an impact on food availability, food access, and on nutrient access (Ziervorgel et al., 2006). It is predicted that the impacts of climate change such as sea-level rise, droughts, heat waves, floods and rainfall variation, could by 2080 push another 600 million people into malnutrition and increase the number of people facing water scarcity by 1.8 billion (UNDP, 2008).

'Health security' aims to guarantee a minimum protection from diseases and unhealthy lifestyles. Climate change is considered to be the biggest global health threat of the 21st century and the effects on health will exacerbate inequities between rich and poor (Costello et al., 2009). Africa is particularly vulnerable with regard to health security as threats to health security are usually greater for poor people in rural areas, particularly children, due to malnutrition and insufficient access to health services, clean water and other basic necessities. Major killer diseases could expand their coverage as a result of global warming. For example, an additional 220–400 million people could be exposed to malaria—a disease that already claims around 1 million lives annually (UNDP, 2008). Other examples for threats to health security include is the threat of a further spread of other infectious diseases such cholera, which is influenced by both global and regional climatic variability (de Magny et al., 2007), the dengue fever (Jansen and Beebe, 2010), and meningitis (Cuevas et al., 2007), among others.

3.2.14.4. Aspects of personal, community and political security: Impact of climate change on violent conflicts, migration and human settlements

While personal security aims to protect people from physical violence by states or individuals, community security is concerned with protecting people from the loss of traditional relationships and values and from sectarian and ethnic violence. Political security addresses the question as to whether people live in a society that honours their basic human rights. All the aforementioned factors are of relevance, when it comes to the issues of violent conflicts and migration. The effects of global warming could lead to increased border tensions, and conflicts over food and water. The effects of climate change on the onset of conflict are considered to have Environmental conflict research and the linkage between climate-related environmental variability and conflict has attracted much attention and debate. While there seems to be consensus in that the environment is only one of several inter-connected causes of conflict and is rarely considered to be the most decisive factor (Kolmanskog, 2010), it remains disputed, whether the changing climate increases the risk of civil war in Africa (see the different views of Burke et al., 2009; Buhaug, 2010). On the one hand, it is argued, that conflicts are more likely in regions with more vegetation (possibly resulting from vegetation recovery after population are displaced out of conflict zones), and that increased levels of malnutrition are related to armed conflicts (Rowhani et al., 2011). Another view emphasises the role of renewable resources such as freshwater and arable land. It is argued that as a long term trend, population growth and resource scarcities result in violent competition (Homer-Dixon, 1994); short term causes may trigger the outbreak of conflict (Hendrix and Glaser, 2007). It is argued that distributional conflicts will arise as due to the degradation of natural resources as a result from over-exploitation and global warming. Rising human populations will be forced to migrate internally or cross borders (Gleditsch et al., 2007).

Environmental migration due to the effects of climate change is closely related to the concept of human security. The causes for disasters, displacement, and migration, are manifold, however, climate change is one of the interlinking issues. Besides low-lying islands and coastal and deltaic regions, sub-Saharan Africa is one of the regions that would be affected by such population movements (Gemenne, 2011), referred to as environmentally induced migration. While the terminology in this respect is varying and inconsistent (Warner et al., 2010) and creates conflicts of legal nature, when it comes to the question as to whether or not a person can be classified as a refugee with the legal consequences of international refugee law, it can generally be stated that there are people who migrate either temporarily or permanently, within their country or across borders, and who have an environmental signal in their reason for migration.

Three types of impacts of climate change on migration have been identified that seem most likely to have an effect on migration patterns: Extreme weather events, sea-level rise and water stress (Gemenne, 2011). A global study conducted in 2009 (OCHA, 2009) reveals that in 2008, at least 36 million people were newly displaced by sudden-onset natural disasters i.e. disasters such as floods and storms which climate change can influence both in terms of frequency and severity. The number of displaced people in Africa has increased from 697,066 in 2008 to 1,1 million in 2009 and 1,7 million in 2010 (IDMC, 2011). Of the 36 million people displaced, over 20 million were displaced by sudden-onset climate-related disasters. It is likely that many more are displaced due to the other climate change-related drivers, including slow-onset disasters, such as drought and sea level rise. It should be noted, however, that estimates on migration flows resulting from climate change remain speculative, as migration drivers are usually not mono-causal but influenced by multiple factors (Smith et al., 2011). Potential drivers of migration are push and pull factors related to the region or country of origin or destination respectively, and intervening factors that facilitate or restrict migration, all of which may interact in different ways (Black et al., 2011).

Climate change impacts on size and characteristics of rural and urban human settlements in Africa. The problems associated with voluntary or involuntary environmentally induced migration to Africa's large

and intermediate cities will exacerbate as a result from climate change. Migration flows can be observed away from flood-prone localities, as well as potentially large-scale internal and cross-border mobility away from agricultural zones undermined by changing climatic conditions or declining water availability (UN-Habitat and UNEP, 2010). Environmental and climatic stress not only raises existing inequalities between rich and poor, it also contributes to rural-urban migration on the African continent (Scheffran and Battaglini, 2011; Hope, 2011). In sub-Saharan Africa, climatic change is considered to be an important determinant of urbanization growth and climatic conditions push people out of rural/agricultural areas to urban areas (Barrios et al., 2006). African agriculture relies heavily on rainfall for watering crops. The declining rainfall, droughts and floods have the potential of rendering agricultural lands unproductive or making rural settlements inhabitable, which in turn affects the livelihoods of rural residents, forcing them to migrate to the urban areas (Hope, 2011). As a result, African large and medium-sized cities experience extreme population growth. In 2009, almost 40 per cent of Africa's total population of one billion lived in urban areas and it is estimated that by 2030, Africa's collective population will become 50 per cent urban and 60 per cent rural by 2050 (UN-Habitat and UNEP, 2010). Africa counts 37 cities with populations above one million, half of which are within low elevation coastal zones (Mosha, 2011). Low-lying cities located on lagoons, estuaries, deltas or large river mouths, such as Alexandria, Cotonou, Dar es Salaam, Lagos, Maputo and Mombasa as well as the Cape Flats area of Cape Town are particularly vulnerable to extreme weather events caused by climate change. They are likely to experience storm surges, sea-level rises, increased flooding, (semi-) permanent inundation, coastal erosion, landslides, and the increase of water-borne diseases, which may all have devastating effects on human settlements, especially, if no measures have been taken to ensure risk reduction in terms of urban planning, land-use management and the quality of housing and infrastructure (Mosha, 2011). In this regard, the high risk for low-lying urban slums has to be pointed out. Although the proportion of urban slum dwellers is decreasing, informal settlements remain one of the major threats to African urban stability and, by extension, to overall political stability (UN-Habitat and UNEP, 2010). African inland cities are rather exposed to experience higher ambient temperatures and more frequent heat waves, with potential risk of water shortages, damage to infrastructure, and desiccating vegetation, due to the impacts of climate change.

Climate change could intensify environmental or resource problems that communities are facing already, exacerbating grievances, overwhelming coping capacities, and at times spurring forced migration. While it is generally agreed that environmental factors, including climate change, can be contributing factors to conflict, the underlying political, economic, social, and cultural context has a strong and more direct causal relationship. Hence, climate change is best thought of as an aggravating factor or trigger in places where some of the characteristic ingredients for conflict already exist. Weak, corrupt, fragile, or failed governments are critical factors. Many of the countries predicted to be worst affected by climate change are plagued by poor governance and social and political instability. Four examples of climate change induced conflicts in Africa are given below.

Darfur Conflict

The Darfur conflict was a complex crisis in the Darfur region of western Sudan. The combination of decades of drought, desertification, and overpopulation are among the contributing factors that led nomads searching for water to drive their livestock south into regions mainly occupied by farming communities. Eventually, tensions between the two groups escalated into conflict. The United Nations estimates that as many as 450 000 people have died from violence and disease and about 2.5 million are thought to have been displaced as of October 2006 (UNHCR, 2006b).

On June 2007, United Nations Secretary General Ban Ki-moon released a statement in which he proposed that the impact of climate change is directly related to the Darfur conflict, as desertification has added significantly to the stress on the livelihoods of pastoralist societies, forcing them to move south to find pasture (BanKi-moon, 2007). Apart from the millions internally displaced, more than 200 000 refugees

were hosted in 12 UNHCR-run camps across the border in Chad (UNHCR, 2006b). Their presence is a transboundary environmental problem, since the need for fuelwood has led refugees to destroy forests around the camps and dig new bore holes for water, which are depleting aquifers.

Amnesty International reported on December 2005 that Janjaweed nomadic fighters attacked the village settlement Bir Kedouas, which is a two square kilometre settlement within Chad, just west of Sudan's Darfur region, burning at least 60 homes and causing widespread destruction (Amnesty International, 2006).

Conflict in the Horn of Africa

The Karamoja is a region northeast of Uganda bordering with Kenya in the West and South Soudan in the North. This region is prone to food shortages due to unpredictable weather patterns but also illustrates how the difficulties with food production and management can cascade into other coping mechanisms like cattle raiding and the proliferation of guns. In the Karamoja region rainfall is unpredictable and there has been a drastic reduction of the vegetation cover of between 4 and 8% in the last 10 years. Throughout the century, it has changed from savannah grassland over steppe to thickets and shrubs today. The World Food Programme (WFP) has a permanent base in Karamoja and distributed food there since 1963. The droughts reoccurred almost permanently since 1982. Prolonged drought periods like this have destabilising effects on a society. Now people do raids to get income, it is done at any time and perpetrated for commercial gain. Raiding used to be controlled by the Council of Elders who allowed the use of small weapons like spears, bows and arrows but currently armed youth gangs use machine guns to control crowds to take their cattle.

*I*n the **Ilemi Triangle**, a disputed territory that sits where the border of South-Eastern Sudan joins with North-western Kenya, and Southwestern Ethiopia the problems are very similar. Due to climate change the pastoralists had to cross over into each other's grazing grounds thereby disrupting the traditional co-existence in this trans-border region and resorting to armed conflicts. **Climate change also has its bearings on the cultural traditions of pastoralist communities in the horn of Africa, more specifically on the initiation of young warriors.** There is a symbiotic relationship between security and economic development, in the sense that as climate change degrades the productivity of land, raiding becomes a coping mechanism. Finally the proliferation of guns in the periphery of the State is the outcome of international vectors, particularly civil conflicts, which have emanated from State collapse and a product of domestic manipulation by irresponsible leaders.

Lake Chad

Lake Chad is a unique trans-boundary natural reserve that crosses national frontiers, linking users across borders and supporting different economic livelihoods. It is located between latitudes 6° and 24°N and longitudes 7° and 24°E. It is the most important natural feature of the conventional basin and is shared by Cameroon, Chad, Niger and Nigeria.

In the Lake Chad area, climate change is not just a future threat, but also a present danger that confronts the communities living around the lake. An obvious major impact of climate change on the lake is the rapid decline of its surface water. Lake Chad lost over 50 per cent of its water between 1973 and 2002. Yet, the lake, like any other trans-boundary watercourse, is a vital source of fresh water and other resources that sustain human, livestock and wildlife communities

in four African states, namely Cameroon, Chad, Niger and Nigeria. Over the past four decades the waters of the lake have continued to diminish. This, in turn, has affected aquatic and terrestrial ecosystems, the quantity and quality of fresh water availability, and the wider environment. Adverse impacts include reduced fish stocks, siltation, loss of vegetation and depletion of grazing land. Although the local people have lived with these problems for many years and have evolved ways of coping with them, albeit ineffectively for the most part, their scale and intensity are exacerbated by climate change as this adds

another dimension to the matrix of global water insecurity.

Historically, Lake Chad received most of its water from the annual monsoon rains that fell from June to August. However, since the late 1960s the region has experienced a series of declines in rainfall, culminating in two major droughts in 1972 to 1974 and 1983 to 1984. Areas of the lake that once experienced a mean annual rainfall of 320 millimetres received less than 210 millimetres. Recently, the United Nations concluded that 'the size of the region affected by this change and its duration are without precedent in hydro-climatic chronicles'.22 Early studies on the hydrological history of the lake have found that the balance between water intake and evaporation is continually fluctuating, with the result that Lake Chad, owing to its shallowness, is continually changing. Although specifics on the impact of climate change on the Lake are still unclear, a United Nations study has identified 'climate change as the most important global change relevant to Lake Chad Basin.

The zone is very heterogeneous and accounts for nearly half the estimated 300 or more ethnic groups in the country. Although different religious faiths are practiced in the region, the inhabitants are predominantly Muslim. The zone shares international boundaries with Niger, Chad and Cameroon to the north, north-east and east respectively. In 2003, it was estimated that of the 20 million people that lived in the Lake Chad Basin, 11,7 million lived in Nigeria, mainly in the north-east zone. The rest of the people included five million in Chad, 2,5 million in Cameroon, 193 000 in Niger and 634 000 in the Central African Republic. As a unique trans-boundary watercourse situated at the edge of the Sahara Desert, Lake Chad provides a lifeline to millions of people living in the catchment area. It is used for sanitation, drinking, agriculture, fishing, and religion cultural activities. Given its relevance to local livelihood and economic progress, further shrinkage of the lake resulting from climate change will undermine the very base of human development in the basin, including in the north-east zone Climate change, population surge and resource overuse in the Lake Chad area. The implications of such an occurrence include, but are not limited to, water scarcity/insecurity, falling health standards, food insecurity, poverty and intensified migration, with the tendency to instigate resource and identity conflicts within and beyond the basin.

Nigerian Niger Delta

The Niger Delta is located on the Atlantic coast of southern Nigeria where the River Niger divides into numerous tributaries. It is the second largest delta in the world with a coastline spanning about 450 kilometres, terminating at the Imo River entrance. With well over 5 200 oil wells in the area, and about two million barrels of crude oil per day that pass through 275 flow stations and are exported through ten terminals, the region has been subjected to the greatest environmental abuse recorded in sub-Saharan Africa.[21] The 7,000 square kilometres of swamp, forest and plains present limitless opportunities for ecotourism. The ecology of the area is highly diverse and supports numerous species of terrestrial and aquatic flora and fauna and human life. Its 15 million inhabitants, comprising more than 40 ethnic groups, is spread over 6,000 communities. About 1,500 of these host oil multinational corporations and their operations.[22]

The Niger Delta region is where nearly 60 percent of the population depends on the natural environment – living and non-living – for their livelihoods' It further reveals the extent of the impact of climate change on the local environment, stating that Another report released by Nigeria's Community Research and Development Centre (CREDC), entitled Coping with climate change and environmental degradation in the Niger Delta of southern Nigeria, highlights in detail the climatic and environmental changes that have occurred in the Niger Delta region and shows the relationship between these changes and poverty and conflict.

One of the causes of climate change and global warming is gas flaring and oil spills. This is also one of the most devastating environmental occurrences in the Niger Delta. Perhaps gas flaring is as old as the discovery of oil in the region. However, it has not abated, but rather is on the rise. Nigeria flares about 24 billion cubic metres of associated oil annually. Almost 70 per cent of the oil fields in the Niger Delta

flare their gas every day.

While the issue of gas flaring is one of the fundamental problems contributing to climate change in the region; the second is oil spillage, another major contributor to climate change. Oil spills devastate the environment and generate conflict between the host community and oil multinationals.

A second environmental change is coastal erosion and flooding. The rise in sea level and flooding are already affecting millions of people worldwide. It is estimated that ten million people are at constant risk of coastal flooding. Moreover, in general, floods are causing three million people to be homeless every year. Nigeria is not excluded from this climatic problem.

A third environmental change is deforestation and land degradation, both of which are affecting large areas of the Niger Delta because of the high levels of industrial activity by multinational corporations (MNCs). According to the federal government of Nigeria, deforestation and land degradation have been on the increase in the Niger Delta and western part of Nigeria.

In the Niger Delta area in particular, the natural resources curse syndrome has left the environment depleted and degraded. Gas flaring, oil and water pollution, bush burning and the emission of carbon monoxide, all a result of oil exploration, have left people dehumanised and subservient to poverty. This situation has also contributed to many and various conflicts, such as for the control of the natural resources, and this has fostered militancy.

Conclusion

In conclusion, the natural resources in Africa are under pressure from the increasing demand and the threat of climate change with serious environmental problems that include land degradation, drought, desertification, loss of forest resources and of biodiversity, flooding, poor environmental health and safety, urban waste and pollution. Conflicts related to inequality of access to resources may be the greatest source of insecurity and instability in the continent today. This chapter has tries to provide information on the methodologies and tools to identify and assess the sensitivity, adaptive capacity, and risk of identified climate change impacts in Africa. The impacts of climate change including changes in temperature, precipitation and sea levels are expected to have severe consequences on food security, human health and economic development. Unfortunately this will affect the attainment of the Millennium Development Goals. Africa is highly vulnerable to climate change on account of its large rural population that remains highly dependent on rain-fed agriculture and on natural resource-based economy. The actions we take today will determine the climate of tomorrow. By choosing to take action now, we can limit the future damage. The alternative is an environmental, economic and humanitarian catastrophe of our own making. There are two types of response available to us:. The first involves reducing emissions of greenhouse gases to slow or stop the process of climate change, a process called MITIGATION. The second, known as ADAPTATION, is learning to cope with the impacts of climate change.

Chapter 4:

ADAPTING TO CLIMATE CHANGE IN AFRICA

In summary, the questions the chapter seems to respond to include:-

- *The existing tools methodologies including literature to support practitioners asses current situation in relation to adaptation.*
- *Options for adapting to climate change*

4.0 Introduction

In general terms, climate change is expected to create worldwide risks and opportunities. Adaptation planning opens avenue for people at national and local levels to make use of opportunities and minimize the risks. Poor people living in developing countries are more exposed to the negative impacts of climate change than in developed countries. Considering that vulnerability is a function of the exposure to climate variability, impacts and adaptive capacity of the affected community, it is usually the poor whose livelihoods largely depend on sensitive sectors that are most vulnerable.

Climate change has the potential to affect development activities in Africa and can jeopardize the achievements of the MDGs. In this regard adaptation to climate change will involve climate proofing development as well as reducing vulnerability of the poor by building their adaptive capacity. These objectives can only be achieved through adopting an innovative approach that builds on existing experiences and knowledge.

An important first step to ensuring climate resilient development is to anticipate risks arising from climatic variability and change while designing the development project –this can produce a more robust project that will cope adequately with future climatic changes. For example a road that is designed to withstand an extreme floods events that historically used to occur every 20 years must be designed in a way that it can withstand a flood that could occur more frequently and with more intensity.

This chapter on adaptation to climate change emphasizes the fact that adaptation is a priority for Africa and attempts to identify existing tools, methodologies and literature available to assess a country's current situation in relation to adaptation and furthermore to assist practitioners identify appropriate actions in relation to adapting to climate change

4.1 Types of Adaptation

Adaptation refers to changes in processes, practices, and structures to moderate potential damages or to benefit from opportunities associated with climate change. Adapting to climate change entails taking the right measures to reduce the negative effects of climate change (or exploit the positive ones) by making the appropriate adjustments and changes" (UNFCCC, 2007). Adaptation therefore aims at reducing vulnerability to climatic change and vulnerability of communities, regions, and nations to climate variability, and in promoting sustainable development (IPCC, 2001). Adaptation varies in both spartial (global, regional, national and local) and temporal scales with options and opportunities ranging from structural to technological to behavioural changes. With respect to time scale, adaptation interventions can be short-, or long- term, localized or widespread, and it can serve various functions and take numerous forms(IPCC, 2007).

Various types of adaptation can be distinguished depending on its timing, goal and motive of its implementation (c.f. Carter et al., 1994; Stakhiv, 1994; Bijlsma et al., 1996; UNEP, 1998; Leary, 1999; Smit et al., 1999; Bryant et al., 2000; Reilly and Schimmelpfennig, 2000; IPCC, 2001). These types (according to IPCC, 2001) include; anticipatory,/proactive, reactive, autonomous and planned, private and public adaptations.

i. **Anticipatory adaptation**; adaptation that takes place before impacts of climate change are observed. This type is also referred to as proactive adaptation.

ii. **Reactive adaptation**; reactive adaptation takes place after the initial impacts of climate change have occurred. Unlike planned adaptation which takes place prior to the events, the reactive adaptation is triggered by the events and starts after the impacts have been felt.

iii. **Autonomous adaptation**; adaptation that does not constitute a conscious response to climatic stimuli but is triggered by ecological changes in natural systems and by market or welfare changes in human systems. Also referred to as spontaneous adaptation, (IPCC, 2007). This adaptation involves changes that systems will undergo in response to changing climate, irrespective of any policy, plan or decision. It can be represented by the reaction of, for example, a household to a reduced water supply by storing water or by economizing its use. Natural systems such as plant communities usually develop autonomous adaptation i.e. adapt reactively,

iv. **Planned adaptation;** according to the IPCC, 2007, is defined as "the result of a deliberate policy decision, based on awareness that conditions have changed or are about to change and that action is required to return to, maintain, or achieve a desired state. It involves policy measures and strategies that aim at building the adaptive capacity across systems and sectors such as the use of a new drought-resistant crop variety or adopting agroforestry approaches (Ardö, J., Beshir, E., 2007). Managing climate change related risks requires the development and implementation of planned adaptation initiatives, the outcome of which must be assessed and systematically evaluated. Planned adaptation can be considered as more effective and less costly than reactive adaptation since the last will act on e.g. reclaiming the damage/retrofitting, while the former aims at minimizing the potential impacts. Long term benefits can also be gained from planned adaptation such as the increasing water availability due to the construction of water reservoirs and improving environment and air quality as a result of expanding green areas and shelterbelts

Another categorization for both the reactive and planned adaptation is based on the actors who fund,/ develop the measures, as either (a) the private or (b) public adaptation.

- Public adaptation is normally initiated by government and aid organizations. Examples are the installation of flood barriers or the issuance of new building standards (planned) and distribution of relief aids to drought-impacted communities (reactive).
- Private anticipatory adaptations may include, for example, modifying the farm practices – changing the crop type or migrating to urban areas.

4.2 Adaptation Requirements

The potential, capability, or ability of a system to adapt to climate change stimuli or their effects or impacts is referred to as adaptive capacity (IPCC, 2001). Adaptive capacity greatly influences the vulnerability of communities and regions to climate change effects and hazards (Bohle et al., 1994; Downing et al., 1999; Kelly and Adger, 1999; Kates, 2000). Building adaptive capacity is an essential step to ensure lasting adaptation. In this respect, adaptation should be seen as a process and not a one time action, particularly as climate is continuously changing and climate variability is expected to increase in frequency and intensity with increasing climate change (IPCC, 2007).

Existing adaptation strategies may not work under future changes and consequently more work on adaptation preparedness would be required. According to ILRI, (2006) increasing efforts are needed if adaptation is to be seen as a dynamic, continuous and non-linear process.

Improved forecasts and early warning systems are increasingly being recognized among the basic requirements for adaptation, particularly to prevent the damaging effects of floods and increasing droughts and tropical cyclones (Tarhule, A., Lamb, P.J., 2003). They can also be useful in predicting disease outbreaks in epidemic prone areas (Kovats et al., 2000). For example a study by Githeko and Ndegwa (2001), using the information of Climate Outlook Forums (COF) to identify climate risks associated with malaria in the western Kenya Highlands indicated that malaria epidemics could be forecasted two to three months before they occur. Prediction can also be made of ENSO onsets and these can feed into the modeling exercises for disease outbreaks (Hales et al., 2003).

Other requirements for adaptation include the creation of awareness on climate change at different levels and scales- from policy makers to communities. Moreover, education and research are key to building adaptive capacity, particularly if linked to practice through extension. The importance of linking research to policy- making is particularly being emphasized along with the need to incorporate the local knowledge on coping strategies and practices (Huq and Reid, 2005).

Improving communication between research communities and users is a pre-requisite for an effective adaptation strategy. Moreover, it is important to identify mechanisms for ensuring the adoption and incorporation of climate information including forecasts into the livelihood strategies of different stakeholder groups (Washington et al., 2004). A number of research studies Hamadalla, 2011; Sewell and Smith, 2004) highlighted the need for improving the format and content of the rainfall forecast messages and to communicate them in a way that ensures their timely use by people in Africa, particularly those living in the disaster prone areas (floods and droughts).

4.2.1 Institutional requirements

The Intergovernmental Panel on Climate Change (IPCC, 2001) recognizes the dynamic social, economic, technological, biophysical, and political context through which adaptation to climate change takes place. These dynamics varies over time, location, and sector and they determine the capacity of systems to adapt. Institutions are described “as a means for holding society together, giving it sense and purpose and enabling it to adapt” (O’Riordan and Jordan, 1999). In order to reduce vulnerability institutional arrangements are important in enhancing entitlement and access to resources for adaptation. Within the society or a community, the need for a strong institutional arrangement is a perquisite to enhancing adaptive capacity. Smith and Lenhart (1996) generalized that; countries with well-developed social institutions are considered to have greater adaptive capacity than those with less effective institutional arrangements commonly, developing nations and those in transition.

Institutions help to create information and conditions as well as taking steps that will help to reduce vulnerability to climate risks or to exploit opportunities (c.f. UKCIP, 2005; Stern, 2006). Governments, as institutions have an important potential role in helping people to build their adaptive capacity through strengthening adaptation. Some of the measures necessary for strengthening adaptation as adopted from Sperling (2003) include; ensuring access to high-quality information about the impacts of climate change and carrying out vulnerability assessments, increasing the resilience of livelihoods and infrastructure, improving governance, empowering communities,integrating climate change impacts in issues in all national, sub-national and sectoral planning processes and macro-economic projections as well as encouraging a core ministry with a broad mandate, such as finance, economics or planning, to be fully involved in mainstreaming adaptation.

4.2.2 Financial requirements

Estimating the costs of adaptation in Africa is a challenging exercise and the existing literature provides a wide range of estimates. These differences are attributed to the variations across the different projections and levels generated by various climate change scenarios, and different hypothetical periods assumed for adaptation to take place and the different methodologies used to assess the costs. These factors make it difficult to arrive at a concrete figure on the cost of adaptation. However, and though some may argue that it is not necessary to have an exact figure before we start funding adaptation initiatives in Africa, nonetheless, an estimation of the future financial requirements for Africa is key to grant mobilization of sufficient resources. Two types of approaches have been conduced so far to estimate adaptation cost (1) A top down' approach which develops regional/national estimates for the costs of adaptation based on aggregate information and (2) A bottom-up approach which is typically less holistic in scope, but has improved accuracy through implementing case studies.

The Bottom-up analysis can provide important additional insights to top-down results. It provides more detailed information regarding different adaptation aspects taking into consideration different sectors or localities and associated socioeconomic specificities of each are/region or sector of the economy. As such it can give better indication as to which area/sector should funds be directed. It is also possible using these bottom-up approaches to extrapolate some of the results from these studies to estimate regional economy-wide adaptation costs, although such analyses are unlikely to be reliable in isolation and are more useful to supplement and guide top-down approaches (World Bank, 2010); Watkiss et al. , 2010.

One of the major constraints to costing adaptation in Africa is the disagreement on how to separate development spending from adaptation spending. Considering the state of development across the different sectors in Africa, it is difficult to decide where development ends and where adaptation starts.

The most recent studies by the World Bank, 2010, suggest adaptation costs in Africa in the region of US$ 20-30 billion per annum over the next 10 to 20 years. However, as indicated above, there is considerable uncertainty around these figures. This compares with a cumulative total of US$ 350m of adaptation funding approved for spending in Africa to date, of which approximately US$ 130m has been received. As a percentage of GDP, Africa's adaptation estimates are higher than in any other region of the world at around 1.3-1.4% (with Sub-Saharan Africa at 1.7-1.8% of GDP). This confirms a similar ranking provided by Agrawala et al., 2010, who present regional adaptation cost curves plotting the proportion of climate damages that are avoided by adaptation and the proportion of GDP that must be spent to avoid these damages. These show Sub-Saharan African and the Indian sub-continent as having the greatest adaptation needs relative to GDP.

4.2.3 Physical and infrastructure requirements

In spite of the fact that climate change is a global phenomenon, its impacts are already being felt by local communities in different parts of the world. The poor state of infrastructure in most African countries is widely known as one of the major factors increasing the vulnerability of the continent. Poor infrastructure is negatively impacting basic needs for the African citizen including, clean water, energy, health, education, access to markets and investment. Projected increases in the magnitude and frequency of extreme events if coupled with underlying infrastructure vulnerability in hazard prone zones, will lead to multiplication of human and infrastructure vulnerability to damages and losses in the future. Access to infrastructure services is crucial to facilitate economic growth and poverty alleviation particularly in poor low-income countries. Efficient infrastructure and services are therefore crucial to Africa's integration and development.

The challenge to develop infrastructure in Africa is huge specially when recognizing that only 13% of the world's infrastructure stock in 2003 was allocated to low income countries; hosting 39% of the world's population. Low-income countries are the ones with largest infrastructure investment needs, around 7%

of their GDP annually from 2005-2010. Moreover, it is expected that Sub-Saharan Africa will need around 5.5% of its annual GDP for development of new infrastructure and maintenance of existing ones (Table 1). This will total up over the next 10 years, to reach over US $250 billion representing the total Africa's infrastructure investment needs in a decade (Griffith et al.,). Furthermore, if Africa is to reach the MDGs by 2015, its average growth rates should grow by more than 7% for the next 10 years- equivalent to US $40 billion between 2005 and 2015 (Estache, 2006).

Table 4.1: Expected annual infrastructure investment needs, 2005-2010[15]

	(new infrastructure &maintenance of existing ones)US$ Mn	%GDP
Middle East and N. Africa	*28,184*	*4.5*
Sub-Sahara Africa	*25,912*	*5.5*
All developing countries	*464,793*	*5.4*

Adapted from Fay and Yepes, 2003

4.2.4 Social requirements

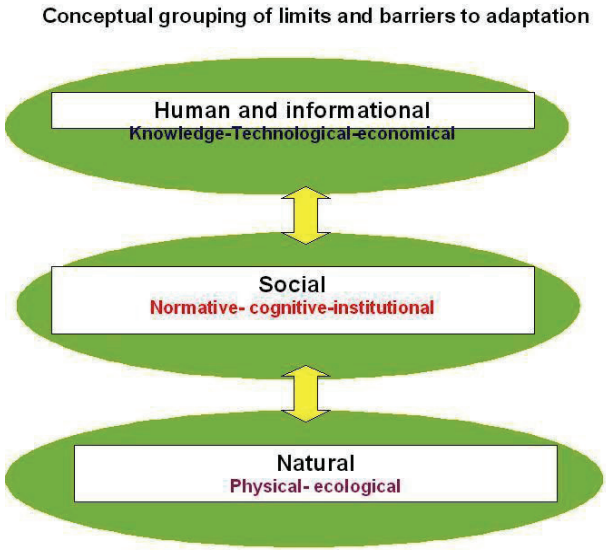
Societies who are most vulnerable to potential impacts of climate change are the ones that should be targeted by adaptation actions to make sure that they are equipped enough to adapt to any threatening impacts and will be able to take advantage of any emerging opportunities. Enhancing climate resilience and social adaptation including capacity building will likely increase the overall cost of adaptation leading to a central benchmark for Africa of around $30 billion/year by the year 2030(WB, 2010). Social institutions are diverse in nature,and can be seen in the form of local farmer collectives, indigenous knowledge institutions, or collective ownership rights to forest resources

Social barriers to adaptation include certain social and cultural processes that govern the means and extent to which people can react to present climate variability and change. The IPCC highlighted that, to date, 'social and cultural limits to adaptation are not well researched', noting the little attention within the climate change literature devoted to addressing social limitations thus far (IPCC, 2007).

This is an important basis with respect to the organisation and structure of social institutions. Institutions in this context are taken to represent the 'rules of behaviour' that govern belief systems, norms and behaviour, and organisational structure (Figure 4.1).

15 Table 4.1 shows the annual needs for new infrastructure investment and maintenance for the period 2005-2010 in MENA and Sub Sahara Africa compared to all other developing countries using estimated annual world growth rate of 2.7% of GDP.

Figure 4.1: Conceptual grouping of limits and barriers to adaptation



Social barriers are made up of various processes relating to cognitive (awareness, perception, reasoning, and judgment) and normative (behavioural) restrictions that prevent individuals or groups from seeking the most appropriate forms of adaptation (see Figure 4.2).

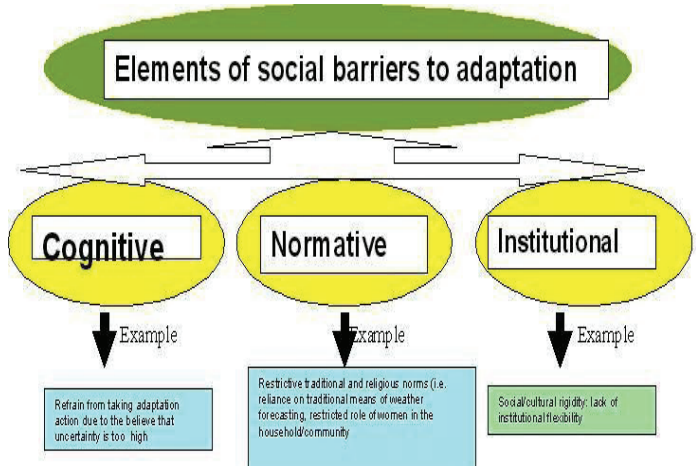


Figure 4.2: Elements of social barriers to adaptation

4.3 Adaptation Options

4.3.1: Assessment of adaptation options

Assessment of the adaptation options are based on Decision Tools that assist analysts in making choices between adaptation options. Some of these tools rely on a single monetary metric and focus on a single decision criterion (e.g., benefit-cost analysis, cost-effectiveness). Others enable the user to use Multi-Criteria Analysis (MCA, see Boxes below, UNFCCC, 2008)) by defining and incorporating more than one such decision criterion (e.g., Adaptation Decision Matrix). Other tools are more generally aimed at

supporting decision and policy makers who are faced with identifying and appraising the selection and implementation of adaptation measures, taking into account the institutions involved and affected when pursuing given adaptation options (UNFCCC, 2008).

Table 4.2a: MULTICRITERIA ANALYSIS (MCA) (UNFCCC, 2008)

Description	MCA describes any structured approach used to determine overall preferences among alternative options, where the options accomplish several objectives. In MCA, desirable objectives are specified and corresponding attributes or indicators are identified. The actual measurement of indicators need not be in monetary terms, but are often based on the quantitative analysis (through scoring, ranking and weighting) of a wide range of qualitative impact categories and criteria. Different environmental and social indicators may be developed side by side with economic costs and benefits. Explicit recognition is given to the fact that a variety of both monetary and non-monetary objectives may influence policy decisions. MCA provides techniques for comparing and ranking different outcomes, even though a variety of indictors are used. MCA includes a range of related techniques, some of which follow this entry.
Appropriate Use	Multi-criteria analysis or multi-objective decision making is a type of decision analysis tool that is particularly applicable to cases where a single-criterion approach (such as cost-benefit analysis) falls short, especially where significant environmental and social impacts cannot be assigned monetary values. MCA allows decision makers to include a full range of social, environmental, technical, economic, and financial criteria.
Scope	All regions, all sectors.
Key Output	A single most preferred option, ranked options, short list of options for further appraisal, or characterization of acceptable or unacceptable possibilities.
Key Input	Criteria of evaluation as well as relevant metrics for those criteria.
Ease of Use	Depends on the particular MCA tool employed. All rely on the exercise of some expert judgment.
Training Required	Choice and application of appropriate MCA technique require some expertise, but can be acquired fairly easily.
Training Available	The United Kingdom Department for Transport Local Government and the Regions (see Documentation) provides nontechnical descriptions of MCA techniques, potential areas of application, and criteria for choosing between different techniques, and sets out the stages involved in carrying out MCA.
Computer Requirements	Personal computer.
Documentation	DEFRA, 2003: Use of multi-criteria analysis in air quality policy: A Report. DTLR, 2001: Multi Criteria Analysis: A Manual. ETR, 1999: Review of Technical Guidance on Environmental Appraisal: A Report by Economics for the Environment Consultancy (http://www.defra.gov.uk/environment/economics/rtgea/8.htm).
Applications	World Commission on Dams. Integrated Decision Making Framework. (http://www.dams.org/report/contents.htm). World Conservation Union Office for West Africa. Sustainable Development Planning Process (http://www.iucn.org/themes/wetlands/). Tyndall Center for Climate Change Research. Framework for Carbon Mitigation Projects (http://www.tyndall.ac.uk/publications/working_papers/wp29.pdf).

Contacts for Framework, Documentation, Technical Assistance	For general information and contact information for sources of assistance for particular tools: Stratus Consulting, P.O. Box 4059, Boulder CO 80306; Tel: +1.303.381.8000; Fax: 303.381.8200; e-mail: jsmith@stratusconsulting.com.
Cost	Depends on particular MCA tool applied, but in general is inexpensive.
References	Bell, M.L., B.F. Hobbs and H. Ellis, 2003: The use of multi-criteria decision-making methods in the integrated assessment of climate change; Implications for IA practitioners, Socio-Economic Planning Sciences 37(4):289-316. Hamalainen, R.P., R. Karjalainen, 1992: Decision support for risk analysis in energy policy. European Journal of Operational Research 56:172-183. Jones, M., C. Hope, and R. Hughes, 1990: A multi-attribute value model for the study of UK energy policy. Journal of the Operational Research Society 41:919-929 Pearman, A.D., P.J. Mackie, A.D. May, and D. Simon, 1989: The use of multi-criteria techniques to rank highway investment proposals In Improving Decision Making in Organisations; A.G. Lockett and G. Islei (eds.); Springer Verlag, Berlin, pp. 158-165.

Table 4.2b: Adaptation Decision Matrix (ADM)

Description	The ADM uses multi-criteria assessment techniques to evaluate the relative effectiveness and costs of adaptation options. Users are asked to specify criteria that will be used to evaluate options and weight the criteria. Scenarios of current climate and climate change can also be used. Users are asked to give a score (e.g., 0 to 5) on how well each criterion is met under a particular scenario for each option. The scoring can be based on detailed analysis or expert judgment. Scores can be multiplied by weights and summed up to estimate which options best meet the criteria. The scores can be compared to relative costs to assess cost-effectiveness.
Appropriate Use	This approach is useful when many important benefits of meeting policy objectives cannot be easily monetized or expressed in a common metric. However, detailed research and analysis are needed to provide a basis for the evaluation; otherwise the scoring may be mainly subjective.
Scope	All locations; all sectors; national or site-specific.
Key Output	Relative cost-effectiveness of alternative adaptation measures.
Key Input	A ranking of how well policy objectives are met using alternative strategies; estimated costs of adaptation measures.
Ease of Use	Relatively easy to apply; more rigorous results require more analysis; only basic computer skills are needed.
Training Required	A user with an understanding of key policy objectives could achieve proficiency in 1 to 2 days; however, additional training may be required to develop skill in estimating costs of adaptation measures.
Training Available	Contact Stratus Consulting for more information (see Contacts below).
Computer Requirements	IBM-compatible 286; Lotus 1-2-3 or Excel spreadsheet software helpful.
Documentation	Benioff, R. and J. Warren (eds.) 1996: Steps in Preparing Climate Change Action Plans; A Handbook, Washington, DC, U.S. Country Studies Program, USCSP, 1999- Climate Change: Mitigation, Vulnerability, and Adaptation in Developing Countries, U.S. Country Studies Program, Washington, DC

Applications	Used by participants in the U.S. Country Studies and UNEP assistance programs (e.g., Kazakhstan, Cameroon, Uruguay, Bolivia, Antigua, Estonia, Pakistan and Barbuda).
Contacts for Tools, Documentation, Technical Assistance	Joel Smith, Stratus Consulting, P.O. Box 4059, Boulder, CO 80306 USA; Tel: +1.303.381.8000; Fax: +1.303.381.8200; e-mail: jsmith@stratusconsulting.com; website: http://www.stratusconsulting.com/.
Cost	No cost for documentation or diskette with template of the decision matrix.
References	Mizina, S.V., J.B. Smith, E. Gossen, K.F. Spiecker, and S.L. Witkowski, 1999: An evaluation of adaptation options for climate change impacts on agriculture in Kazakhstan. Mitigation and Adaptation Strategies for Global Climate Change 4:25-41.

Table 4.2c: Screening of Adaptation Options

Description	This matrix-based decision-making tool sets up a series of criteria that allow the user to narrow the list of appropriate adaptation measures. The user sets up a table with evaluation criteria across the top: Will the measure target a high-priority area? Will it address targets of opportunity? Is it likely to be effective? Will it generate other benefits (e.g., economic, environmental)? Is it inexpensive? Is it feasible? The user can insert or substitute other criteria if they are more appropriate. The user then evaluates each measure against these criteria, entering a simple "yes" or "no" in the cells. This tool is frequently combined with expert judgment.
Appropriate Use	This is a useful tool at the beginning of the decision-making process, allowing the user to create a manageable although possibly subjective list of options, which can then be analyzed more rigorously.
Scope	All locations; all sectors; national or site-specific.
Key Output	A simple matrix, clearly showing the strengths and weaknesses of a wide range of options.
Key Input	Basic summary information about options under consideration.
Ease of Use	Depends on specific application.
Training Required	Requires background knowledge of both the options and the climate change issue being addressed.
Training Available	Contact Stratus Consulting for more information (see below).
Computer Requirements	IBM-compatible 286; Lotus 1-2-3 or Excel spreadsheet software helpful.
Documentation	Benioff, R. and J. Warren (eds.) 1996: Steps in Preparing Climate Change Action Plans; A Handbook, U.S. Country Studies Program, Washington, DC, USCSP, 1999; Climate Change-Mitigation, Vulnerability, and Adaptation in Developing Countries, U.S. Country Studies Program, Washington, DC
Applications	Used by several participants in the U.S. Country Studies and UNEP assistance programs (e.g., Kazakhstan, Cameroon, Uruguay, Bolivia, Antigua, Barbuda, Estonia, and Pakistan).
Contacts for Tools, Documentation, Technical Assistance	Joel Smith, Stratus Consulting, P.O. Box 4059, Boulder, CO 80306; Tel: +1.303.381.8000; Fax: +1.303.381.8200; e-mail: jsmith@stratusconsulting.com; website: http://www.stratusconsulting.com/.
Cost	No cost to obtain documentation or diskette with template of the decision matrix.
References	Mizina, S.V., J.B. Smith, E. Gossen, K.F. Spiecker, and S.L. Witkowski, 1999: An evaluation of adaptation options for climate change impacts on agriculture in Kazakhstan; Mitigation and Adaptation Strategies for Global Climate Change 4:25-41.

4.3.2: Sectoral adaptation options in Africa

4.3.2.1 Water resources

For the water resources sector the following adaptation activities have been implemented in Africa

Rainwater harvesting

Develop necessary skills and knowledge on water harvesting techniques at different levels from community to household (Box 4.1 below). Water harvesting and moisture conservation (through construction of rainwater control and management structures and conservation agriculture or) and rainwater storage (in farm ponds, water pans, sand/sub-surface dams, earth dams, tanks, etc.) are gaining prominence as viable techniques providing supplemental irrigation. Farmers are adopting a variety of innovative rainfall harvesting mechanisms (RHM) to cope with recurrent droughts (Ngigi et al., 2008).

Boxes 4.1 and 4.2 below show typical case studies in Seychelles and Togo respectively.

Box 4.1: Demonstration and Promotion of Rainwater Harvesting as a viable climate change adaptation option in Seychelles

Seychelles has two seasons, a rainy and a dry season. During the rainy seasons, when rain is in abundance, most of it is lost through run-offs. And during the dry season, water is scarce and what has been collected for distribution is usually not enough to meet consumption demand. Due to climate change and increased climate variability, the country is experiencing extreme low rainfall during the dry season, whereas the rainy seasons often are extremely wet. Moreover, due to increased economic and social development, as well as population growth, the demand for water consumption has increased tremendously. Water shortage during the dry season, has therefore become an environmental, social and economic problem. The Case Study demonstrated the use of rainwater harvesting as climate change adaptation measure to collect and store water and use it for watering school garden, clean ups and toilets. Cleaner water from utilities is reserved and conserved for human consumption.

In this demonstration, the Environment Education Unit of the Ministry of Education partnered with Schools, Eco-School Committees and the Water and Sewage Division in the Public Utility Cooperation and: Procured and installed rainwater harvesting equipment and infrastructure in eight (8) schools, Trained school teachers on climate change and on rainwater harvesting techniques and technologies Conducted rainwater harvesting in schools to educated the school children on the impact of climate change on water sources and the use of rainwater harvesting as climate change adaptation measure, meet their needs and to reduce the cost of their water bills, and to share the schools' experience on water harvesting with other organizations;



Training of Teachers Installed Rainwater Tank School Children with Model Measure saves money. The success of the project in the schools has inspired consideration of the institutionalization of rainwater harvesting in government institutions and communities. (*Source: Final Technical Report 2010 – Seychelles/CC DARE Rainwater Harvesting Project)*

BOX 4.2 & 4.3: Rehabilitation of water reservoirs in the Savannas Region to enhance climate change resilience and livelihoods particularly for the benefit of women and youth groups

Togo, like many countries in sub-Saharan Africa, has an agrarian economy that is essentially climate dependent. Reduced rainfall in northern Togo since the late 1960s has reduced water availability and water levels of the water reservoirs that were established in northern Togo. Climate change is projected to lead to more water stress in this area. Building resilience of communities and ecosystems and enhancing livelihoods in this zone under a changing climate has become urgent. The Department of Village Water Supply of Togo, Civil Society Organizations and communities in the Savanne Region of Togo partnered to access funds from the CC DARE Programme and implement the following activities to enhance adaptive capacity in the region. Enhanced the knowledge and capacities of the staff of the Department and communities of the District of Savannes in Northern Togo on climate change risks and measures to adapt to the risks. Forged partnership between the Department of Water Resources, Private Construction Company and the Local Government and Communities of Savannes District and ;1-Rehabilitated two Water Reservoirs (Damone and Timbou) in the Savannes District of Togo 2- Water storage capacities increased from 9,000 to 24,000 M3 of water at Damone Reservoir and from 50,000 to 70,000 M3 of water at Timbou Reservoir

Degraded Reservoir

Rehabilitation works

Rehabilitated Reservoir

4.3:

Healthy Watershed

Happy Community

Water is Life: Water is available to the communities of Damone and Timbou all year round reducing migration of the communities and livestock in search of water during the dry season and the consequential conflicts; Conflict during the search for water and pasture has been reduced Availability of water has injected vigour in the livelihood activities such as fishing, horticulture and animal husbandry Climate change resilience of the population and ecosystems have been enhanced with continued and effective management of the reservoirs Communities have put in place management committees, policies, regulations to conserve the water and maintain hygiene.

The promotion of an integrated water management approach will be needed in dry parts of sub-Sahara Africa. This is particularly required for smallholder farming systems. The use of an integrated water

management approach involves the encouragement of people to economize the use of water and ensures an appropriate division of water between the different economic sectors.

4.3.2.2 Coastal zones (adaptation to sea level rise) and marine ecosystem

As part of the recently increased efforts to address outcomes of climate change, different countries in Africa have been working to develop adaptation strategies and intervention methods to offset the impacts spanning across from community to national levels. Experiences and knowledge on adaptation strategies derived from this progression from planning to implementation is steadily accumulating, however, there exist a number of constraints that still impede the development and instigation of suitable and sustainable approaches, methods and intervention strategies. These include a) weak or limited capacity within and between national agencies; b) vulnerable communities largely incapable of developing coping mechanisms and strategies for adaptation and disaster/risk management; c) limited implementation of integrated coastal management as an tool for adaptive management in a changing environment; d) lack of tools and systems to enable appropriate planning and implementation of climate change adaptation; and e) inadequate information to inform policy on adaptation and sustainable development options.

Adaptation options for coastal zones and marine ecosystems

Adaptation options for coastal and marine climate change in Africa need to focus on conservation responses to increase resilience of coastal and marine ecosystems as well as strengthen adaptive capacity of coastal communities. In this regard, adaptation to climate change in coastal zones and marine ecosystems will the following key objectives:

i. **Enhancing the resilience of coastal zones and marine ecosystems against climate change and variability.**

   African countries need to adopt measures to reduce vulnerabilities and build resilience to the impacts of climate change, including measures for enhancing the protection of critical habitats from anthropogenic alteration and sustainable exploitation. This could include strategies such as those aiming at protecting mangroves through evaluating potential for payments to coastal resource users for mangrove conservation and restoration financed by carbon markets (REDD+ scheme).

ii. **Improving the understanding of climate change.**

   Better understanding of climate change and variability is needed to inform local, national and regional responses. In addition to enhancing capacity for generating, analyzing and managing climate related data sets relevant to coastal and marine environment, it is essential the following are also undertaken:

   - Development of a long-term monitoring and a network of coastal surface ocean observatories using in-situ loggers, weather stations and satellite products to understand the regional seasonal and inter-annual variability of the major marine ecosystems
   - Development of an Early Warning System for extreme events (storms, floods, and drought), critical ecosystems (coral reefs, mangroves, wetlands), and focus on specialized topics such as invasive species, pests, and disease.

iii. **Strengthening of Governance and decision-making processes.**

   Countries have responsibilities for addressing the risks and effects of climate change in the context of their national sustainable development strategies. Here are some of the strategies geared towards strengthening legal, policy and institutional frameworks for addressing the risks and impacts of climate change impacts:

- **Increasing social resilience**. In addition to efforts to increase adaptive capacity through improved livelihoods, resources should be directed towards the development and implementation of disaster risk management plans, ideally, integrated with other adaptation responses.
- For islands and low lying coastal areas, countries should begin to analyze requirements for migration and relocation, including required changes in land tenure and policy, implications for livelihoods and social and cultural values
- Promote climate-resilient Integrated Coastal Zone Management. Climate vulnerability assessments should be integrated into assessments of non-climate stressors, and climate impacts considered explicitly in identifying and assessing ICZM policies and other actions.
- Enforcement of setback lines. To address beach and shoreline erosion, assess appropriate set-backs for infrastructure and enforcement of construction and design standards on beaches.

iv. Improving awareness

Increased awareness and understanding of risks and impacts of climate change is important particularly at the community level to increase their resilience. Also improving awareness, understanding of and promoting actions on different aspects of ecosystem management and climate change, targeting policy-makers, civil society and the private sector, is essential.

BOX 4.4: Rehabilitation of water reservoirs in the Savannas Region to enhance climate change resilience and livelihoods particularly for the benefit of women and youth groups

The city of Xai-Xai in Mozambique is located in the lowlands of the Limpopo River as it empties into the Indian Ocean. It is highly vulnerable to climate change events, such as floods and soil erosion. These events have destroyed road infrastructure, properties and lives. The severity of the impacts of the climate and climate change events are exacerbated by the lack of urban planning and the spiraling increase in population leading to many unplanned constructions into the city.

The Municipal Council of Xai Xai (Conselho Municipal da Cidade de Xai-Xai) took advantage of the financial and technical support provided by the CC DARE Programme and: Mobilized its citizens, particularly women and youths, for effective participation in community work; Procured materials and equipment; Trained the communities, particularly the youths, on construction and landscaping; Produced soil retaining blocks, acquired and multiplied soil retaining plants and grass species; Constructed and maintained soil erosion and sand stabilization walls landscaped with vetteverd grass and shrubs in the city to serve as adaptation measures to climate change and sea level rise induced erosion and destruction of properties;

Water Erosion Infrastructure Destroyed Construction of Wall. Finished Water The Municipal Council and citizenry of Xai Xai have the tool and capacity to address soil erosion and its consequential damage to infrastructure and personal property as a climate change adaptation measure.

Source: Final Technical Report, 2010 - Mozambique/Xai-Xai City Council/CC DARE Project

4.3.2.3 Biodiversity and ecosystem services

Ecosystems provide many goods and services critical to individuals and societies (Millenium Ecosystem Assessment, 2003). However ecological systems are intrinsically dynamic and are constantly influenced by climate variability, changes in climate have the potential to affect the ecological systems and its associated functions (IPCC, 1997). To ensure continuity of ecosystem functions under a changing climate, conservation and management strategies that maintain and restore biodiversity are important in order to reduce some of the negative impacts from climate change. However, there are rates and magnitude of climate change for which natural adaptation will become increasingly difficult (CBD, 2009).

"The resilience of biodiversity to climate change can be enhanced by reducing non-climatic stresses in combination with conservation, restoration and sustainable management strategies" (CBD, 2009; Devisscher, 2010) provides some of the options to increase the adaptive capacity of species and ecosystems in the face of accelerating climate change, these includes the following;

- Reducing non-climatic stresses, such as pollution, over-exploitation, habitat loss and fragmentation and invasive alien species.
- Wider adoption of conservation and sustainable use practices including through the strengthening of protected area networks.
- Facilitating adaptive management through strengthening monitoring and evaluation systems.
- To maintain and enhancing the ability of ecosystems to absorb and recover from change while maintaining and increasing biodiversity; that is increased ecosystem resilience.
- To accommodate the potential impacts of climate change: considering both gradual change and extreme events (e.g. planning projects and programmes that consider the ensemble of possible future climate scenarios for the specific location, while building socio-institutional and ecological adaptive capacity).
- Successful adaptation requires ecosystem and biodiversity conservation to be integrated with other sectoral and local government management activities (e.g. mainstreaming community-based natural resources management in all sectors)
- To develop the knowledge/evidence base and plan strategically: to effectively plan for an uncertain future, the best available evidence is needed to help social ecological systems adapt (e.g. developing a knowledge management system that will help share up-to-date and credible information among decision-makers and practitioners and promote an open-dialogue to promote social learning and collective generation of knowledge).
- To use adaptive management: to deal with uncertainty using a flexible approach for effective conservation and adaptation planning, based on iterative processes of learning by doing, reviewing, and refining (e.g. considering the dynamic interactions between social and ecological systems, lessons learned, and changes over time in land-use planning processes, both in reserve land and in common land).
- To enhance vulnerability assessments and monitoring systems: to allow evidence to be collated, existing schemes to be strengthened and new requirements incorporated (e.g. introducing programmes to study response of species to climate change (i.e. physiological, behavioral, demographic) into Community Based Natural Resource Management (CBNRM) in order to create awareness, while systematically obtaining data on key indicators of change over continued periods of time).
- The most effective adaptation to the decline of trees and shrubs in semiarid areas is natural

regeneration of local species (IPCC, 2001)

"Without global action to mitigate climate change, both the impacts and adaptation costs will be much larger and so will be the need for richer countries to help the poorer and most exposed countries. The costs of climate change can be reduced through both adaptation and mitigation, but adaptation is the only way to cope with impacts of climate change over the next few decades" (Stern, 2006).

Integrating climate change adaptation into policy processes and decision-making across a range of sectors and scales remains important in order to manage impacts of climate change. Due to higher adaptation cost, Handmer *et al.,* (1999) posit that poorer regions and countries will have difficulty in adapting to climate change, since they lack to wherewithal technical and financial. However developing countries can take advantage of adaptation financing opportunities from developed countries and as agreed in Conference of the Parties to the United National Framework on Climate Change; for example; the Least Developed Country Fund, Special Climate Change Fund and Adaptation Fund (under the Kyoto Protocol).

Agriculture, fisheries, and food security

IPCC reports that impacts of climate change vary between regions but in each situation the regions production system will be affected by either water stress or flooding and/or land degradation. Adaption in agriculture offers multiple benefits for food security and environmental protection. Incentives, policy approaches and institutional mechanisms, including adequate financing, technology and capacity-building support to enable the adoption of these options, could make agriculture a significant part of the solution to the interdependent challenges of climate change and food security in Africa. However, the ability to adapt to climate change has been shown to be intertwined with sustainable development and poverty reduction in both a positive and negative sense (Sathaye et al., 2006).

A range of strategies to climate change agriculture in Africa have been proposed (Downing et al., 1997; IPCC 2007; Gwary 2009; Gwary, 2010).

They include: Planning for irrigation schemes particularly in regions where water supplies are uncertain, should include risk factor for climate change. The most certain aspect of climate change is increased CO_2 concentrations. Efforts to enhance the positive CO_2 responses in new cultivars may be worth the investment in plant breeding and agricultural technology, irrespective of changes in moisture availability. This research and development should be undertaken by national and international research centres.

Education and awareness

Governments, Non Governmental Organizations, Community Based Organizations should work together to raise awareness among the communities and people on the impacts and benefits of climate change and how to cope with such changes when they occur. This can involve the use of different instruments and languages and dilates to reach out to all in the urban, semi-urban and rural areas.

Climate forecasting

One of the important strategies to cope with climate variability in Africa is to use seasonal climate forecasting. Protection against present and future extreme events should be a priority. Drought early warning and preparedness is urgent, building upon the considerable improvements that are already under way in many regions of Africa. Making better use of climate predictions is a key aspect of adaptive strategy Results of analyzed information should be disseminated to farmers by extension agents for their practical use.

Water management

Water is a natural resource vital to plant, animal and human life. Water quality and the availability of fresh water resources are two of the major environmental issues confronting humanity today. Water scarcity and poor water quality threatens public health, food and energy production. Water availability

influences domestic life as well as the development of pastoralism or certain agricultural techniques. In dry lands more than everywhere else, the availability of water is vital requirement. These areas are characterized by high evaporation, and surface waters (rivers and lakes) generally tended to disappear relatively quickly. People therefore have to develop different ways to access underground sources. In the dry lands of Africa adaptation to water shortage have involved many strategies that include among others, rain water harvesting. Rainwater is harvested or captured in water tanks or containers and/ or in depressions within fields or in stream flood plains for domestic use, and agriculture. When used for agriculture it is generally for the production of high value crops such as vegetables and livestock watering. In areas susceptible to flooding, the adaptation strategy is different. Excess water must be drained quickly to avoid crop damages and crop loss as well as to maintain correct water levels for fisheries.

Restoration of degraded lands

In order to restore degraded lands for increased food production, cropping techniques should be improved by stabilizing the soil while enriching them with organic matter. Both plants and animals provide inputs of organic matter to soils. The relative importance of litter and manure as inputs of organic matter for soil improvement varies between cropping systems and spatially within a system. In rural northern Nigeria, some farmers have developed a stable system, which strongly emphasize the use of animal manure on crops. Within a cropping system, manuring practice varies with location. On the traditional farms, the area nearer the household is highly fertilized with organic manure while the more distant fields receive little or no organic matter (Fussell, 1992). Fussell (1992) describes the inevitable need to use inorganic nutrients or organic nutrients from off-farm sources such as wastes from cities to complement farm organic matter in the Sahel. This is been promoted under semi-urban farming in many semi-arid countries in Africa. For example in Western African Savanna 10 ton/ha per year of manure are required for sustainable cropping of millet or sorghum, but in northern Nigeria 2.5 tons/ha per year are sufficient to maintain yields in most areas (FAO, 2007)..

Appropriate soil tillage

During dry years, the land often becomes bare and subject to erosion by wind and water. One important operation involves plowing the bare ground with single furrows up to 25cm deep and 3-10m apart, depending on soil type. The aim is to produce large clods to help resist erosion. Water conservation currently, tillage is seen as appropriate for some objectives, for example to break impervious layers of sub-soil and to incorporate organic matter topsoil. Tillage is the mechanical manipulation of soil to enhance the outcomes from a cropping system.

Diversification of food production

Diversification of crop and animal production enables better utilization of land resources and prevents the over-production of a single product. A piece of land can sustain different plants and animals under mixed farming over long periods since their nutritional needs vary and the resource they remove from the land are complementary. Farmers can be encouraged to meet formally or informally to discuss and develop sustainable cropping practices. Prolonged monoculture should be avoided on the same piece of land and system of rotational crop production should be established to restore soil fertility.

Utilization of improved crop varieties

Various national and International Research Institutes are involved with crop improvement programs. More funds should be allocated for the breeding of crops varieties that are heat and drought tolerance, low-water-use efficiency, and salt tolerance for use in dry lands and flood tolerance for the coastal region. The use of such varieties will enable farmers to diversify and produce profitably even under adverse conditions. Substantial progress is being made through national Research Institutes and International Research Institutes such as ICRISAT and IITA in the provision of such needed crop varieties which are

being distributed through the Africa.

Cropping adjustments

Throughout the world agricultural scientists have devised various means of coping with variability in weather. Fallowing land for water conservation or nutrient conservation or nutrient restoration is an age-old practice of proven value in modern and traditional agriculture. Deep seeding and wide spacing of plant increases the chances of soil moisture being available for seedling establishment and growth. Terracing to reduce run-off and to conserve soil moisture in steep cultivated hillsides or areas are also good cropping practices.

Crop farmers in dry regions make frequent decisions about crops to plant. If rains come early, long-season cultivars are planted to take advantage of their greater yield producing potential. If rains are late or if dry periods kill crops planted early, short-season cultivars of the same crop or a different crop are planted. Management decisions of this type are a normal response to temporal variability in rainfall, whether or not the season turns out to be drought affected.

Establishment of strategic food reserves

Governments and communities should establish strategic food reserves to buffer potential increases in the variations of local and national production. Efforts should also be made to preserve excess fruits and vegetables that are wasted in many African countries due to neglects or lack of facilities for preservation

Alternative economic activities

Farmers can engage themselves in other production activities that are less pruned to variability of weather. Such profitable enterprises now operating are intensive poultry and pig productions as well as rabbit production and animal fattening as well as fish pond fisheries.

Adaptation in forestry

The loss of forest resources is seriously impacting peoples' livelihoods and well-being in Africa, as well as on the incomes of various nations and on the environment. Adaptation and mitigation measures have been developed and in some cases adopted in response to these impacts in Africa. Sustainable forest development in Africa requires integrating livelihood, climate adaptation and mitigation initiatives with forestry, agriculture and other land based activities.

Some forest-related adaptation strategies adopted in Africa include *1)* reliance on forest products

as a buffer to climate-induced crop failure in climatically marginal areas for agriculture (Dube *etal.*, 2001); *2)* decentralization of local governance of resources, for example through the Community Based Natural Resource Management (CBNRM) approach, to promote use of ecosystems goods and services, as opposed to exclusive reliance on agriculture (in climatically marginal areas for agriculture), and *3)* transformation of land use leading to land use shifts, e.g. from livestock farming to game farming as in the case in southern Africa (UNFCCC, 2006).

Energy (energy security)

It is a prerequisite to deal with energy poverty in all efforts to reduce vulnerability of the population and to help them adapt to changing climate. Energy is vital to economic, social and environmental development. Secure and affordable access to energy makes it possible to fulfil basic needs. A sustainable energy system is needed for speeding up the economic and social development process and to reduce the vulnerability of the population by improving their welfare.

Despite, the huge potential of renewable energy in Africa, the energy system is characterized by a dual

structure which highly depends on oil imports on the one hand and on biomass products on the other. Only half of the urban population have access to modern energy and on average, 8% in the rural area. Those characteristics clearly show that the energy system is highly vulnerable and also is environmental unsustainable due mainly to the gap between the pressure on forests for energy purposes and the reforestation process, especially in the Sahel countries.

Meeting the energy needs for development while addressing climate change issues are now majors issues to be considered for reducing economic, social and environmental vulnerability of the population. We all recognize the transversal role of energy which its lack can significantly reduces the ability to operate and expand commercial and social investments.

Therefore, moving towards a more sustainable energy system requires securing the supply and improving the demand side management by meeting a lot of pre-requites like:

Diversification of Energy Sources: no source of energy is a panacea to the energy poverty. Since the energy resources are unevenly distributed among Africa's regions, each country need to see the comparative advantage of its region and to exploit to disposal potential of energy source, solar within the entire continent, geothermal in East, hydroelectricity in Central and West Africa and wind in Small Island and coastal area.

Provision of financial resources for investment: source of funding is essential to realize he huge amount of investment needed in the energy sector. Institutional constraints like inadequate legal framework and lack of good-governance can impede investments. Now a lot funding instruments exist under the area of climate change, but unfortunately Africa has not taken profit of available international climate funds.

Knowledge sharing and technologies transfer: these constitute key factors to provide a basis for the development of best practice for reducing the energy poverty. In this regards the recommendation of the convention and its protocol encouraging developed countries for providing financial, capacity building and technology should be considered.

Tourism

A wide-range of climatic and non-climatic changes will particularly affect the tourism industry in Africa This is mainly because in many African countries, tourism depends to a large extent on natural resources (wildlife sanctuaries, forests biodiversity, water falls coastal beaches, marine life etc.) With its close connections to the environment and climate itself, tourism is considered to be a highly climate-sensitive economic sector. The IPCC has concluded that increases in the frequency or magnitude of certain weather and climate extremes (e.g. heat waves, droughts, floods, tropical cyclones) are likely as a result of projected climate change (IPCC, 2007a[16]). Globally occurring changes that have major bearing on tourism in Africa include:

- The rise in temperatures
- Water shortage,
- Extreme weather conditions and their consequences (storms, flash floods, forest fires)
- Decreasing snow cover and snow reliability
- Coral bleaching
- Loss of biodiversity
- Sea level rises

16 *IPCC, (2007a): Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel* on Climate Change [Solomon, S., Qin, D., Manning, M., Marquis, M., Averyt, K., Tignor, M.B., LeRoy Mil H., (eds.)]. Cambridge University Press.

On the other hand, tourism has the potential to lift people out of poverty through the employment and entrepreneurial opportunities it provides, and the recognition of tourism's role in poverty alleviation has made it a substantial component of the international development and trade agenda (Hall & Coles, 2008). Policy makers should take climate change into account when making decisions regarding investments on tourism infrastructure.

Considering the crucial role of the tourism sector in addressing poverty reduction and development of local livelihoods in many African countries and small islands, it is essential that specific adaptation interventions that involve targeted social, economic and climate responsive policies be developed. Such adaptation interventions include diversifying a tourism portfolio to include less climate sensitive sectors in order to reduce the vulnerability of the country to the anticipated changes in the climate. Provision of incentives to encourage sustainable tourism is equally important. .

Health

Climate change is expected to have direct impacts i.e. through temperature extremes, insufficient rainfall, physical impacts of floods and indirect impacts through impacts on climate sensitive diseases, natural systems, agriculture, human infrastructure and the economy in general on human health. Some of the likely impacts of climate change on health in Africa are discussed in chapter 3.

Droughts in Africa are associated with a lack of access to water supplies for consumption and sanitation, as well as with poor agricultural productivity. Water scarcity will increase for both urban and rural populations in Africa over the next century (Boko *et al.,* 2007). Climate change is expected to bring more frequent and longer droughts to the region. Drought in Africa is always associated with famine and in-migration to urban areas, further stressing urban infrastructure and expanding the poverty rates and populations living in slums. The United Nations Human Settlements Programme (UNHABITAT) defines a slum as an urban area with a lack of basic services (sanitation, potable water, and electricity), substandard housing, overcrowding, unhealthy and hazardous locations, insecure tenure and social exclusion. In general terms, the vulnerability of a population to a health risk depends on the local environmental conditions, the availability and accessibility of material resources, the effectiveness of governance and institutions, the quality of the public health infrastructure and the access to relevant local information on extreme climate events. In sub-Saharan Africa, 71.8% of urban dwellers live in slums, the highest proportion in the world. According to Robinson and Clark (2008) "Africa carries 25% of the world's disease burden yet has only 3 % of the world's health workers and 1 % of the world's economic resources to meet that challenge.

Against this background it is clear that adaptation to climate change is closely linked to issues of sustainable development. Climate change and variability is an additional hindrance and a serious threat to achieving the MGD‟s in Africa. Given its, weak institutions and poor infrastructure responding to the impacts of climate change will be a major challenge for Africa.

Detailed and context specific analysis of the impacts of climate change at , regional, national and local levels is key for Africa, to reduce the negative effects of climate change, ensure efficient adaptation and facilitate access of information to policy-makers and development practitioners.

Risk management and adaptation

Understanding a population's capacity to adapt to new climate conditions is crucial to realistically assessing the potential health and other effects of climate change.

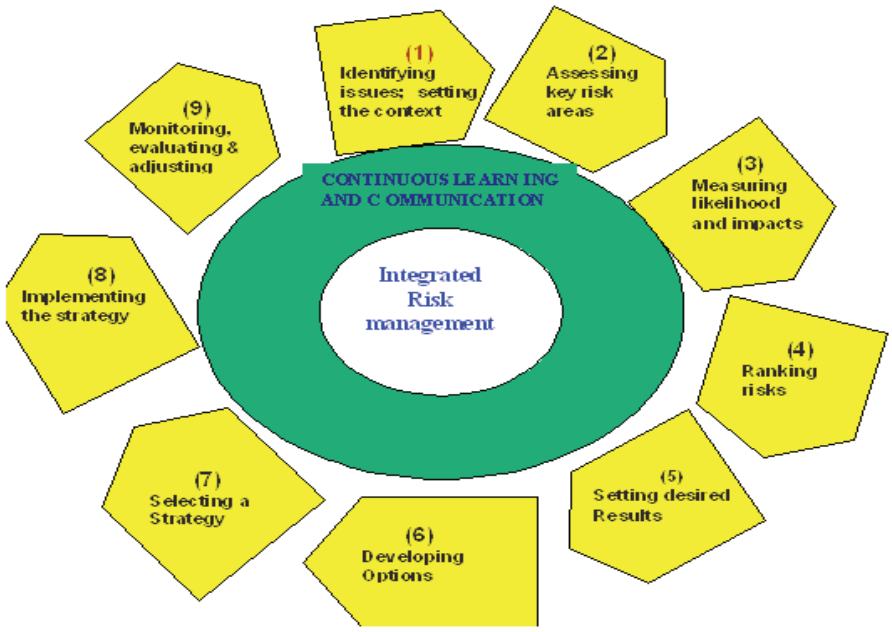
Applying appropriate risk management principles, tools, and measures can reduce current and future vulnerability to climate variability and change. A number of risk management approaches/frameworks

have been developed that can be modified to address national, regional and local assessment needs (Annex 1).

Steps for risk management (see figure 4.3)

- Identifying risks and assessing exposure and response. Risk identification involves evaluating whether a specific exposure is a risk to human health and well-being.
- Once a type of exposure is determined to be a risk such as (floods leading to a water over flows),
- Assessing the exposure and response to determine the consequences of exposure for the health and wellbeing of the impacted population. This involves describing: the magnitude and frequency of the risk; the likelihood of exposure; who is or will be at increased risk of adverse health effects by level of exposure; and what is or will be at risk that could adversely affect health, such as damage to built infrastructure and/or interference with health and social services.
- Assessing existing capacity to identify the strengths and weaknesses of the human and financial resources available to reduce/manage the risks. This might include assessing the ability of public health units, and relief and emergency services
- Assess the ability to cope with risks that increase gradually, such as progressive droughts declining water resources and increasing crop failures.

Figure 4.3: Risk management cycle



Adapted from WHO Guide

.This framework is very crucial for raising awareness and communicating risks, the impacted economic and social sectors to different stakeholders at different levels and scales from local, to regional and national levels. Priorities need to be established for how, by whom, how quickly, to what extent and in which order the risks should and could be reduced. This means that comprehensive and efficient information-gathering and consensus-building is essential. Such comprehensive risk management

plan could contribute to building local adaptive capacity and pave the road for long-term adaptation. Adaptation in health sector includes the strategies, policies and measures undertaken now and in the future to reduce potential adverse health effects. Adaptive capacity describes the general ability of institutions, systems and individuals to adjust to potential damages, to take advantage of opportunities and to cope with the consequences. Examples of adaptation interventions include:

- Effective public warning systems for floods and storm surges such as advice on water use, pavement and evacuation from lowlands
- Broad scale immunization; early warning systems and public information
- Incorporate disaster planning response and into governance systems; engage vulnerable civil society groups in participatory forum to address their vulnerability and identify adaptations to climate impacts; examine existing laws and regulations for opportunities to improve governance and resilience to climate variables – .
- Increased access to primary care and preventive care e.g., mosquito nets, broad spectrum drugs); improved disaster preparation and emergency response.

Human settlements and urbanization -

Cities in Africa, like the rest of the world have begun to adapt to the impacts of climate change via various approaches including effective urban management. These have included, planning and land use controls to prevent people from building in zones at risk of flooding and landslides. For example, restrictions have been instituted on building within 50 year floodplains in South Africa. In other parts of the world, guidelines and regulations, such as a decision issued in 2006 by the Thua Thien Hue provincial authorities in Vietnam to encourage cyclone-resistant building practices, can increase resiliency. Likewise governments can design infrastructure so that it is climate-proof: an example is the US$ 1 billion Confederation Bridge in Canada, which was built one metre higher than current conditions would require, to accommodate anticipated sea-level rise. Likewise local governments can mobilise stakeholders to contribute their technical and even financial resources towards joint endeavours. Such adaptation measures make economic sense. As the IPCC *Report* points out: “The adaptation costs for vulnerable areas are much less than the costs of inaction”

Various local authorities, both rural and urban have begun to implement local adaptation strategies and plans. Adaptation strategies that have been identified include both structural adjustments and institutional tools. Structural changes include the construction of upstream water storage and flood control systems (e.g. dams and reservoirs), levees, and the expansion of the city’s drinking water and sewage systems. Institutional tools include changes in zoning systems and improved governance. Some local governments such as Cape Town and Durban in South Africa are beginning to address both adaptation and mitigation measures (See Box 4.5: Cape Town case study below).

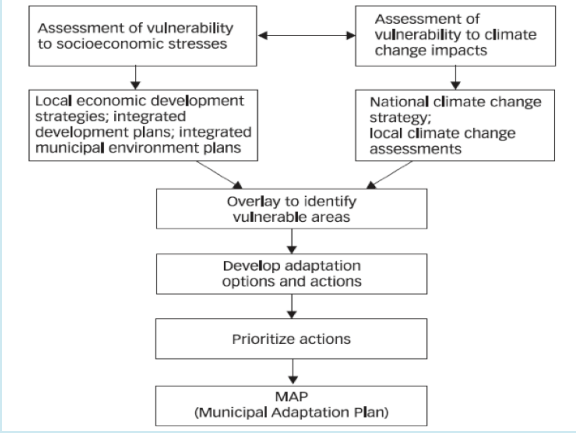
The Cape Town example illustrates how local governments and communities can play an increasing important role in climate change adaptation processes, even when their national governments do not accept or acknowledge the challenges.” Local urban planners can develop a vision for future development that considered climate change’s impact on the local area.

It is necessary to include mitigation measures (reducing energy demand and emissions) as well as adaptation plans, such as improving flood defences. In order to achieve the most effective strategy, it was necessary for urban planners to seek the views of the local community, including businesses and residents. International and national policies also have a role to play in supporting urban and rural areas. These include financial support, reducing bureaucracy and improving awareness and knowledge of climate change and its possible impacts.

Box 4.5: Case study: Developing a Municipal Adaptation Plan in Cape Town

Cities in South Africa have played an active role in planning strategically to respond to climate change. In Cape Town, the process for developing a Municipal Adaptation Plan recognizes that this cannot simply be a linear process, but requires a variety of parallel and interlocking activities (see Flow Chart below). At each stage, these steps are complemented by two cross-cutting processes: *stakeholder engagement and adaptive capacity assessment.*

Flow Chart for the Development of a Municipal Adaptation Plan



Source: Mukheibir P, Ziervogel G (2007) 'Developing a Municipal Action Plan (MAP) for Climate Change: the city of Cape Town' Environment and Urbanization 19(1): 143-158.

In Maputo, Mozambique, taking action to address climate change has resulted in the establishment of institutional mechanisms, the formulation of policies and modification of existing policies, and explicit incorporation of adaptation in projects – some of which are identified in table 4.2 below.

Table 4.3: Specific Adaptation Responses: examples from Maputo, Mozambique

Key Vulnerabilities	Specific Adaptation Responses
Urban Infrastructure and planning	• Improved drainage/storm water system • Development and implementation of urban plans
Housing and Building Codes	• Construction of environmentally sustainable social houses • Development and application of building codes which confer
Water, Sanitation and Health	• Sustainable use and supply of water resources • Provision of basic services to the urban poor • Health education and promotion
Urban Environmental Quality and Green Areas	• Improved solid waste management • Support of urban agriculture development • Protection of green areas and wetlands • Installation of ecological water treatment systems

With regard to adaptation, many of the key interventions require general improvements to the urban fabric, with corresponding benefits for slum upgrading and the provision of water, sanitation,drainage, and transportation. To date, very few climate change adaptation projects have explicitly included these broader social and environmental goals; conversely, very few urban sanitation projects have sought to address climate change. For example, urban planning strategies that enable low-income communities to settle on land that is not exposed to hazards of flooding or landslides can enhance their security of tenure while reducing their vulnerability to climate risks. Similarly, improvements to water supply sanitations that take into account increasing uncertainty in rainfall can also serve to expand water availability to low-income households with wide-ranging health and social benefits.

4.4 Insurance as Climate Change Adaptation Tool

Extreme atmospheric changes and related disasters during the last years (2003, 2004 and 2005) have attracted the global attention to climate change and its likely role in increasing the frequency and intensity of extreme weather events. The IPCC's Fourth Assessment Report confirms that climate change will bring more frequent and more intense extreme weather events. The increase in hazard exposure and in vulnerability; point to a continuing trend of increasing losses due to natural disasters. The losses from the natural associated with natural disasters such as heat waves, droughts, bush fires, tropical and cyclones, tornadoes, hailstorms, floods and storm surges are increasing, a trend that could also be attributed to the increasing concentration of people and economic properties in urban areas and coastal regions, that are particularly exposed to the natural hazards. As climate change drives an increase in the frequency and intensity of natural hazards, the challenges faced by African food-insecure communities struggling to improve their lives and livelihoods will also increase. Building rural resilience against weather-related risk is critical for addressing poverty (IPCC, 2007).

Aware of the challenges, communities at risk, governments, international organizations, industry, and NGOs are trying to explore solutions for preventing/reducing the increasing impacts of these extreme events. One of the solutions is the risk transfer/financial management of natural disaster is getting more attention on the agendas of international financial organizations. The United Nation Framework Convention on Climate Change *Recognizes* the need to strengthen international cooperation and expertise in order to understand and reduce loss and damage associated with the adverse effects of climate change, including impacts related to extreme weather events and slow onset events (Including sea level rise, increasing temperatures, ocean acidification, glacial retreat and related impacts, salinization, land and forest degradation, loss of biodiversity and desertification) (Cancun Agreement, 2010)Decision 1/CP16 FCCC/CP/2010/7/Add.1). Article 4.8 of the UNFCCC, and the supporting Article 3.14 of the Kyoto Protocol, call upon developed countries to consider actions, including insurance, to meet the specific needs and concerns of developing countries in adapting to climate change. Throughout the international climate change negotiations following the Bali Action Plan (UNFCCC, 2007 FCCC/CP/2007/6/Add.1), risk management and insurance were featured prominently in discussions of the Ad Hoc Working Group on Long Term Cooperative Action (AWG-LCA) (UNFCCC, 2008-2011).

4.4.1 Insurance mechanisms and work programs

In Cancun the Conference of the Parties (COP 16) decided to establish a work programme in order to consider approaches to address loss and damage associated with climate change impacts in developing countries that are particularly vulnerable to the adverse effects of climate change to enhance adaptive capacity, and requested its Subsidiary Body for Implementation (SBI) to agree on activities to be

undertaken under the work programme. During the next two years, countries will consider options on how to manage and reduce the climate change risk to developing nations. This includes the possible development of a climate risk insurance facility. It also includes ways to address rehabilitation from the impacts of such climate change-related events as sea-level rise (Cancun Agreement, 2010). At its thirty-fourth session the SBI considered the importance of addressing the following thematic areas in the implementation of the work programme:

a. Assessing the risk of loss and damage associated with the adverse effects of climate change and the current knowledge on the same;

b. A range of approaches to address loss and damage associated with the adverse effects of climate change, including impacts related to extreme weather events and slow onset events, taking into consideration experience at all levels;

c. The role of the Convention in enhancing the implementation of approaches to address loss and damage associated with the adverse effects of climate change. (SBI 34th session FCCC/SBI/2011/L.20).

When dealing with the uncertainties of climate change, reducing vulnerability to today's climate through disaster risk reduction is an excellent method of building adaptive capacity for the future. Communities can be protected from disasters relatively cheaply and there are tools and methodologies that are well developed and can be employed immediately in communities. Thousands of lives could be saved and economic losses prevented each year if more emphasis was placed on this. The disaster risk reduction is therefore considered as a vital component of climate change adaptation (Africa UP in Smoke, 2005). However, so far it is not yet clear within the climate change community how can insurance play an effective role in contributing to adaptation – what are the insurance-related mechanisms that should be considered – more lessons and successful experience need to be brought out to improve the understanding on the role of insurance in adaptation.

4.4.2 . Challenges and opportunities for Africa:

Africa is the hardest hit continent by climate change and has the weakest coping capacity, resources to help Africa manage disaster risk and adaptation to climate change are limited and segmented (APF and NEPAD, 2007). The new SBI work programme (Approaches to address loss and damage) stands as a good opportunity for strengthen resilience of vulnerable and poor communities in Africa. That could be facilitated through a combination of improved resource management(risk reduction), micro-credit ("smart" risk taking), and risk transfer (insurance). As the work programme is still under discussion the continent have the opportunity of selecting what suits the African vulnerable communities

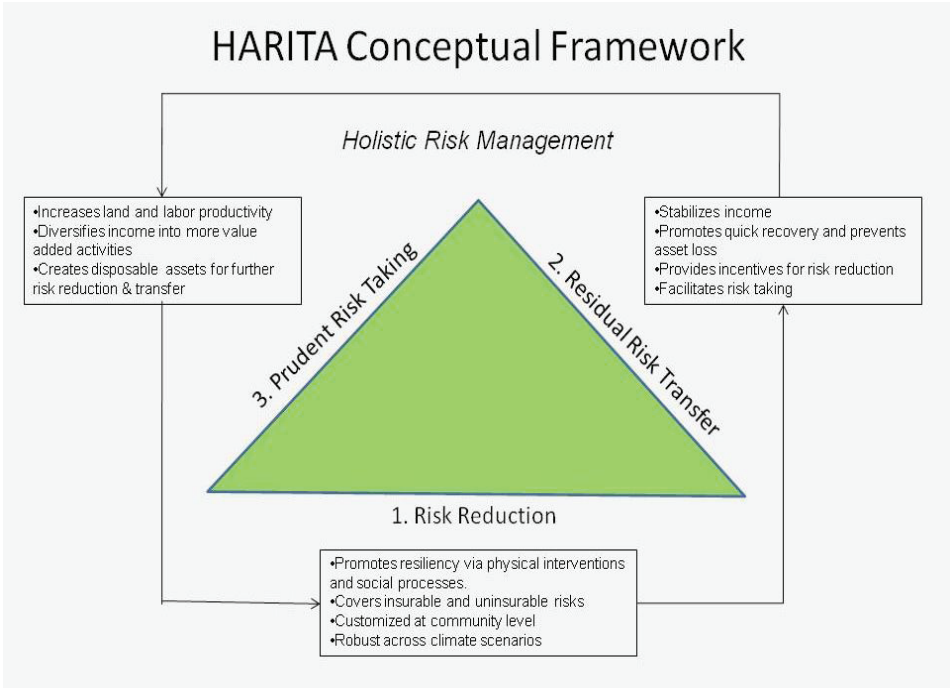
Box 4.6: Kenya index-based livestock insurance (IBLI)

IBLI is piloted among pastoralists in northern Kenya, where insurance markets are effectively absent and uninsured risk exposure is a main cause of poverty. The more than three million people who occupy northern Kenya's arid and semi-arid lands (ASALs) depend overwhelmingly on livestock, which represent the vast majority of household wealth and account for more than two-thirds of average income. Livestock mortality is the most serious economic risk these pastoralist households face. Most livestock mortality is associated with severe drought. In the past 100 years, northern Kenya recorded 28 major droughts, 4 of which occurred in the last 10 years (Adow, 2008). By statistically designing the contract and its underlying index of predicted area-average livestock mortality using longitudinal observations of household-level herd mortality fit to remotely sensed vegetation data. Household-level performance analysis based on simulations finds that IBLI removes 25-40% of total livestock mortality risk.

Insurance and other ex ante risk financing mechanisms form a critical part of a comprehensive disaster risk management strategy, and have the potential to play an important role in disaster risk reduction and climate change adaptation in Africa. Financial products need to be tied to efforts and incentives for investment in risk reduction (Commission on Climate Change and Development, 2008). There are few good examples of the use of micro-insurance for helping climate change vulnerable communities in different parts of Africa. In the Horn of Africa (Ethiopia) a project called the Horn of Africa Risk Transfer for Adaptation (HARITA) is helping the farmers to get access to loan which will be used to purchase farm inputs with the support of and national organisation that provides Agricultural Extension Services for farmers including securing better Market Access (See Fig 6 & Box 2). The MicroEnsure also provide Weather Index Insurance to cover the farmers in the event of crop failure due to drought (HARITA, 2010). MicroEnsure project introduced in the growing season of 2005-2006 its first Weather Index Crop Insurance pilot in Malawi. This product provided protection against crop failure caused by drought or excess rain and enabled farmers to access credit in order to purchase quality seeds and fertilizers in order to maximise output. By linking farms to local weather stations and introducing an automatic payout process farmers were not required to file a claim or go through an expensive loss verification process in the event of crop failure. Following a successful pilot scheme Weather Index Crop Insurance was extended to cover farmers across Africa in Tanzania and Rwanda and Asia in India and the Philippines (*http://www.microensure.com/products-weather.asp*&*http://www.microensure.com/news.asp?id=102*)

These experiences of micro-insurance in Africa (MicroEnsure) need to be strengthened and considered in order to be expanded and adopted and used for climate change vulnerable communities in different parts of the Continent. However, for Africa beside consideration of successful experiences, there is still strong need to develop sustainable models in order to reach the poorest and ensure equitable and efficient ways to manage and reduce risk.

Figure 4.4: HARITA Conceptual Framework



Box 4.7:Horn of Africa Risk Transfer for Adaptation (HARITA)

HARITA model is innovative in its holistic approach to risk management. The approach consists of three main components: risk reduction, risk transfer, and prudent risk taking. HARITA considers risk reduction the foundation of any holistic risk management approach.. In the case of climate change, risk reduction requires farmers to reduce their vulnerability to climate shocks by adapting their farm management practices. Through HARITA, farmers enrolled in the Ethiopia's Productive Safety Net Program (PSNP) have the option to work extra days beyond those required for their normal payments, but instead of earning cash or food for this additional labor, they earn an insurance certificate protecting them against deficit rainfall. In other words, through this premium-for-work arrangement, farmers can receive —predictable transfers for unpredictable needs .

Weather index insurance entails risk transfer against events that cause loss. If a pre-defined weather event occurs during a pre-defined time, such as a shortage of rain during a crucial period in a crop's growth, this event triggers pre-determined payments to farmers who buy the policy. —Index refers to the fact that the insurance is based on a proxy for loss and an objectively verifiable measure of weather.

Index insurance differs from traditional insurance where compensation to a policyholder is based on the estimated value of what was actually lost. Traditional crop insurance is problematic because farmers have an incentive to neglect their crops in order to gain a higher payout. When properly designed, index insurance avoids this problem of —moral hazard since the index cannot be influenced by farmers' behavior. Index insurance also has lower administrative costs, because it is generally easier and cheaper to verify weather (e.g. rainfall levels) in a given region than to visit individual farms to assess damage. Because administrative costs are lower, index insurance packages are more affordable. Importantly, the payout can be set up to occur as soon as the loss-causing event is detected.

In the case of insufficient rains, this gives farmers resources and time to manage a shortage in food production. Thus weather index insurance could help smallholder farmers by allowing them to stabilize their incomes and recover more quickly from climate-related shocks.

4.5 A programmatic Approach to Adaptation

It is a coherent approach to planning and implementing adaptation at strategic, regulatory, budgetary, and operational levels. The programmatic approach can help African countries that are poor and vulnerable to climate change to integrate climate resilience into their development plans. A number of organizations have started developing a programmatic approach for addressing climate change concerns such as OECD and GEF.

4.5.1 Why a programmatic approach:

The real impacts and effectiveness of adaptation measures at the project level is usually difficult to monitor or evaluate. Compared to an individual adaptation project, a program approach that incorporate a number of sectoral projects will have a better chance of incorporating adaptation components at the policy and regulatory .Moreover the chances for expansion and scaling-up financial resources for adaptation through e.g. GEF is greater for program activities that incorporate a number of focal areas and sectors. Figure (4) shows the elements and the links between the different levels of a program approach.

4.5.2 GEF Programmatic Approach[17]

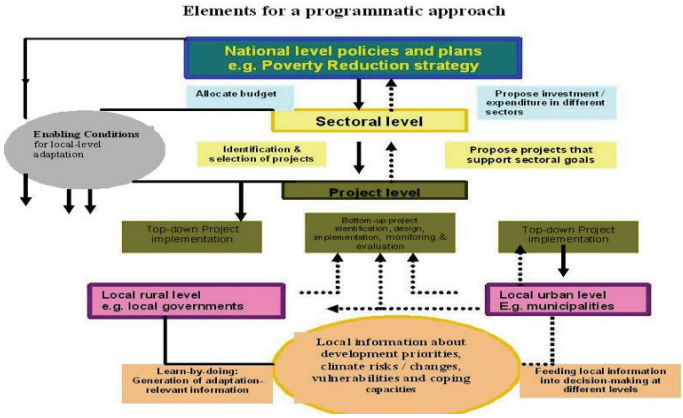
The GEF programmatic approach can be defined as a long-term and strategic arrangement of individual yet interlinked projects aimed at achieving large-scale impacts on the global environment. The program aims at achieving these impacts making available to countries, the GEF, and other GEF stakeholders synergies across the Focal Areas of the GEF within the framework of national and regional sustainable development; by facilitating specific activities and provide for duplication of successful initiatives and

17 http://www.thegef.org/gef/sites/thegef.org/files/publication/Programmatic_Approach.pdf

scaling up global environmental benefits. This is expected to encourage donors and funding agencies to invest more depending on the scope of the program.

In contrast to project-based approach, the programmatic approach provides greater incentives for GEF agencies by providing a better, more flexible operational fit with their own country engagement strategies and comparative advantages. Additionally, it gives all agencies a common program management and results structure and allows them to coordinate knowledge management under one strategic framework and to harmonize project monitoring and evaluation. Moreover, this approach is expected to assist countries effect sector-wide transformation and address barriers to driving economic sectors onto following a more sustainable ecological and socioeconomic path, in a strategic and coordinated manner, by helping integrate horizontal and vertical global environmental concerns into decision making.

Figure 4.5: Elements for a programmatic approach to adaptation



Adapted from Shardul Agrawala, (2009)

4.6 Mainstreaming Climate Change Adaptation

Mainstreaming climate change adaptation describes a process of considering climate risks to development projects, and of adjusting project activities and approaches to address these risks. It involves the integration of policies and measures that address climate change into development planning and ongoing sectoral decision-making, so as to ensure the long-term sustainability of investments as well as to reduce the sensitivity of development activities to both today's and tomorrow's climate." (Klein et al., 2007).

The assumption is that the project has a goal related to poverty reduction, livelihood security, or improved well-being for target populations, and that the sustainability and impact of the initiative can be increased by integrating climate change (see figure 1). This is different from a "targeted" community-based adaptation project, where the explicit goal is to build resilience to climate change. Mainstreaming climate change adaptation can therefore ensure that development programs and policies are not at odds with climate risks both now and in the future.

4.6.1 Why mainstreaming?

Mainstreaming climate change adaptation can provide for: 1st. Minimizing the climate change risks to development initiatives -what is referred to as climate-proofing and building adaptive capacity of target population, while achieving development goals. The main objective of climate-proofing is to protect

development investments and outcomes from the impacts of climate change, hence ensuring the sustainability of the projects. This is ensured through the detailed analysis of the potential risks posed by climate change to the project activities, based on the result modify or adjust the project design to minimize the exposure to risk. 2nd. Mainstreaming provide for co-benefit through selecting of activities that contribute to reducing inherent vulnerability of the people resulting from e.g. poverty, desertification and land degradation, recognizing that development activities that seek to reduce poverty can also build the adaptive capacity to climate change impacts of the most vulnerable groups and so increase the outcome of the development activity. For example, the introduction of improved crop variety combined with shelterbelts, land conservation and the use of appropriate technology can make a real change in the community compared to a project that focuses mainly on increasing agricultural production with the use of high-inputs. In this regard mainstreaming climate change adaptation will be necessary for ensuring the long-term objective of achieving an equitable and sustainable human development and social justice.

4.6.2 At what levels can mainstreaming take place?

Mainstreaming climate change adaptation can occur at the strategic level (top-down) or the operational level. At the strategic level mainstreaming addresses issues related to institutions and organisational setup within which policies and programmes are developed and implemented. A strategy aiming at mainstreaming climate change concerns into development programs must be preceded by a work plan aiming towards creating the enabling environment necessary for ensuring popper planning for mainstreaming adaptation, including creating awareness, building capacities and technical skills.

At the operational level (bottom-up), mainstreaming involves undertaking an evaluation of risks to poverty reduction activities associated with climate variability and change, and identifying effective, efficient and equitable adaptation measures that should be developed in order to reduce those risks and harness opportunities for building adaptive capacity.

Top- down approach for mainstreaming requires the creation of a general awareness at institutional level regarding climate change issues and focuses mainly on key policy and planning ministries. Mainstreaming from bottom –up creates awareness at local levels (NGO and public awareness building campaign/ outreach strategy), and focuses more on working within key local development entities in order to help building an effective case for mainstreaming.

4.6.3 What are the requirements for mainstreaming?

Several factors are required for effective mainstreaming of climate change adaptation into development activities. These include:

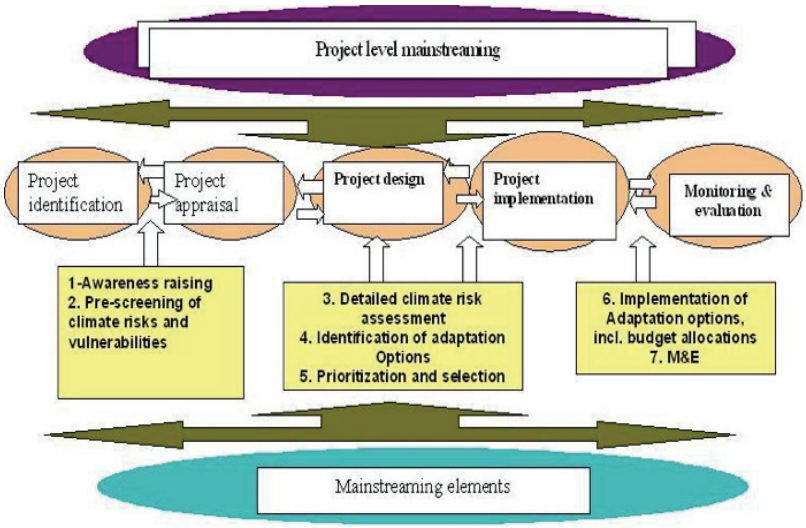
- Availing climate change information to inform the decision making process. This includes information on the potential impacts of climate change, cost of adapting to these impacts, and what measures should be considered. Mainstreaming should be considered as a systematic and a continuous process rather than a one-off process of utilizing climate information in decisions", (UNDP, 2009).
- Developing and applying climate risk screening tools to assess risks of climate change to the development activity and identify potential response measures.
- Link climate change adaptation to existing initiatives of priority concern to governments such as the poverty reduction strategies, disaster response measures and land use planning to ensure adequate attention and commitment for adaptation. It is also important to include climate change consideration in the planning process and make it part of the environmental impact assessment.
- Work to strengthen coordination between relevant institutions at national and regional levels to ensure the exchange of information and cooperation particularly in dealing with cross-sectoral and cross boundary issues.

4.6.4 Methodologies and tools for mainstreaming adaptation

A logical first step towards mainstreaming is to screen program and project portfolios to identify to what risk they are exposed and to what extent they could be impacted. Screening a project is therefore; include risk assessment, vulnerability, and potential impacts as well as the identification of adaptation responses (Figure 5).

A number of screening methods/tools have been developed by different agencies including the, World Bank[18], OECD-DAC, KLIMOS[19]. Some of the tools are developed to support local level planning. For example the Community-based Risk Screening Tool – Adaptation and Livelihoods (CRiSTAL) is designed to help project planners and managers integrate climate change adaptation and risk reduction into community-level projects **(IISD/IUCN/SEI, 2009)**[20]

Figure 4.6: Mainstreaming adaptation at project level



4.6.5 Addressing maladaptation

Maladaptation is an action or process that increases vulnerability to climate change-related hazards. Maladaptive actions and processes often include planned development policies and measures that deliver short-term gains or economic benefits but lead to exacerbated vulnerability in the medium to long-term. Barnett, J. & O'Neill, S.J., (2009) defined maladaptation as "action taken ostensibly to avoid or reduce vulnerability to climate change that impacts adversely on, or increases the vulnerability of other systems, sectors or social groups".

Maladaptation can be the result/side effect of a policy that when this unintentionally increase the vulnerability to climate change. For example, an agricultural policy might support the expansion of high-

18 http://sdwebx.worldbank.org/climateportal/

19 http://www.biw.kuleuven.be/lbh/lbnl/forecoman/klimos/toolkit/text/agricultureandfoodsecurity.pdf

20 http://www.iisd.org/cristaltool/documents/cristal-manual-english-may2009.pdf

input mono-cropping mechanized farming in rainfed areas e.g., through subsidies—with the objective of maximizing the overall production and secure food sufficiency. As a consequence, these farmers will become more exposed to the impacts of climate variability having a one crop. Moreover, small scale farmers will be more marginalized and may loose their income. A legal or regulatory framework that narrowly focuses on the interest of a one group or economic sector may undermine many long-term adaptation investments involving other economic sectors.

Best practices and case studies

Box 4.8: Improving adaptation of cattle to climate change through introduction of genes obtained from drought and heat tolerant cattle. : Case Study in Ethiopia

Irob and Afar are two breeds of cattle in Ethiopia that are unique in their adaptation to their specific localities and they represent a unique genetic resource. They are drought tolerant and have a unique browsing ability. The Irob cattle breed is highly adapted to a rugged terrain in the north Eastern Ethiopia while Afar cattle breed is adapted to very high temperatures.

The study conducted in Ethiopia by the Animal Genetic Resources Team of Institute of Biodiversity Conservation and collaborating laboratories obtained genes of these breed that make them drought and heat tolerant and used them as input towards modifying and improving the genetics of other productive breeds and thus increase livestock productivity under a changing and harsher climate. The approach included the following steps: Conducted consultations with zonal and district agricultural officers, local farmers and pastoralists;

Collect samples of blood and other material from the animals; Conducted analysis of morphological and biochemical traits on 40 Irob cattle pertaining to resilience to harsh environment using visual observations of various physical structures, measurements of morphometric characters and taking blood sample for biochemical traits; Conducted comparative study and additional sampling from the 40 Afar and highland cattle; Conducted joint analysis with School of Veterinary medicine at the Addis Ababa University (AAU); and Identified and documented adaptive traits that can be used by national and international researchers and geneticists in determining climate change adaptation options, and they can be used in extension, development research, animal breeding, and targeted and strategic crossbreeding with adapted breeds. Use the results of this study to conserve, utilize and conduct within breed genetic improvement. A prior literature review work and discussion with the community keeping the breeds will be done to be followed by field collection of data and sample for additional biochemical study under laboratory. Advise livestock keepers which type of animals to keep behind and which animals to destock. Provide policy and decision makers with the basic results and information to allow them develop policies and plans to multiply the acquired traits from the Irob and Afar breeds which would allow a realization of improved production and productivities of cattle.

Source: Institute of Biodiversity Conservation/CC DARE Project Report (www.ibc-et.org, www.ccdare.org)

Box 4.9: Enhancing Resilience of Communities through Provision of Tool and Policy Change in the Gishwati Area of Rwanda

The Giswati Area of the Nyabihu District of Rwanda is one of the most agriculturally productive parts of the country. Refuges returning after the 1994 genocide flocked into this area and settlements were haphazardly established on lands that are prone to climate related disasters such as floods and landslides. The consequential and alarming rate of loss of lives and property which are recently exacerbated by climate change, forced the Central and Regional Governments to mobilize resources and expertise to face the challenges.

The Giswati Area of the Nyabihu District of Rwanda is one of the most agriculturally productive parts of the country. Refuges returning after the 1994 genocide flocked into this area and settlements were haphazardly established on lands that are prone to climate related disasters such as floods and landslides. The consequential and alarming rate of loss of lives and property which are recently exacerbated by climate change, forced the Central and Regional Governments to mobilize resources and expertise to face the challenges.

With backing and support from the Rwanda Environment Management Authority (REMA), the Rwanda Environment NGO Forum (RENGOF) partnered with Nyabihu District Council and the Gishwati Sector Government to access financial and technical support from the CC DARE Programme in 2009 with the objective of determining appropriate climate change adaptation strategies for the area. In this case study: Consultations were conducted, partnerships were established and stakeholder participation was enhanced;. RENGOF and partners conducted public sensitization and awareness raising, using consultation and joint implementation of some of the activities; Partnerships were forged between various Civil Society Networks (Media and NGOs) both nationally and regionally, that led to the training of Civil on climate change issues and reporting as they affect agriculture and food security, forestry and ecosystem management, population pressure and migration, sustainable development, community based adaptation and gender. Information, education and communication (IEC) materials were produced and disseminated in different formats as print and electronic (radio, television, and website) materials. The RENGOF project conducted small-scale demonstration activities as learning-by-doing exercises to further sensitized and capacitated stakeholders so that they easily accept ownership, willingly take up responsibilities, and adjust culture and attitudes towards climate and natural disasters; The demonstration activities excellently captured near accurate estimates and information and contributed immensely to the design of the Land Suitability and Land Use Map and Plan; Through a Consultant and in close working relations with key stakeholders a Land Suitability and Land Use Map and Plan were developed for the Gishwati Area of the Nyabihu District;

Planed relocation of Communities; Landscaping to reduce landslides; Land Suitability and Use Map. Handed Over the validated Land Suitability and Land Use Plan to Local and Central Government partners for resource mobilization and implementation;

REMA and the Local Governments of Nyabihu and Gishwati particularly use the Map and Plan for the implementation of climate change adaptation initiatives such the LDCF and Africa Adaptation

Source: Synthesis of CC DARE Projects in Rwanda, 2010

4.8 Research and Data Gaps

Gaps persist in terms of scientific and technical research in climate change adaptation in Africa. Several structures have been established to promote research activities in adaptation, but the sharing of experience is not on a large scale and level of awareness is still limited (UNEP, 2009). African people, mostly illiterate adopt a strategy of adaptation to climate change that the class learned minority considered primitive. Indeed, there is a malfunction in understanding the phenomena of climate change and adaptation between scientific and sociocultural realities of the populations in almost all African countries. Prediction of future climate suffers from several uncertainties. Despite the establishment of research centers and trade, production data is not always easy given the inaccessibility of some areas and inadequate technical and financial means. Weather data is much more reliable for air navigation and less reliable for crop production.

The learning mechanism for adaptation (ALM) and WeAdapt (we adapt) are designed as interactive platforms acting as a focal point for Internet verification, information dissemination and research process of authentic adaptation to climate change. These platforms have limitations, because some places do not have efficient access to the Internet. Recent projects AIACC Program (Assessments of climate change impacts and adaptation options) have given researchers and specialists from all over the world the opportunity to collaborate, exchange information and develop networks. They also helped to develop, for Africa, a number of concrete projects to adapt to climate change. Few African researchers are aware of this program. Should be encouraged for those networks that African countries take ownership of the data to strengthen their capacity to adapt. The AIACC (Assessments of climate change impacts and adaptation options), the CCAA (Climate Change Adaptation in Africa) and ACCCA (Capacity building to support adaptation to climate change) should encourage the governments of African countries rely on the results of research to make good decisions and ensure the survival of their populations in the face of extreme weather events. The training of future researchers through scholarships and internship is required as part of capacity building in climate change adaptation. This is the case Scholarship Program for Research on climate change in Africa (ACCFP) in collaboration with the program START (System for Analysis, Research and Training affecting change globally), the Institute Resource Assessment (IRA), University of Dar es Salaam and the African Academy of Sciences (AAS), with support from the Centre for Development Research Centre (IDRC) (Canada) and the Department UK International Development (DFID). However, the criteria for the granting of these scholarships are very difficult to meet for some students and African researchers who have no structures and teachers nationally for the supervision of theses.

Simple initiatives put in place in some villages in Africa to collect data on climate change adaptation should be promoted and popularized the same. This is the observatory villagers of climate change. With the village chief, trainees recorded in notebook extreme weather events that occur in the locality. During the passage of researchers, discussions are organized around these events, their frequency, and magnitude and adaptation strategy as adopted by the population. This is a departure for awareness campaigns that can enable rural people to be alert. Many problems are not resolved on the African continent to reduce deforestation and forest degradation in order to strengthen the capacity of forest cover to sequester carbon and mitigate climate change. The slash and burn agriculture continues to devastate the forests and land, while it is possible through research of stability fields and livestock. Households still use firewood as an energy source, while there are a lot of opportunities with solar energy. Logging companies continue to cut trees, so they can grow well in themselves. Many areas in Africa lack water surface, while there, in large quantity and good quality in the basement. We also know that biodiesel does not pollute the atmosphere, but it is difficult for some African states to engage in this endeavor. Indeed, the research activities in climate change adaptation in Africa should be intensified in order to ensure the survival of populations and development activities. The implementation of the green economy will require more research.

Chapter 5:

THE ROLE OF MITIGATION

This Chapter attempts to answer the following questions:-

- *With the prime focus in Africa being on adaptation, what is the place of mitigation?*
- *What are the mitigation opportunities and challenges?*
- *How can these be identified?*
- *What technological capacity is required and how will this be financed?*
- *How to identify and analyse mitigation measures?*
- *How can mitigation efforts be moved closer to implementation?*

5.1 Introduction

For Africa the climate change debate has primarily focused on adaptation rather than mitigation as historically Africa's contribution to global GHG emissions has been small - approximately 1.75% of global energy CO^2 emissions from 1950-2000; and 3.85% of annual GHG emissions in 2000 (Winkler and Zipplies, 2009)whereas the African continent has been identified to be the worst affected by the impacts from climate change (2007 AR4 IPCC). Therefore understandably the focus amongst practitioners, particularly in the context of the UNFCCC climate negotiations, has been on attracting finance to build Africa's adaptive capacity. Whilst as a non-Annex 1 region, it is excluded from any quantified mitigation commitments under the UNFCCC, and therefore less emphasis is placed on mitigation.

Yet according to the Stern Review (Stern Review, 2006) even if the developed world takes on responsibilities for absolute cuts in emission of 60-80% by 2050, developing countries must take significant action too, in order to avoid temperature increases above 2.0, 2.4°C. Furthermore though Africa needs to develop economically to meet her priority of eradicating poverty. Developing along a cleaner energy path and moving towards low carbon development will be necessary in order to maintain economic competitiveness in a global economy. Therefore mitigation is an opportunity for Africa as there are many environmental, social and economic benefits from shifting towards low carbon development paths and the 'green economy' is seen as an opportunity for job creation and developing new markets – both attractive for Africa.

The Bali Action Plan requires Annex 1 countries to provide financial, technical and capacity building support to non-Annex 1 countries in identifying and implementing their nationally appropriate mitigation actions (NAMAs). The extent of action depends on the level of support. However identifying the appropriateness of a mitigation action from a national level, requires practitioners to engage in the mitigation debate and take responsibility for driving processes across the necessary sectors in the national economy in order to identify the relevant mitigation actions.

This chapter aims to outline the main issues relevant to climate change mitigation in the African context and bring to light some of the opportunities and challenges that exist, as well as provide insight into the practical approach towards identifying mitigation needs and moving these closer to implementation. It is acknowledged that some mitigation issues are still being negotiated and therefore their final form is undecided such as NAMA's and MRV whereas some processes such as the CDM mechanism and Technology Needs Assessments have been operational for some time. Therefore this chapter attempts to address topics relevant to both as practitioners may be involved in negotiation of unresolved issues

or practical implementation or existing mechanisms at a project level. Where possible it will also point the reader to other literature and organisations who are considering mitigation initiatives in a developing country context.

5.2 Background of African Position in International Climate Change Mitigation Policy Debate

For Africa, climate change mitigation considerations are anchored on Article 3 of the United Nations Framework Convention on Climate Change (UNFCCC) i.e. the principle of equity and of "common but differentiated responsibilities and respective capabilities" (CBDR, UNFCCC, 1992). The CBDR principle recognizes the historical differences in contributions by developed and developing country Parties to GHGs concentrations in the atmosphere, and also takes cognizance of differences in their respective economic and technical capacity to tackle mitigation. This principle is particularly relevant when we consider that the African continent's total emission of greenhouse gases to the atmosphere is much less than other continents, as illustrated in Figure 5.1

(Source: http://en.wikipedia.org/wiki/File:Countries_by_carbon_dioxide_emissions_world_map_deobfuscated.png*).*

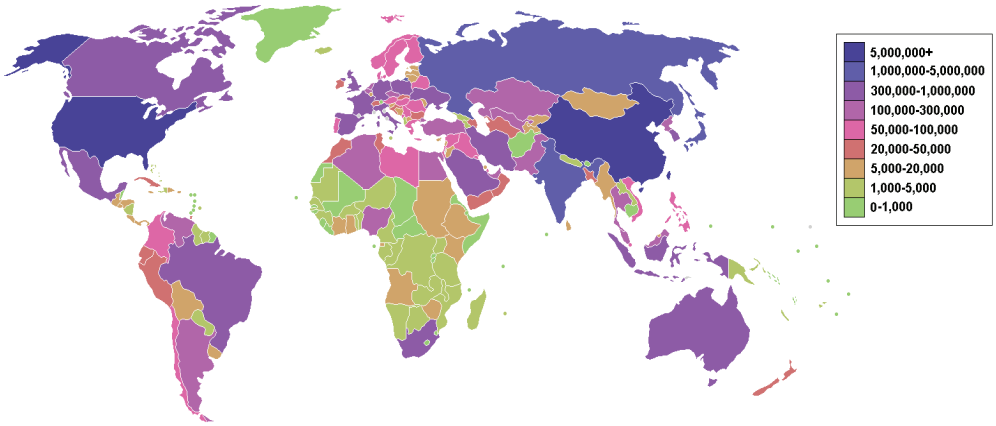


Fig. 5.1: Carbon dioxide emissions by country

Nevertheless, there is a global need to mitigate from the point of view of long-term horizons i.e. "stabilization of greenhouse gas concentration in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system" (UNFCCC Art 2).

The Africa Group have called on developed countries to undertake a number of key actions relating to mitigation. These include:

1. A science-based aggregate target for developed countries to ensure they individually or collectively reduce emissions in accordance with science, equity and historical responsibility;
2. Individual commitments that are negotiated among all Parties to ensure developed countries make adequate and equitable contributions to the Convention's objective;
3. Individual commitments that are binding in international law not merely statements of intention, or

commitments that are binding merely in national law;

4. Effective reporting on achievement of their commitments (under KP Articles 5.7 and 5.8);
5. Review and continuing commitments by developed countries in second and subsequent commitment periods; and
6. Mechanisms for compliance to ensure that developed countries fulfill their legally binding commitments in practice.

Equity consideration have been taken as a key issue especially the issue of emissions per capita. Developed country Parties emit more carbon dioxide emissions in metric tonnes per capita per annum than the per capita average for African countries. For example, the USA emits about 19 tonnes compared to an average of 1 tonne per capita in African countries (US Department of Energy's Carbon Dioxide Information Analysis Center (CDIAC, 2008). Greater emissions in the past in both cumulative and per capita terms means that individuals in developed countries are more responsible for global warming and therefore more obliged to reduce emissions. In the same vein, the negotiators subscribe to the contraction and convergence proposal to address the imbalance in the global per capita emissions. The proposal holds the developed Parties responsible for cutting their per capita emissions (contraction) thus meeting developing countries in the middle (convergence). This translates to allowing non-Annex I Parties to develop and increase per capita emissions to a level equal to developed countries.

The Africa group of negotiators have called for the need to observe full separation between the two tracks of negotiations (AWG-KP and AWG-LCA) and the importance of avoiding any efforts to use the AWG-LCA (Convention) to delay the negotiation on the second commitment period under the AWG-KP (Kyoto Protocol i.e. the AWG –KP[21] and the AWG-LCA[22]. The main reason behind this demand was the fact that the Kyoto Protocol is the only legally binding instrument under the climate change negotiations, legally committing industrialized countries to reduction of greenhouse gas (GHG) emissions to an average of five per cent against 1990 levels over the five-year period 2008-2012. The Convention has as its objective to stabilize GHG emissions globally, while allowing development to proceed sustainably. This requires all countries to make a contribution. On the basis of equity, however, developed countries must take leadership and make commitments to reduce emissions, whereas developing countries do so on a voluntary basis.

On the whole, the African Group insists on the elaboration of a detailed and clear work programme for the Kyoto Protocol with the aim to adopting a final decision for the second commitment period in Durban in 2011.

On policy approaches on issues relating to REDD, African Country Parties are willing to undertake the following mitigation measures commensurate with their respective capabilities and national circumstances:

a. Reducing emissions from deforestation;
b. Reducing emissions from forest degradation;
c. Conservation of forest carbon stocks; (d) Sustainable management of forests, and
d. Enhancement of forest carbon stocks.

5.3 Mitigation Opportunities and Challenges

National emission profiles vary across different African countries depending on the structure of the economy and sectoral activities. Therefore the focus of mitigation efforts will also vary accordingly. In

21 AWG-KP – Ad hoc Working Group on the Kyoto Protocol

22 AWG-LCA – Ad Hoc Working Group on Long-Term Cooperative Action

South Africa mitigation efforts focuses on the energy sector – for example specifically the electricity sector as South Africa is ranked 13th in the world in terms of carbon intensity of electricity production (CAIT, 2011) whereas for the central African region, the major activities that would be considered under mitigation activities are logging and agriculture (Sonwa, D., 2010). This section presents some of the different opportunities for mitigation efforts for the African region.

5.3.1 Opportunities from REDD+

In Africa, though the forestry sector entered the climate change debate rather late, significant advancements have been attained especially through REDD+. Discussions under REDD+ have succeeded in mobilizing attention and resources for the sector to address the climate change mitigation issues, i.e. those related to reducing deforestation and degradation, enhancing carbon stocks, improving the protection of forests, and enhancing sustainable management of forest resources. This is now relevant especially since REDD+ was adopted at the COP16 of the UNFCCC negotiations (Chidumayo, et al., 2011)

Interventions that hold significant potential in terms of REDD+ in African forests include improvements in crop and livestock agriculture, enhancement of bio-energy efficiency, better wood and non-wood forest products harvesting and processing techniques, diversification of rural livelihood options, better planning and management of other land uses like communication infrastructure (like dams, roads, railways and power lines), large scale crop and forest plantations, and urbanization; all of which are land based. Existing national forest programmes (NFPS) in many African countries and programmes/ projects/activities that implement various international agreements, initiatives and conventions (like CBD, UNCCD, etc) all target the key components of REDD+(Chidumayo, et al., 2011)

5.3.2 The Clean Development Mechanism (CDM)

The Kyoto Protocol establishes three cooperative mechanisms designed to assist Annex 1 parties in reducing their emissions levels by achieving cost effective reductions in other countries than they would domestically. These are the (1) International Emission Trading (2) Joint Implementation and the Clean Development Mechanism (CDM). The CDM established under Article 12 of the Protocol has the following twin objectives:

- to assist Parties not included in Annex I in achieving sustainable development and in contributing to the ultimate objective of the Convention, and
- to assist Parties included in Annex I in achieving compliance with their quantified emission limitation and reduction commitments under Article 3.

However, Sub Saharan Africa has not benefited from CDM due to a host of problems such as lack of underlying finance, high transaction costs, small size of projects, weak institutional environment and lack of human capacity to develop projects – hence the Nairobi Framework (an interagency network aiming at improving regional distribution of CDM projects). which was was initiated at COP12/CMP2. The May 2011 comparative UNEP RISOE pipeline statistics of CDM projects in Africa and other regions of the world bring out a stark contrast:- Africa: 166 versus 5067 CDM projects for the Asia-Pacific region. PoAs allows carbon finance to be scaled up. This is supported by statistics – 24% of projects in pipeline are from Africa; whereas traditional CDM projects constitute only 4% (http://www.iges.or.jp/en/cdm/report_cdm.html).However, the number of projects in Africa has started to increase compared to earlier years, albeit off a very low base.

The African Ministerial Conference on the Environment in June 2009, deliberated on the continent's participation in the CDM and called for "the improvement of the Clean Development Mechanism to ensure equitable geographical distribution of projects contributing to sustainable development efforts on the continent and for the expansion of eligible categories to […] include sustainable land use, agriculture and forest management"(AMCEN Nairobi Declaration, 2009).

Africa is also participating in the voluntary carbon market whereby individuals and companies are

developing projects on Verified Carbon Standard basis. It does not comply with the Kyoto Protocol regulatory framework. Credits from voluntary projects are termed verified emissions reductions (VERs). Emissions reductions from voluntary projects are typically purchased by private and/or public sector stakeholders who wish to respond to climate change.

5.3.3 Regional initiatives:

In an effort to increase the number of CDM projects in Africa, the 3rd Africa Carbon Forum(2011) was held in Morocco with the motto "Marrakech Plus 10". It discussed progress made thus far as well as providing pointers for the road ahead. Regional DNAs, banking institutions, officials from the energy sector and potential CDM and PoA developers participated in the regional event. After two Carbon Forums, the event has established itself as the region's premier carbon finance trade fair and conference as well as knowledge sharing platforms.

5.3.4 CDM reform

In order to enhance carbon finance in Africa, some CDM reforms need to be introduced by the relevant actors (carbon market regulators: the EB, UNFCCC Secretariat; Annex I Parties - they constitute the demand for African credits; and carbon market investors). CDM reform can assist in the scaling up of carbon finance in Africa especially the LDCs. Some areas for possible reforms are:

- Make CERs bankable. CERs could be an important contribution if they are bankable at the point of financial closure. However, this is not currently the case due to inherent structure of the registration cycle.
- The EB needs to take a top-down approach. This has already been taken up by the Executive Board by means of approving consolidated methodologies, which provide a degree of standardization, e.g. for electricity and land-fill gas. Working Groups on small-scale CDM projects have also worked more top-down than the 'big' project types, which initially were strictly project-based methodologies. Furthermore, the CMP launched negotiations to further standardize baselines.
- Registration fees needs to be paid after first issuance of CERs.

5.3.5 Carbon finance: Market based mechanisms

Various approaches, including opportunities for using markets, - to enhance the cost-effectiveness and to promote, mitigation actions, bearing in mind different circumstances of developed and developing countries are being considered by Parties. These include:

a. Ensuring voluntary participation of Parties, supported by the promotion of fair and equitable access for all Parties;

b. Complementing other means of support for nationally appropriate mitigation actions (NAMAs) by developing country Parties;

c. Stimulating mitigation across broad segments of the economy, and

d. Safeguarding environmental integrity;

All these measures attempt to ensure a net decrease and/or avoidance of global greenhouse gas emissions.

5.3.5 Non-market mechanism –

This is also under negotiation in 1b(v) of the Long-term Co-operative Action (AWG-LCA) of Bali. It is not clear whether a distinct mechanism will emerge for public funding, or whether the system of support through the Registry (agreed in Cancún in COP16) linking with the financial, technology and capacity building mechanisms and frameworks will become the channel for public investment. From an African perspective, the potential for public funding to be directed towards development-oriented mitigation

actions is of interest.

5.3.6 Nationally Appropriate Mitigation Actions (NAMA's)

In order to assess the opportunities or challenges of particular mitigation initiatives, it is first necessary to identify what the nature of the mitigation action could be, how it might be financed and how it could be implemented.

One means of identifying a mitigation action is through the process of preparing Nationally Appropriate Mitigation Actions (NAMA's). A term that originated in the Bali Action Plan:

1(b) Enhanced national/international action on mitigation of climate change, including, inter alia, consideration of:

> ii) Nationally appropriate mitigation actions by developing country Parties in the context of sustainable development, supported and enabled by technology ,financing and capacity-building, in a measurable, reportable and verifiable *manner;*

It was agreed in Bali that Annex 1 countries will have to provide financial, technical and capacity building support to non-Annex 1 countries to implement their nationally appropriate mitigation actions. The final format of a NAMA is unclear, however some Parties have started submitting potential NAMA's to the UNFCCC[23] including anything from energy efficiency programmes, to reduction in emissions in the agricultural or waste sector.

Unlike the CDM, the NAMA concept is geared to not only focus on volume of CO_2 emission reductions, but also to drive mitigation actions 'in the context of sustainable development' i.e. which have large sustainability co-benefits such as job creation, improved local air pollution or addressing any other sustainable development priorities relevant to the national context. It would be in Africa's interest to define NAMAs as developmental actions. These are more likely to be funded through international public investment (REF UNEP report on public investment flows). The CDM has a different purpose (Helme and Davis, 2011). It was designed as a market mechanism with investments flowing to the largest markets and cheapest credits – which has not been towards Africa in the past.

NAMAs seek to scale up beyond the project level. The 'action' in NAMAs is perhaps best defined as programmatic. This suggests a link to programmatic CDM, which has already developed detailed approaches (PoAs). Programmatic CDM emerged out of an energy efficiency programme in Ghana, and the links between PoAs and NAMAs (Sutter and Schibli, 2011) may be useful for Africa to explore. For further reading see: Ecofys (Fumeaux, 2009; Holm Olsen, Fenhann and Hinostroza, 2009; Kim, Corfee-Morlot and de T'Serclaes, 2009; Klein et al., 2009; TERI, 2010)

5.3.7 Technology mechanism

The Cancún decision (UNFCCC, 2010) established the Technology Mechanism to accelerate technology development and technology transfer[24]under the guidance of and accountable to the COP. It is made up of a Technology Executive Committee (TEC) and a Climate Technology Center and Network (CTCN). The fundamental role of the TEC is to map the technology needs of developing countries while that of the

23 see NAMA submissions to the UNFCCC:

http://unfccc.int/documentation/documents/advanced_search/items/3594.php?rec=jandpriref=600006178#beg

24 This guidebook adopts the definition of technology transfer as "… a broad set of processes covering the flows of know-how, experience and equipment for mitigating and adapting to climate change amongst different stakeholders such as governments, private sector entities, financial institutions, NGOs and research/education institutions. Therefore, the treatment of technology transfer in this Report is much broader than that in the UNFCCC or of any particular Article of that Convention. The broad and inclusive term "transfer" encompasses diffusion of technologies and technology cooperation across and within countries. It covers technology transfer processes between developed countries, developing countries and countries with economies in transition, amongst developed countries, amongst developing countries, and amongst countries with economies in transition. It comprises the process of learning to understand, utilize and replicate the technology, including the capacity to choose and adapt to local conditions and integrate it with indigenous technologies" (Metz, Davidson, Martens, van Rooijen, and Van Wie McGrory, 2000).

CTCN is to support the implementation of technological solutions in identified countries.

The TEC consists of 20 experts nominated by Parties – 11 from developing and 9 from developed countries. Its main functions include:

- Facilitating the effective implementation of the Technology Mechanism and the further implementation of the technology transfer framework.
- Evaluating needs and providing recommendations.
- Facilitating collaboration on technology development and transfer.
- Catalyzing the achievement of international plans and roadmaps.

The CTCN comprises a small center and a large global network. Its primary function is to facilitate national, regional, sectoral and international networks to provide advice and support at the request of developing countries.

The Technology Mechanism is currently recognized as a significant step forward for international technology cooperation. Its establishment underlines the intention of countries to elevate the importance of development and deployment of the clean technologies within the climate framework.

But while agreement on its basic structure was reached at COP 16, the Technology Mechanism is, and will likely remain, an evolving structure over the long run. For the Technology Mechanism as a whole, one important issue that is yet to be resolved is the relationship between the Technology Mechanism and the existing Financial Mechanism. Another major question has to do with how the TEC and the CTCN must relate to each other.

At the time of writing, the nomination of experts to the TEC is well underway. The CTCN, however, remains the subject of ongoing negotiations regarding its detailed modalities. Details pertaining to its formation, such as governance structure and the role the TEC should play in its functioning were discussed at a meeting in Bangkok conducted by the AWG-LCA in April 2011, attended by 175 countries. Other key issues discussed at this meeting included oversight, accountability, and reporting by the CTCN. All the countries emphasized that the centre must have adequate financial resources to support technological needs of the developing countries and to launch the technology mechanism promptly. It would be important that one or more nodes of the CTCN is established in Africa, focusing on technologies appropriate for mitigation and adaptation in an African context. Several regional nodes might be contemplated to encourage innovation systems (see below).

These outstanding matters are expected to be addressed at the upcoming COP 17 in Durban, South Africa and beyond. In the meantime, most negotiators are of the view that the Technology Mechanism should ultimately be nimble, should build on existing initiatives and should coordinate them cost-effectively. While a solution along these lines is generally expected to be reached at COP 17, the more contentious matter of intellectual property rights may remain under negotiation for a longer period of time.

5.3.8 Opportunities for Africa – Technological innovation systems perspective

The Technology Mechanism has initiated actions towards deployment of more effective processes of technology transfer from developed to developing countries in ways that ensure low-emission, climate resilient development. As such, it opens up new prospects for African countries to build and strengthen the technological innovation systems[25] on which their long term capacity to absorb and/or develop clean technologies ultimately rests. From this standpoint, African countries can capture new opportunities[26]

25 Defined as"…dynamic network of agents interacting in a specific economic/industrial area under a particular institutional infrastructure and involved in the generation, diffusion, and utilisation of technology" (Carlsson and Stankiewicz, 1991).

26 In this regard, African negotiators engaged in negotiating details of the TM might want to consider the recommendations from one experienced negotiator that may help improve Africa's chances of getting a fair share of the benefits, i.e.: ensuring that African positions are based on sound scientific and economic

made possible by the TEC and CTCN to improve their technological innovation systems. Following a commonly accepted general model of such systems, opportunities for Africa are described in the next section in terms of 'domains of opportunity'.

5.3.9 Domains of opportunity

Entrepreneurial activities: Supporting entrepreneurs translate knowledge into business opportunities, and eventually innovations.

5. **Knowledge Development:** Enhancing learning activities related to mitigation technologies as well as markets, networks, users etc.
6. **Knowledge Exchange:** Facilitating exchange of knowledge between all the actors involved in climate technology development and transfer, including promotion/funding development of partnerships between actors, for example technology developers, but also meetings like workshops and conferences.
7. **Technology Needs Assessments and Technology Transfer Policies:** Supporting country-driven assessments of needs, requirements and expectations of actors with respect to their support of clean technologies.
8. **Market Formation:** Stimulating technology transfers through creation of 'artificial' (niche) markets e.g. funding the use of a specific renewable energy technology, or by taxing the use of competing technologies.
9. **Resource Mobilisation:** Increased access to new/expanded funds for climate technology investments and (smart) subsidies.
10. **Clean Technology Communities of Practice'/Advocacy Coalitions:** Support countries to more effectively counteract resistance, e.g. to clean energy technologies from actors with interests in the incumbent energy system. This opportunity is of particular importance because advocacy coalitions—unlike governments -- often do not have the power to change formal institutions directly.

5.3.10 Financing for technology transfer

Developing countries, particularly LDCs, are in a phase of massive infrastructure build up and the failure to leapfrog immediately to low carbon technologies could lead to a lock-in in high-emissions systems for decades to come (IPCC, 2007).

One hundred and ninety- two countries have ratified the UN Climate Change Convention, in which the developed country Parties are obliged to transfer finance to developing countries (Article 4.3) and committed themselves to "promote, facilitate and finance, as appropriate, the transfer of, or access to, environmentally sound technologies and know-how to other Parties, particularly to developing countries to enable them to implement the provisions of the Convention" (Article 4.5, UNFCCC). Article 4.7 of the Convention states that the extent to which developing country Parties will effectively implement their commitments under the Convention will depend on the effective implementation by developed country Parties of their commitments under the Convention related to financial resources and the transfer of technology. Consequently, the Global Environment Facility (GEF), as an operating entity of the financial mechanism under the Convention, has been established and mandated to provide financial support for technology transfer. Since Cancún, the Green Climate Fund has been established, and designated as another operating entity, although detailed arrangements are still be negotiated and concluded.

The GEF-led strategic programme on technology transfer provides financing support for: (i) technology

analyses; building support for these positions at Ministerial and Head of State level, as appropriate; continuing to strengthen the African Common Negotiating Position; and devising and deploying democratic and transparent modalities for representation of African position at all levels, including during COP high-level segments (July 2010, Dakar, Senegal).

needs assessments (TNAs); (ii) technology transfer pilot projects; and (iii) dissemination of technologies and practices. A recent GEF report on investment for technology transfer shows that a number of African countries have benefitted from GEF-coordinated transfer of environmentally sound technologies (ESTs), notably in the areas of energy efficiency, renewable energy and transport technology such as bus-rapid transit systems (AU, NEPAD, UNECA, 2009). Beyond the institutional financing framework presented above, technology transfer is also happening on a bilateral and commercial basis. In fact, the major part of investment in climate mitigation technologies is coming from non-public sources.

The climate mitigation financing needs in Africa are considerable and matching funds are not available. The main challenge for project developers on the continent is to access finance. This is linked to perceptions of high degrees of risk associated with climate mitigation projects, the lack of policy support that can make project economically viable thus decreasing opportunity costs of such projects.

Some of the barriers and risks associated with access to finance for technology transfer and some ways on how to reduce the effects of these hurdles are outlined in a background paper: Innovative Options for Financing the Development and Transfer of Technologies

in the context of the United Nations Framework Convention on Climate Change (UNFCCC)

http://unfccc.int/ttclear/pdf/Workshops/Canada/Montreal%20background%20paper-edited.pdf

The UNFCCC has also developed a guidebook on "Preparing Technology Transfer Projects for Financing" to assist project developers in developing countries and relevant stakeholders in preparing project proposals that meet the standards of international finance providers. A practitioner's guide was developed by the Secretariat in close collaboration with the Expert Group on Technology Transfer (EGTT) and numerous practitioners involved in project development and financing. This guide was published in 2006.(http://unfccc.int/ttclear/jsp/Guidebook.jsp)

5.4 Identifying Mitigation Needs

There are different approaches for identifying mitigation needs and potential areas for mitigation

5.4.1 GHG inventory

An essential first step is to determine the national greenhouse emissions for different sectors so as to focus on activities with most emissions. This is done using the 2006 IPCC Guidelines.

(http://www.ipcc-nggip.iges.or.jp/index.html)

Under the IPCC guidelines, the basic approach for calculating emissions of a particular gas from a particular sector is a simple concept:

Emissions = Activity Level x Emission Factor

The guidelines allow for the use of a range of methods at different levels of detail, including flexibility to allow for national circumstances. Although the national greenhouse gas inventories are determined using the IPCC methods, there are instances when local factors are incorporated into the overall IPCC methodology and these are given in the relevant sections. This is the case where certain processes are well known and local experts have confidence in the science of the process.

Default methods and assumptions are provided for calculating the major emissions and removals of greenhouse gases at the minimum acceptable level of detail. In most cases, IPCC default emission factors and conversion coefficients are used. The IPCC default methods have been developed with efficiency in mind. They build on data that are readily available and should be easily applicable to all countries of the world. More detailed methods are also discussed in the Guidelines and national experts are encouraged to use them wherever this is possible and likely to produce more accurate national estimates. In some

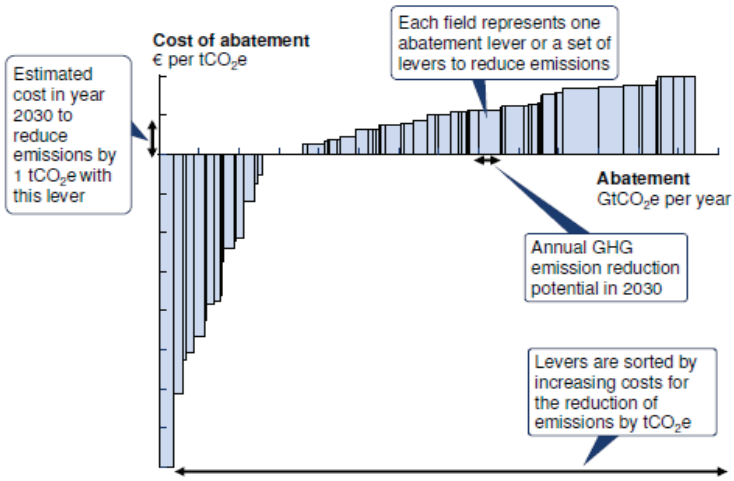
cases, national experts may choose to use an entirely different methodology if they believe this better reflects their national situation. Common reporting instructions are therefore needed to accommodate inventories developed at different levels of detail and (potentially) with different methods. The objective of the instructions is to establish minimum requirements for reporting data which allow for comparison and identification of differences in inventory construction (transparency). For this reason the IPCC recommends that all users of the Guidelines follow the Reporting Instructions explicitly when they communicate their national inventories to the UNFCCC or other international bodies. The level of confidence of data for the commercial use of energy should be over 95% while between 80% and 90% accuracy is acceptable for agriculture, industrial processes, land-use, forestry and waste management sectors.

5.4.2 Mitigation cost curves

Another approach to identifying and prioritising mitigation needs is done by constructing GHG mitigation scenario cost curves. The curves are based on the cost of GHG emission reductions per tonne of CO_2 equivalent for specific time horizons and reduction targets. The cost of the investment technology relative to each tonne of GHG reduced per sector is read on the curve. GHG mitigation cost curves are compared so as identify cost-effective mitigation options for different sectors - thus facilitating the prioritisation. Assessment of sectoral GHG emissions is done through the use IPCC emission factors. For example the latest emission factors can be obtained in the 2006 IPCC Guidelines discussed in section 5.4.1 above.

Using the Mitigation Abatement Curve (MAC) curve concept outlined below, is an established methodology for looking at independent mitigation options in isolation rather than a systems approach.

Figure 5.2: Global MAC curve beyond business as usual - 2030



Source: McKinsey Global GHG Abatement Cost Curve V2

5.4.3 Low carbon[27] development strategies

By Decision 1/CP.16, Parties decided that developed countries should develop low carbon development strategies (LCDS) or plans, and it "encourages" developing countries to do the same. For developing countries, LCDS provide a potential context to understand a wide range and diversity of NAMAs (see 5.3.6). They are not, however, a precondition – i.e. support for NAMAs should not be conditional on first submitting a LCDS.

Several African countries are developing LCDS. South Africa undertook a process called the Long-Term

27 Carbon implies CO_2 equivalent.

Mitigation Scenarios (ERC 2007; SBT 2007) (see LTMS Box 5.3), which was a precursor of LCDS. Based on this experience, a programme of South-South collaboration called Mitigation Action Plans and Scenarios (MAPS) was launched in 2011, and may be extended to African countries in following years.

Rwanda is another example of an African country that is undertaking a LCDS. This is a nine month project funded jointly by the Climate and Development Knowledge Network (CDKN) and the Department for International Development (DFID) in Rwanda. The project objectives are to: (i) develop a roadmap for future climate resilient and low-carbon economic growth in the country as well as laying a solid foundation for the development of a regional capacity in climate impact modelling techniques The project, which is funded under that the technical assistance programme of the CDKN, will result in the drafting of a "National Strategy on Climate Change and Low Carbon Development Report" for the Government of Rwanda. The report will also provide a framework around which detailed sectoral studies and implementation plans can be built.

Table 5.1: Some Examples of LCDS/LEDS /(NAMAs) Support Programs and Activities in Africa

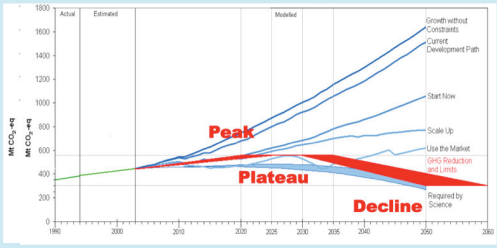
Ghana	Paving the way for LCDS(ECN)
Morocco	Low Carbon Planning in the energy sector(ESMAP)
Nigeria	Low Carbon Planning in the energy sector(ESMAP)
Zimbabwe	Terms of reference for LCDS(CDKN)
Egypt	Clean Technology Fund(World Bank)

Source: http://africacarbonforum.com/2011/docs/Presentations/D3/P6/Carnahan.pdf

An example of this is the Long Term Mitigation Scenarios process in South Africa.

Box 5.1: LTMS – Long Term Mitigation Scenarios (South African case study)

Theme 1: GHG emission reductions and limits (Cont.)



The Long Term Mitigation Scenario in South Africa, provides an interesting case study on a high emitting developing country facing the challenge of managing a development path and reducing emissions (Winkler, 2010).

The LTMS was a multi stakeholder research based scenario process that has produced an assessment of country's mitigation potential (DEA, 2009). It was a rigorous, peer reviewed and inclusive process based on energy, non-energy and economy-wide modeling.

What made the LTMS unique in the field of mitigation was that research fed into a facilitated stakeholder process, producing evidence-based scenarios. Central to this was building a Scenario Building Team which brought together sectors across government, business and civil society (Winkler, 2010).

The process focused on two scenarios: Growth Without Constraints (GWC) and Required by Science (RBS) the first highlighting where emissions were going in South Africa and where they should be going in response to the latest climate science. Strategic options were developed the Scenario building suitable for the South African context. In 2008 the South African cabinet agreed that SA emissions will 'peak (between 2020 & 2025), plateau and decline':

For more info:www.environment.gov.za, www.erc.uct.ac.za/Research/LTMS/LTMS/intro.htm,

5.4.4 How to identify and engage with stakeholders

As seen in the above LTMS Box 5.1, the stakeholder participation process was key in the development of scenarios and also eventually providing sufficient robustness for political buy- in.

The process of identifying mitigation needs will benefit from a multi-stakeholder participatory approach from different sectors and representatives of the economy. These will vary for different country contexts, but would typically include representatives from Government, labour, civil society, NGOs,academic research, facilitators and technical experts. Different participatory processes are required for the different components of developing low emission development strategies -for example:

- Identifying scenarios – different industry representatives
- Technical evaluation –academic and technical experts
- Political buy in – Roundtables (as in the case of the LTMS)

There are a number of challenges that have to be taken into consideration when effectively managing a stakeholder process. GHG emissions occur in different sectors of the economy and therefore trying to build consensus in an approach towards shifting to a low carbon growth trajectory will require compromise across all sectors. Stakeholders from carbon intensive sectors such as industry or mining will have different values and conflicting views than those stakeholders from, for example, environmental NGO's. Also there will, inevitably, be more influential players in a national economy who will have vested interests in the outcome of such a process, and therefore it is essential to take into consideration potential power dynamics emerging from this. It is important for this reason to have competent independent facilitators who can manage such dynamics.

Obviously the larger the group of stakeholders involved in the process, the greater the input and the more representative of the national economy. Yet larger groups will make it more complex to come to a consensus than a smaller group. Therefore it is important to define the number of stakeholders and plan what the process is aiming to achieve. (see Raubenheimer, 2011; Winkler 2010)

5.4.5 Green economy

Implications of Green Economy in Africa entails solutions for economic, environmental and social challenges, new and renewable energy resources, creating green jobs, reducing poverty and income gaps whilst tackling climate change and environmental degradation. UNEP defines a green economy as one that results in improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcities. GE ought to encompass low carbon development, resource efficiency and socially inclusiveness as well as a new paradigm which focuses on environmental protection whilst enabling economic growth. It should also be noted that the concept of a "green economy" is not meant to replace sustainable development. However, it is generally accepted that achieving sustainability will largely be anchored on greening the economy.

Africa's unique circumstances bears potential opportunities and benefits in pursuing Green Growth. The continent is poised to adopt a new development paradigm at an early stage of economic development paying attention to the following issues:

- Less importation of fossil fuels resulting in low level CO_2 emissions compared to other regions
- Abundant land resources, such as forestry, serving as a carbon sink
- High potential for renewable electricity production compared to other continents of the world

Within the framework of its Green Economy advisory services, UNEP has developed the following methodology which can be adapted to different economic country contexts: developing a Green Economy Scoping Study, Green Sector Report, Green Economy Report, and Green Economy Special Review(see Box 5.2). As may be relevant, national workshops and training and capacity-building activities will be organized as part of the process of delivering advisory services.

*See the UNEP report "***Towards a Green Economy: Pathways to Sustainable Development and Poverty Eradication"**

Available :http ://www.unep.org/greeneconomy/GreenEconomyReport/tabid/29846/Default.aspx

Box 5.2: Developing a national green economy strategy

Within the framework of its Green Economy advisory services, UNEP has developed the following methodology which can be adapted to different economic country contexts: developing a Green Economy Scoping Study, Green Sector Report, Green Economy Report, and Green Economy Special Review. As may be relevant, national workshops and training and capacity-building activities will be organised as part of the process of delivering advisory services.

A Green Economy Scoping Study (GESS) is a short macro-economic report produced in order to provide an overview of opportunities and challenges to promote green economy initiatives and reforms in a particular country. It will typically identify the priority areas for investment and policy reforms, focusing on sectors of highest return and immediate results, in terms of efficiency gains and reduced environmental liabilities, employment creation, and broader economic benefits. A GESS will include a stock-taking exercise that reviews green economy-related policies and initiatives in the country. This will help to ensure synergy with ongoing activities, avoid duplication, and provide an opportunity to build partnerships to fill existing gaps.

A Green Sector Report (GSR) is an in-depth macro-economic and policy analysis of the opportunities and challenges associated with increasing investments in a specific green economic sector. Drawing on the findings of the GESS, a typical GSR will contain, at a sectoral level, an analysis of the economic costs and benefits of investing in that sector.

A Green Economy Report (GER) is an economy-wide national or regional road-map for a green economic transition, including an analysis of economic benefits and costs of investment in green sectors and specific policy recommendations. Building on the findings of a GESS and GSR, and the outcomes of a national workshop, a typical GER will provide a basis to articulate a strategy for achieving a transition to a green economy, based on a set of green economy "action" and "outcome" indicators.

Green Economy Special Reviews (GESR) are undertaken at the request of a government and may be provided in the form of a policy review of existing national green economy plans or strategies. A GESR may be a sector-specific or economy-wide review.

Source: http://www.unep.org/greeneconomy/SuccessStories/tabid/4652/Default.aspx#panel-2

Examples of African Success Stories on Green Growth

(a) Renewable energy feed-in tariffs in Kenya

Kenya adopted a renewable energy feed-in-tariffs (REFIT) in 2008, a policy it revised in January 2010. The REFIT aims to stimulate market penetration for renewable energy technologies by making it mandatory for energy companies or utilities to purchase electricity from renewable energy sources at a pre-determined price. This price is set at a level high enough to stimulate new investment in the renewable sector. This, in turn, ensures that those who produce electricity from renewable energy sources have a guaranteed market and an attractive return on investment. Aspects of a REFIT include access to the grid, long-term power purchase agreements and a set price per kilowatt hour (kWh). Kenya REFIT covers electricity generated from wind, biomass, small hydro, geothermal, biogas 1300 MW of electricity generation capacity.

The advantages of this policy include: (a) environmental integrity, including the reduction of greenhouse gas emissions; (b) enhancing energy supply security, reducing the country's dependence on imported fuels, and coping with the global scarcity of fossil fuels and its attendant price volatility; and (c) enhancing economic competitiveness and job creation. As Kenya's greatest renewable energy potential is in rural areas, the effects of the feed-in tariff policy are expected to trickle down and stimulate rural employment.
For more info: http://www.unep.org/greeneconomy/SuccessStories/tabid/4652/Default.aspx#panel-2

(b) Tunisia's solar energy plan

In order to become less dependent on energy imports and the volatile prices of oil and gas, the government of Tunisia decided to develop its potential for domestic renewable energy generation. A

2004 law on energy management provided a legal framework. In 2005, funding mechanisms such as the National Fund for Energy Management became available for deploying renewable energy technologies and increasing energy efficiency. Between 2005 and 2008, clean energy plans enabled the government to save nearly €900 million in energy bills (equivalent to 10 per cent of primary energy consumption), with an initial investment in clean energy infrastructure of only €260 million. The renewable energy supplies and energy efficiency measures are expected to have reduced total energy consumption from conventional sources by about 20 per cent in 2011. In December 2009, the government presented the first national Solar Energy Plan and other complementary plans with the objective of increasing the share of renewable energy sources to 4.3 per cent of total energy generation in 2014, up from the current level of 0.8 per cent. The objective is to transform Tunisia into an international clean-energy hub. The Solar Energy Plan is based on three main technologies: solar PV, concentrating solar power and solar water heating systems, and comprises 40 renewable energy projects. The Plan's budget through to 2016 is €2 billion, while its savings on energy imports are expected to reach more than 20 per cent per year by the end of that year. (Agence Nationale pour la Maîtrise de l'Énergie, 2009))

Key messages with policy implications for attaining Green Growth in Africa:

- Africa should develop its own balanced and sustainable development strategies to leapfrog traditional industrial development path;
- International cooperation should be strengthened so as to facilitate technology/knowledge transfer as well as seeking funding support from developed countries;
- Regional cooperation within Africa should also be strengthened so as to address trans-boundary issues as well as sharing Green Growth knowledge; and .
- Strong Government Leadership should encourage action-oriented Green Growth strategies at the same time putting in place appropriate political/institutional framework, national strategies on green growth, green technology development plan, etc.

(Source: Myung-Kyoon Lee, Green Growth Institute, South Korea, 2011)

5.4.6 How to identify technology needs for TNA

The framework for meaningful actions to enhance the implementation of **Article 4.5** defines Technology Needs Assessments (TNAs) as, "a set of country-driven activities that identify and determine the mitigation and adaptation technology priorities of Parties other than developed country Parties, and other developed Parties not included in Annex II, particularly developing country Parties. They involve different stakeholders in a consultative process to identify the barriers to technology transfer and measures to address these barriers through sectoral analyses. These activities may address soft and hard technologies, such as mitigation and adaptation technologies, identify regulatory options and develop fiscal and financial incentives and capacity-building" **(Decision 4/CP.7**).

The purpose of technology needs assessments is to assist in identifying and analysing priority technology needs, which can be the basis for a portfolio projects using environmentally sustainable technologies (ESTs) and programmes which can facilitate the transfer of, and access to, the ESTs and know-how in the implementation of Article 4.5 of the Convention. Figure 5.3 shows an example from Ghana for the Technology Needs Process.

Figure 1. Ghana Technology Needs Assessment Process

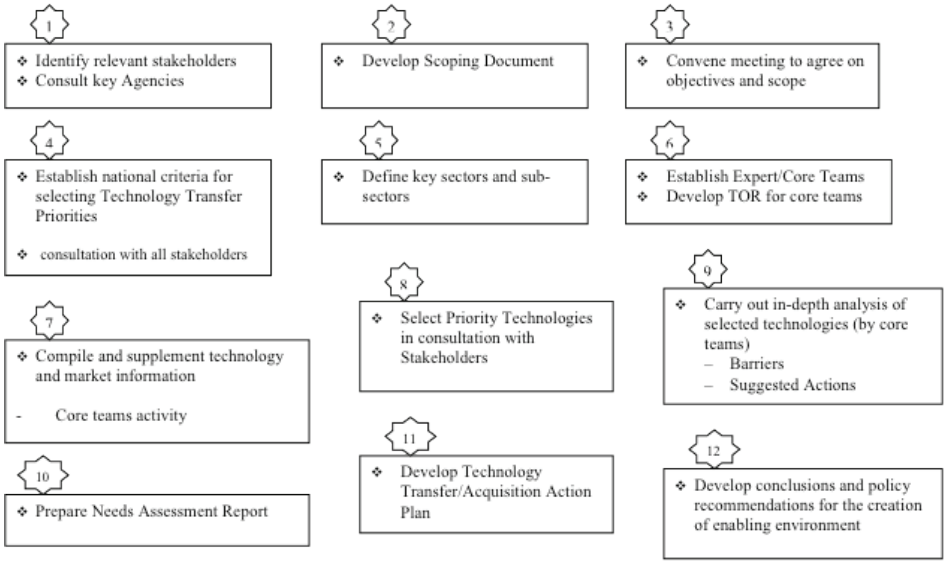


Figure 5.3: Extract from Ghana Technology Needs Process
Available: unfccc.int/.../TNA/Ghana/

Section 5.4 has outlined some of the different approaches and considerations to identifying and assessing mitigation needs and opportunities. This next section considers some of the issues relevant to taking these mitigation opportunities closer to implementation.

5.5 Moving Mitigation Opportunities Closer to Implementation

The previous sections have touched upon issues relating to the opportunities and challenges from mitigation and considerations when identifying mitigation needs. However once these important factors have been taken into account, then we need to identify mitigation opportunities closer to implementation. This will depend on the national circumstances, the type of mitigation need, the scale of resources and technical skills. Some potential considerations (not necessarily sequential):

Identify the action: stakeholders from industry or government

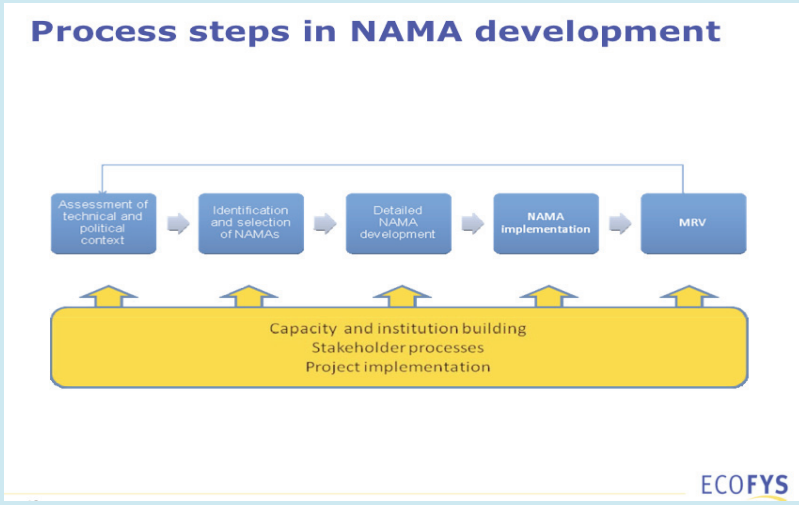
- Assess appropriateness of enabling environment: policy drivers/disincentive
- This process should be undertaken through multi-criteria analysis (MCA) that will involve stakeholders. The process of MCA is described in chapter 4.
- Technical assessment: CO2 Emissions, cost – need modeling capacity and good data
- Allocate responsibility: which institution will drive this and engage?
- How will this be measured: identify performance indicators, is there domestic capacity to MRV?
- Implement the action: Even once action has been identified who will implement?
- Operationalisation: is there capacity to construct/ operationalise the project?
- Project related issues: Ownership, financing, design, construction etc.
- Measuring and reporting action: Undertaking the MRV

Some of these issues need to be resolved at a domestic level (such as enabling environments). International technical, capacity or financial support can also be provided for preparing these components. However the nature of a 'nationally appropriate' mitigation action requires initial mapping of processes, capacity and resources to be done at a domestic level.

Box 5.3: NAMAs – framing mitigation actions as investment opportunities?

The process of identifying potential mitigation actions and framing them as a NAMAs is an essential step for taking mitigation plans, scenarios or broad policies into implementable actions. African countries should undertake mitigation actions that are well aligned with their development goals, with domestic resources. But for actions, which impose an additional cost, they can then seek support – whether it is international, bilateral or regional. The extent of action by African countries will thus depend on how support flows to the continent. Preparing a NAMA is effectively a way of presenting a business plan to attract funding to implement a mitigation initiative. Although the final format and function of a NAMA has not yet been finalized, work is emerging on the potential elements of a NAMA (see Ecofys, 2010)

Potential Process Steps in NAMA development



(Ecofys, 2010)

Regardless of the final format, preparing a NAMA is likely to require technical capacity to identify the mitigation action and potentially quantify the costs or tonnes of CO2 reduced. This requires the technical experts and institutions with the relevant expertise to undertake for example modeling of the potential CO2 reductions; undertake an economic assessment or identify the relevant stakeholders and institutions. Whilst also taking into consideration that actions framed as NAMA's need not only be emissions driven but focus on sustainable development and co-benefits. Furthermore sufficient skills and capacity are required not only to develop a proposed NAMA but also to implement and operationalise it.

5.5.1 Attracting and receiving investment

The CDM mechanism is one way of financing a mitigation project through carbon revenue.
In order for a project to attract investment as CDM it has to meet the following criteria:

i. reduces a GHGs;
ii. additionality;
iii. supports sustainable development in the host country;
iv. uses a specific approved methodology; and
v. results in real, measurable emissions reductions.

However in order to prepare a CDM project sufficient capacity is needed to i) identify the CDM project ii) prepare and submit a CDM application and then iii) finally to implement the CDM project.

Similarly, financial support will be provided to support developing countries to prepare and implement

their NAMAs, however this requires sufficient capacity to identify, prepare and then eventually implement the mitigation action.

5.5.2 . Monitoring Reporting and Verification (MRV)

Sound MRV processes are necessary to demonstrate and track implementation of mitigation efforts and also to ensure financial support is being delivered. It also provides an opportunity to showcase tangible mitigation efforts that have been implemented and estimate their contribution to national emissions reductions. Robust MRV processes in a developing country context will assist in attracting support from international climate finance as it provides a reporting mechanism. Developing countries expect developed countries to fulfill their commitments on 'measurable, reportable and verifiable' support on technology, financing and capacity building (UNDP, 2008).

The Bali Action Plan calls for mitigation (emissions reduction) commitments or actions by developed countries and mitigation actions by developing countries, as well as support for the actions of developing countries in the form of technology transfer, financing and capacity building. All three parts of MRV need to be understood together (Winkler, 2008). According to the plan, these commitments, actions, and support would all be "measurable, reportable and verifiable".(MacMahon, et al., 2009). This language on "measurable, reportable and verifiable" (MRV) was introduced to apply both to developed countries' commitments and actions (paragraph 1b(i) of the BAP) , as well as to "nationally appropriate mitigation actions by developing country Parties in the context of sustainable development, supported and enabled by technology, financing and capacity-building" (paragraph 1b(ii) Ellis ,2009).

At COP16, the Cancun Agreement issued guidance for developed and developing country Parties in terms of MRV provisions as they relate to actions by developing countries. This is outlined in paragraphs 61 and 62[28]. The actual reporting requirements for both internationally supported and domestically supported mitigation actions are still undecided - "with guidelines to be developed under the Convention". In this regard it is difficult to know how and what will have to be reported on. However there is agreement that only actions relying on international support are subject to international MRV guidelines whereas domestic actions only require MRV at a domestic level.

Although there is agreement that mitigation actions, as well as financial support, are subject to MRV, it is not clear yet what metric will be used as a measure. In terms of the mitigation actions will it be the efforts or effects (see The National Development and Reform Commission (NDRC) of the mitigation action,which will be measured e.g. measuring the installation of the wind turbines or measuring the reduced emissions based on offset grid electricity? These metrics will vary depending on whether the mitigation action is based on REDD, energy, transport or land use.

Whilst there are still decisions being made around the format and metrics adopted in the International Guidelines for MRV, it is also important to consider what the implications are for those actions which are only subject the domestic MRV.The process for carrying out MRV of mitigation actions can also vary, thus countries may need to agree on specific issues around the requirements for the 'M' the 'R' and the 'V'(Ellis and Moarif, 2009)).

A 'domestic MRV' system may entail different elements for developing countries.Sufficient capacity and resources are needed for identifying existing systems and data collection methodologies, which can then be built upon to create a robust domestic MRV system. Furthermore mitigation actions can span different sectors and inevitably data availability and reporting will vary across different sectors such as transport, energy or agriculture. There are different stakeholders potentially already involved in such

28 Para 61. Also decides that internationally supported mitigation actions will be measured, reported and verified domestically and will be subject to international measurement, reporting and verification in accordance with guidelines to be developed under the Convention; Para 62. Further decides that domestically supported mitigation actions will be measured, reported and verified domestically in accordance with general guidelines to be developed under the Convention (UNFCCC, 2011)

processes and there will be issues around confidentiality. Technical capacity to undertake the MRV such as measuring, collecting and analysing data and then compiling this information is critical.

In terms of the MRV of financial support from developed countries, the Cancun Agreements established a registry that will help developing countries match their projects with available international support.[29] The registry's function to facilitate matching of action and support will be important to ensure the MRV'able support is provided (para 57 of 1/CP.16). The work programmed outlined in para 66 of 1/CP16 include the development of modalities and guidelines for "facilitation of support to nationally appropriate mitigation actions through a registry" and "measurement, reporting and verification of supported actions and corresponding support". A common reporting format for finance will be crucial in ensuring transparent MRV of support. In other words, MRV will be further elaborated through negotiations, while the funds themselves are negotiated in the Transitional Committee that is designing the GCF.

5.6 Key benefits, opportunities and challenges and main actionable points

In summary, some of the key benefits, opportunities and challenges that could be realised by considering mitigation in the African context are outlined below. (See also Annex 1)

- Although mitigation has not historically been the focus for the Africa region, there is recognition that moving to a low carbon development approach could be beneficial for a developing country economy competing in the global context
- Practitioners must be aware that some of the issues relevant to mitigation are still being negotiated under the UNFCCC such as the form and function of NAMA's, the NAMA registry and MRV whereas other initiatives such as the TNA's and CDM mechanism have been operational for some time. Therefore the focus for practitioners will vary depending on which aspects of mitigation they are involved in from UNFCCC negotiation through to on-the-ground project implementation.
- This chapter has outlined some of the opportunities from mitigation efforts relevant for the African region:
    - ◊ The REDD mechanism offers an opportunity for rural communities in terms of cash flow as well as new technologies that can contribute to the reduction of deforestation and degradation;
    - ◊ Through the Technology Mechanism the transfer and deployment of new and existing technologies provide an opportunity to access alternative mitigation technologies, introduce new markets as well as develop technical skills and capacity;
    - ◊ Similarly, the CDM mechanism allows for north-south collaboration for knowledge sharing and technical capacity building through mitigation projects;
    - ◊ NAMA's can be framed in such a way to increase the sustainable development and co-benefit opportunities from mitigation initiatives
- Different approaches for identifying mitigation needs have been presented – from GHG inventories, to Low Carbon Development Strategies. The approach appropriate for the national context must be pursued and will also depend on local resources and capacity.
- In terms of taking mitigation initiatives closer to implementation, an outline of steps from identification of the appropriate mitigation action through to outlining an appropriate MRV strategy has been provided in section 5.5. Furthermore it is essential to develop capacity to identify mitigation needs and frame them in such a way that they can attract the necessary and available finance – whether through NAMA's or CDM.

29 http://www.wri.org/stories/2011/04/transparency-climate-finance-results-cancun-and-next-steps

Chapter 6:

OPPORTUNITIES FOR AFRICA TO PARTICIPATE AND BENEFIT FROM INVESTMENT IN ADAPTATION AND MITIGATION FOR SUSTAINABLE DEVELOPMENT

Introduction

Climate change is a global threat that will impact the entire African continent. In addition, the continent's low economic development, extreme poverty, dependence on primary sectors, means that it has a limited capacity to adapt and protect itself from these impacts (Boko et al., 2007). While climate change has made new challenges emerge for African countries, it has also provided new opportunities for both public and private investments which, if embraced, can create new development opportunities and drive economic growth.

Substantial political efforts will be required in order to promote increased and improved climate change investments especially as increasing investment to mitigate climate change and co-benefit the ongoing adaptation effort can also provide an opportunity for African countries to sustain national efforts aiming at achieving Millennium Development Goals (MDGs) and poverty Reduction strategies. The resources necessary to help Africa's adaptation and mitigation efforts including managing disaster risk and following a low carbon development are limited and scattered among many national priorities and competing agenda such as poverty reduction, and conflict resolution.

Total existing commitments to funds for dealing with climate change is inadequate as compared to the substantial requirements. And the current carbon finance mechanisms are not delivering the resources which Africa needs. The large deficit of funding and the impediments that hold back Africa from accessing these funds have made financing a major concern in the fight against climate change. Moreover, the ability of Africa to access these resources is constrained by the lack of capacity to develop fundable projects and get sufficient funding. Disbursing adequate financial resources to Africa would assist the continent address adaptation needs, develop institutional capability, acquire and build capacity for applying technologies and promote long term investments.

This chapter will present the role of national, regional and international policies and institutional frameworks in enabling African countries to access climate change financing and the role of institutions in providing supportive frameworks for governments when making decisions on climate change priorities and fully integrating climate change issues into national policies. Such policy initiatives will provide clear signals for project developers (public and private sector promoters, NGOs, communities) and local authorities on potential areas for mitigation and adaptation activities. Guidance is also provided on the main sources of funding for the African region and the socioeconomic impact of climate proof investments in Africa, on the investment priorities by sectors to address some of the most urging development issues in the region which if addressed will support employment, improve economic performance and alleviating poverty. Finally, the chapter will examine the means of making climate investments happen and ensuring their sustainability through appropriate human skills and entrepreneurship and a conducive investment climate on the African continent.

6.1 Policy Overview: Climate Change Related National, Regional and International Policies

Some of the policy frameworks cited as relevant to enabling climate change mitigation and adaptation (Dovers and Hezri, 2010; Hussey and Dovers, 2007; IPCC, 2007) include:

- National policies
- Integrated planning and policies
- Financial incentives (e.g., eco-taxes, environmental friendly subsidies)
- Research and development policy
- Standards and regulations that incorporate climate change considerations
- Integrated land use planning
- Linkages across policy sectors and to 'sustainable development'.

One of the indicators for African countries engagement in the global frameworks for climate change mitigation and adaptation is the submission of each country's Initial National Communication (INC) and National Adaptation Programme of Action (NAPA) to the UNFCCC. Without Climate Change Policy framework or at least elements of it in place, host countries cannot approve CDM projects and are limited in their access to adaptation funding, which poses an additional investment risk to potential project developers or hinders the funding of adaptation projects or programs (Coninck, et al., 2007; UNCCD, 2009).

However, the established institutional frameworks to support the development of mitigation and adaptation projects in Africa is generally weak. The INCs are of variable quality and in many cases offer limited guidance as to the mitigation and adaptation priorities of each country. More encouraging is the overall quality of the NAPAs that appear more focused and propose several detailed project examples for which clear goals, objectives and funding requirements are established. Many of the project ideas relate to the agricultural land-use, forestry, and renewable energy sectors. More specifically activities that focus on reforestation and improved forest management, improved agricultural land management, installation of solar voltaic panels and improved cooking stoves, and improved grazing land management have all been proposed. However, the lack of clarity observed in some of these key documents raises concerns as to the degree that mitigation and adaptation priorities have been identified and incorporated into national policies. While the region has received little in the way of financing for on-the-ground mitigation or adaptation activities, the sheer number of initiatives, particularly in relation to REDD, are an encouraging sign that this region will take a more prominent role within the carbon markets in the future (UNCCD, 2009; URT, 2007).

6.1.1 Level of engagement of African countries

The argument for a strong response to climate change from those responsible for development policy is becoming clearer and more urgent, and is now widely supported (IPCC, 2007). The policy response that is required needs to be better, quicker and more coherent to capture natural dynamics and encompass human systems (Boyd et al., 2009). In this regard, however, government responses have been low and face constraints in driving adaptation (Handmer and Dovers, 2007; Penning-Rowsell et al., 2006) and much of the adaptation efforts have been done by private sectors.

So far, the region has been unsuccessful at accessing adaptation funding. African countries are exclusively Non-Annex I countries (i.e. developing countries) and therefore only able to benefit from the CDM (UNCCD, 2009). Although the CDM is the largest project-based market currently operating

for GHG mitigation projects; Africa's presence within the voluntary carbon markets is similarly limited. Up to 2008, CDM projects hosted in African countries accounted for only 2% of all over-the-counter transaction volumes in 2007 (Hamilton et al., 2007). On the 1st February 2009, only 28 African CDM projects, representing 2% of all projects were registered for Africa. The majority of these projects were located in South Africa (14 registered projects), Morocco (4), Egypt (4) and Tunisia (2). Nigeria, Tanzania, Kenya and Uganda also registered one project each. As of yet, there were no registered projects in the Central African sub-region (UNCCD, 2009; UNEP Risoe, 2009).

In light of the constraints, African countries face in mitigation and adaptation processes, Africa's greatest mitigation potential lies in the AFOLU sector. This recognition has led to a series of regional and sub-regional programs being established to improve the continents access to carbon markets. The UNFCCC launched the Nairobi Framework, while the efforts of the Common Market for Eastern and Southern Africa (COMESA), ECOWAS, SADC and Commission for the Forests of Central Africa (COMIFAC in French) are most notable for their coordinated efforts at a ministerial and sub-regional level. Generally, adaptation must become an organizing principle across policy sectors and acted upon in the near term, inviting a focus on how that can be achieved through public policy and administration (UNCCD, 2009).

6.1.2: Benefits of engagement

Some of the significant benefits for African countries to participate in the global initiatives of mitigating and facilitating adaptation from climate change impacts include the access of funding opportunities coming through the UNFCCC. Under the UNFCCC, industrialized countries recognize the responsibility to assist developing countries' adaptation efforts, primarily through the provision of financing for adaptation measures. These funds represent the most concerted efforts to date by the international community to finance activities and projects aimed at improving the adaptive capacities of communities in developing countries. Some of the global fund sources for mitigation and adaptation to climate change include:

- **Global Environment Facility** covered under chapter 7
- **The Strategic Priority for Adaptation Fund**, especially to finance concrete adaptation projects, primarily in the areas of biological diversity, climate change, international waters and land degradation.
- **Least Developed Country Fund** –focusing on supporting the implementation of LDC NAPAs and their most urgent adaptation needs; Special Climate Change Funds –focusing on projects in Non-Annex 1 countries to support adaptation, transfer of technologies, energy, transport, industry, agriculture, forestry, and waste management, and activities to assist developing countries whose economies are highly dependent on income generated from the production, processing, and export or on consumption of fossil fuels and associated energy-intensive products in diversifying their economies (UNCCD, 2009).
- **Adaptation Fund**- established under the kyoto protocol for concrete adaptation projects and programmes in developing countries that are particularly vulnerable to the adverse effects of climate change.
- **Clean Development Mechanism (CDM)** that promotes investment in GHG abatement technologies in, among others, forestry and agriculture, energy generation, energy usage, waste management, and transportation sectors by providing an incentive for emission reductions in the form of tradable credits (More on these funding sources, please see chapter 7}.

In parallel to the Kyoto markets – fundamentally compliance markets shaped by governmental regulation – voluntary carbon markets have stimulated a growing number of project developers implementing projects, many of them in developing countries, to create offset credits for the voluntary markets (ibid). Despite initiatives in place to balance future climate conditions, there are indicators showing that

determining the future of the climate regime is a complex process influenced by the need to balance the diverse interests and national circumstances of developed and developing countries, to enable continued economic development in all countries, and to promote significant energy development in developing nations (IISD, 2009; UNCCD, 2009)

6.2 Approaches to Climate investments in Africa

Africa is well positioned to attract climate investments as global climate change financing architecture takes shape and realigns with the general interests of the Least Developed countries. Opportunities may be explicit or implicit in the current global and regional investment financing frameworks. This section of the chapter focuses on opportunities for climate related investments in current and future terms and links with Chapter 7, which will elaborate how the opportunities can be tapped through financing mechanisms. Opportunities for Africa are in respect to advancements, gains and profits that lie with strategies of adaptation and mitigation to climate change investments. Realizing the difficulties that African countries face to tap into the opportunities, the chapter will end with a summary of key challenges to realizing the identified opportunities. The challenges can offer a basis for tapping the opportunities if identified up-front.

6.2.1: Overview of investment approaches in national climate strategies

A number of countries have or are in the process of developing strategies to address climate challenges. These strategies manifest in form of NAPAs, NAMAs, INCs, PRSPs, National Climate Change Strategies (NCCS) and more recently NAPs or specific sectoral strategies. A key thread in these broad strategies is the identification of extent of risks and vulnerabilities on the backdrop of which interventions or projects are identified and prioritized. From continental to national level, the most dominant approach is the project-based planning and implementation of climate change investments. Through multi-lateral, bilateral and other financing arrangements, funding streams are likely to increase with high confidence. But as funding gets available and Africa taps into the opportunities, three main approaches to investing in climate change related strategies are important to evaluate. The choice of the approach will differ from one country to another and between strategies al different levels.

Project based approach

The project-based approach is by far the most widely used entry point for investing in climate change related activities. Most available financing mechanisms (CDM, GEF, AfDB, World Bank) require countries to submit projects many of which are sector and thematic specific. Projects that have been implemented range from agriculture, energy, water, waste-energy and forestry. The processes for accessing resources to implement these project differs from institution to another (this is covered in chapter 7) but the likelihood of continuity to access resources and investing in climate change strategies through project-based approach is high. Most financing mechanisms such as CDM, REDD+, GEF and the new arrangements under AfDB still require preparation of project proposals with two key issues; first the capacity to develop proposals by African governments and secondly the alignment of national priority adaptation and mitigation issues with the priorities under the financing mechanisms. This way, opportunities will be realized for Africa's investment in adaptation and mitigation and the focus is near to short-term interventions. The key challenge of this approach is the dotting around the continent of projects which hardly hang on a framework with scalable impacts or outcomes.

Programme based approach

The program-based approach focuses on a specific sector to develop a medium to long term strategy for adaptation and or mitigation. The spatial scale is important for this approach which implies a series of sequenced investments in a sector over time and across country or regional levels. This program based approach has not widely been used due to resource requirements and capacity to plan for the scale of investments. However, there are some cases though not climate related where programs have been developed and implemented mainly through institutional investments. In the cases where the approach is appropriate, projects are identified and implemented on case-by-case basis but linked to the program aim and framework. The key challenge of this approach is in relation to resource requirements, mobilization and it may require cross-border collaborative strategies, differences in country and regional priorities may hinder progress in investments that are appropriate for use of this approach. The programme based approach is for instance used by the European Commission within its cooperation initiatives.

Sector-wide approach

A third level approach to investments is the sector-wide approach which is a recently adopted approach due to increasing realization of the inter-connectedness of adaptation strategies and now also to mitigation. The discourse around co-benefits, spillover effects of adaptation and mitigation strategies is enabling a wider planning for climate change investment that is also long-term and covers extensive spatial scale in terms of coverage. More recently national sector-committees have been established and now emerged as an arm of the governance structure for purposes of directing and reviewing performance of budgets and development programs. This is an opportunity for climate change related investments that can be mainstreamed into the sectoral reviews, planning and guidance. One such sector-wide committee is the Agriculture, forestry and natural resources management committee at national level but also AMCEN at continental level. Climate change investment ideas and programs can be initiated, designed and guided by this approach with an upstream benefit of cross-border scale investments.

In summary the three approaches have varying degrees of use in Africa but as financing mechanisms evolve and become more streamlined for climate change investments, the choice for an approach will mots likely be determined by the priorities and process requirements of the financing institutions on one hand but also the priorities of the countries and their level of engagement and capacity to plan and design climate investments at various scales.

6.2.2: Tools and approaches to identify investment needs

Various tools and approaches can be utilized to identify climate change investment needs. **The generic tools are embedded in the Initial National Communication reports (INCs), the National Adaptation Program of Action (NAPAs), National Appropriate Mitigation Action (NAMAs), National Action Programmes (NAPs) and Poverty Reduction Strategy Papers (PRSPs) that have mainstreamed climate change.** These tools offer the first level identification of areas and projects, which would attract investments. At this level there is a more general outlook at what can be done as determined by the priorities in the strategies. More specifically analytical tools are needed to assess the feasibility of the investment ideas especially those, which may require involvement of the private sector. Investments that may need private sector involvement and or participation have to be commercially viable to attract investments. A number of tools are available for this level of investment need identification, which transcends to feasibility analysis.

The Cost-Benefit Analysis and NPV analysis offer a robust methodology for assessing which investment can be viable in social, environmental and economic sense. **The Benefit-Cost Ratio** is useful in enabling choice making about different scenarios of a specific investment. These are standard tools that have been utilized and the capacity to undertake national and regional investment needs assessment exists.

The mapping and identification of needs will be a requirement for **participatory consultations** on some of the investments especially the downstream investments that may target households and or communities. Acceptability and chances of adoption will very much depend on community preferences, which have to be taken into account. In addition to acceptance is the strategic requirement to couple climate change investments with development goals so as to realize co-benefits of adaptation and mitigation strategies.

6.2.3: Financial investment mechanisms and instruments internationally established investment initiatives

Financing climate change investments in Africa are done through internationally established initiatives such as CDM, which is a Global Environmental Investment and Credit Scheme that allow compliance trading of certified credits.

Trade-credit offsets

Trade-credit offsets which correspond to credits from trade transaction between developing and developed countries. In the case of a deficit, it can be offset after negotiations through technology transfer, capacity building and or other viable exchanges. There are some countries in Africa, which have explored this tool especially in the energy sector . These tools and instruments for investment offer opportunities for augmenting climate change capital allocation and transfer of technology in Africa.

Voluntary trading of carbon credits

Voluntary trading of carbon credits has also emerged over the past years and provides opportunities for Africa's participation in climate change investments. A set of platforms for international finance investment mechanisms exist in addition to CDM, such as IFC's Financial intermediaries, AfDB's Africa Green Fund and multi-lateral related funding mechanisms which are crucial in tapping resource opportunities for Africa's investment into adaptation to and mitigation of climate change. Within these mechanisms is another set of possible instruments for designing implementing projects and programs.

Private public partnerships

The public-private partnerships have emerged as relatively tested mechanisms for allocating of capital by both sectors to climate friendly investments. The role of the public sector is detailed in the subsequent section but it is important to note that the public sector can create an enabling environment through a set of fiscal tools like risk transfers, insurance and equities in partnership with private sector which may allocate capital to commercially viable investments and with a long tenor or repayment period guaranteed by the public sector.

6.2.4 Role of the public sector

Addressing investment risks

As highlighted in the preceding section, the public sector's role in attracting, guiding and facilitating climate change investments undisputable. One of the biggest barriers for investments both by public and private are risks associated with the country and currency. For example as observed by UNEP 2009, a large proportion of the low-carbon sector only exists in response to carbon policy which makes the public sector institution's role unparalleled. One of the instrument through which the public sector can play a significant role is through the Public Finance Mechanism (PFM).

If implemented well by removing institutional barriers, PFMs can have co-benefits and spillover effects for adaptation and mitigation. In addition to this innovative package, public sector can also play the

traditional role of regulating, guiding, establishing climate funds and monitoring the use of the fund. A key issue for tapping the opportunity is the need for institutional readiness to invest in climate change investments that requires institutional transformation. In addition, African institutions at all levels may require to lead and guide by example through institutional process changes including but not limited to energy use, institutional climate policies (reducing energy use, business process re-engineering, greening of the economy) providing green stewardship in respect to a range of public sector investments and programs.

Public partnerships involving public institutions (donor agencies, local governments, public financial institutions etc) and private sector insurance and financial institutions are needed in order to develop innovative risk management mechanisms that share the risk between the two parties and that would attract investments in climate related sectors such as renewable energy, sustainable agriculture, etc (UNEP, 2009).

Box 6.1: Public Finance Mechanism (PFM)

PFM is in form of a package that includes risk cover rather than direct financing. PFM can focus but not limited to country risk, currency risk with an all share risk and transfer arrangement between the institutions contributing to an investment. PFM can also include equities, concessional loans and negotiated long repayment periods removing barrier of entry into climate investments by private sector investors or institutional investors, which opens up capital inflows. PFM is potentially useful for enabling investments become commercially viable

Offering a conducive economic and social environment for private sector investments

Adaptation, which is the primary concern of African countries, is primarily a private-sector response and should involve relocation of people, changes in the sectoral structure of production, and changes in crop patterns. The role of government is primarily to provide the information, incentives, and economic environment to facilitate such changes. In parallel, mitigation undertaken elsewhere will have a major impact on Africa, both positive (e.g. transfer and emergence of new technologies) and negative (e.g. commodity price changes arising from biofuel policies) [Collier, Gonway, Venables, 2008], something that governments need to be aware of in order to take the appropriate initiatives.

6.2.5: Role of the private sector

Understanding the linkages between public actions and private reactions

Private actors are presumed to respond appropriately to changing conditions depending on adequate information, appropriate incentives, and an economic environment conducive to investing in the required changes (Handmer and Dovers, 2007; Penning-Rowsell et al., 2006) through which the government has to play a major role. An associated issue for government disengagement is the poor linkage between generic discussions of climate change and possible options, and locally relevant decision-making contexts, and making information on climate change and adaptation relevant at local scales. Other reasons for government slow-rate on climate change adaptation efforts and policy frameworks are significant uncertainty surrounding timing and magnitude, especially at scales at which national, sub-national, and local governments, communities, and firms comprehend and make decisions regarding their portfolio of responsibilities (Brooks et al., 2005; Adger, 2006; Folke, 2006; Nelson et al., 2006; IPCC, 2007)

Improved public private cooperation to define investment priorities

The preoccupation of the private sector is to make sure that their investments are not at risk and in that context can help the state by contributing to the definition of national/sartorial priorities. Within public-private partnership they can also be at the position of providing good data (related to their activities) to the state so that the government had a good overview of the vulnerability situation of the country. In addition private sector has a huge potential for being climate change stewards by adopting company green policies in various ways that include and not limited to business process re-engineering, social corporate responsibility, environmental corporate responsibility and technological transfer.

6.3 Climate Change related Investment and financial trends: qualitative and quantitative assessments

African states face challenges when attempting to mobilize funding for climate change mitigation and adaptation projects. According to the figures published by the Africa Progress Panel Policy Brief published in June 2010, there is a need of $10.8–20.5 billion per year to finance Adaptation, disaster and coastal protection. Achieving the MDGs while taking into consideration climate change will require some $100 billion per year. At the moment, for adaptation despite the lacking of clear figures it is estimated that some $50–100 million are flowing per year to Africa. The African development bank estimated that 12% of climate financing flows from Multilateral Development Banks reach Africa, compared to 37% for Europe and MENA, 26% for Asia-Pacific and 24% for Latin America.

6.3.1: Water (availability and quality)

Water scarcity will increase for both urban and rural populations in Africa over the next century. Climate change is expected to bring more frequent and longer droughts to the region. Drought in rural areas may be a major trigger for in-migration to urban areas, further stressing urban infrastructure. Falling agricultural productivity in the region will place increased strain on local food markets, thus increasing rates of malnutrition in slums.

Sanitation investments

Until a decade ago, investments in sanitation and water management were focusing on urban area with the AfDB, for instance, allocating 80% of such investments in urban programmes. This trend is now shifting to rural areas. The Rural Water Supply and Sanitation Initiative(RWSSI) of the ADB is one of the main African initiatives working to increase water and sanitation in Africa and to provide sustainable water and sanitation services to about 300 million people in rural Africa by 2015. This effort requires USD14.8 billion of which 3 billion was estimated to have been mobilized in phase 1 (2003-2007) out of the 4.5 required for that phase. In 2009, between USD 4.5 and 5.5 billion were mobilized and the additional funding required from 2010 - 2015 is expected to be about USD 9 to 10 billion.

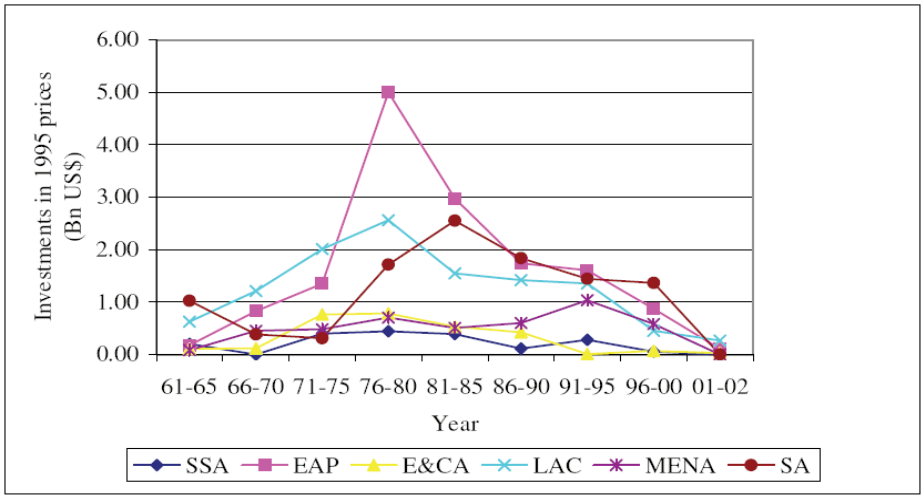
Irrigation investments

More than three quarters of the poor in Africa are in rural areas, dependent on smallholder agriculture and related trade, services and crafts for their livelihood [IFAD, 2001]. Improved management of land and water can make significant contributions to overcoming some of the major challenges confronting sub-Saharan Africa: feeding a growing population, providing opportunities to escape poverty, and achieving sustained economic growth. However, in sub-Saharan Africa (SSA) a decreasing trend is observed from already very low levels of investment. More than turning around the decline, in SSA the issue is how to substantially increase the historically very low levels of spending on irrigation and drainage. The common denominator in the declines and low investments is the disappointing performance of development to

date in terms of sustainability and returns on investment. Moreover, the decline in irrigation lending has been matched by declining farm-gate prices for food crops and further depressing returns to investment in agricultural water. That decline and low level of investment has continued for more than 20 years indicates that the sector has been slow to respond and adapt to change. However, if the decline in investment is to be turned around and increased substantially, innovative approaches to agricultural water development are now required [African Development Bank, 2004].

Historical figures on lending for infrastructure development for irrigation and drainage by region show general declines for all regions with Africa receiving the least. See figure 6.1.

Figure 6.1 Trends in Investments in Irrigation and Drainage, 1961-2002



Sources of data: World Bank, Asian Development Bank, and the Intern-American Development Bank. SSA stands for sub-Saharan Africa, EAP for East Asia and the Pacific, E&CA for Europe and Central Asia, LAC for Latin America and the Caribbean, MENA for Middle East and North Africa, SA for South Asia.

Assessing and mapping freshwater resources

Assessment of freshwater is becoming of increasing importance with regard to the growing pressure on this scarce resource. The current interest in issues related to global water resources assessment has been emphasized after the UN-CSD called for a freshwater assessment exercise and more recently when the World Water Council, the Global Water Partnership and the World Commission on Water in the 21st Century decided to promote a World Water Vision for the year 2025 [FAO, 2011].

For the African continent as a whole, 85 % of water withdrawals are directed towards agriculture and this percentage is even higher in the arid and semi-arid part of Africa. In those areas the water withdrawn for agriculture from the hydrologic system may represent a significant part of the water resources. Assessing the impact of irrigation on water resources, the potential for future development and the overall impact of human activities on the water cycle requires an approach by river basin. In the framework of the AQUASTAT survey, data on water use for irrigation were collected and presented on a country basis (FAO, 1995a; FAO, 1995b). Africa is the first continent for which the AQUASAT information system has been completed. The information collected and processed consists of a set of tables and maps on water resources and irrigation at continental level and by river basin (major basins and sub-basins) resulting from simulations on the water balance model [FAO, 2011] and should be used by African states in the

context of water irrigation and sanitation infrastructure projects.

6.3.2: Coastal zones

African coastal zones are of significant cultural, environmental, social, and economic importance. Though there are ecological similarities across African coastal zones, the heterogeneity in biodiversity, social-cultural values and environmental services is of critical importance to sustenance of these fragile ecological systems. Based on history of exploitation, degradation and factors that are locale specific, coastal zones accommodate differing densities of human habitation [UN Habitat, UNECA, CIESIN, SEDAC, WCS, 2008].

Investments to restore and rehabilitate coastal zones

By 2003, only 1% of the coastal and marine zone total area was protected [WRI, 2003]. Realizing the extent of degradation, African governments, local governments and communities are responding by mobilizing resources to restore and rehabilitate coastal zones [Darkwa, 2010]. The key driver of coastal restoration is the ecological but also economic value of the mangroves that support livelihoods of many communities in Africa but also the associated commercial potential. Thus regeneration of natural vegetation, upstream soil-water conservation and river-mouth management to resuscitate ecological services from the coastal zones has been an investment area by African governments. Through bilateral, multilateral and other financial arrangements, coastal zones of Saint Louis, Djibouti, Mombasa, Durban, Cape Town, Niger Delta, Port Said, Alexandria, Casablanca, Mozambique and Cape Coast in Ghana have attracted international attention and technical as well as financial support to restore the ecosystems [Darkwa, 2010; Rebelo, 2009].

Investments in environmental management for coastal zones

Financial flow streams indicate an increase in funds generally targeting environmental management with a proportion for coastal zone restoration. Due to clouding of climate change funding by REDD+, knowledge gaps exist in regard to funds targeted at coastal zones specifically [Ballestros, 2011]. The trade value of marine and brackish resources in sub-Saharan Africa has increased from 100.3 metric tons to 10,758 metric tons the latter valued at 2.4 billion USD [WRI, 2011]. As a proxy for resource use, the export values indicate a surge in resource extraction which couples with other pressures of tourism, transportation and oil exploration. On the other hand the economic value also reflects to some degree the finance inflows for countries with extended use of coastal resources.

Putting coastal zones on the agenda for adaptation financing

Despite this level of vulnerability, coastal areas have not been raised up the agenda for climate change adaptation and mitigation especially in the context of marine resource use and restoration of ecosystems. However there is considerable degree of planned and ongoing responses in coastal zones with high population densities which are synonym to cities [Rebelo, 2009]. Whereas the targets of mitigation are quantifiable and can easily be monitored, when it comes to adaptation in coastal zones, the indicators are largely qualitative. In addition learning is key as communities and governments work on adaptation issues of coastal areas. There are a couple of challenges for effective utilization of the financial inflows. These are the longstanding issue of corruption, absorption capacity of governments and effective monitoring and evaluation. Thus formulating monitoring and evaluation frameworks utilizing participatory evaluation approaches promise to engage all stakeholders in restoration of coastal zones.

6.3.3: Terrestrial ecosystems and biodiversity

Assessing the value of ecosystems and biodiversity

Ecosystems influence climate, and vice versa, and climate change has an adverse effect on the balance of ecosystems (UNCBD, UNEP, 2007). From an economic point of view, biodiversity and ecosystems can broadly be seen as part of our natural capital, and the flow of ecosystem services is the "interest" on that capital that society receives (Costanza and Daly, 1992). Just as private investors choose a portfolio of capital to manage risky returns, there is a need to choose a level of biodiversity and natural capital that maintains future flows of ecosystem services in order to ensure enduring environmental quality and human well-being, including poverty alleviation (Perrings et al., 2006). Thus, there is a need to assess the monetary value of ecosystems services and biodiversity in order to develop appropriate conservation policies and quantifying required investments. In summary, there are at least six reasons for conducting valuation studies (TEEB, 2010):

- Missing markets Imperfect markets and market failures
- For some biodiversity goods and services, it is essential to understand and appreciate their alternatives and alternative uses.
- Uncertainty involving demand and supply of natural resources, especially in the future.
- Government may like to use the valuation as against the restricted, administered or operating market prices for designing biodiversity/ecosystem conservation programs
- In order to arrive at natural resource accounting, for methods such as Net Present Value methods, valuation is a must.

The valuation of ecosystem services has been at the heart of the United Nations Convention on Biological Diversity which called for the conservation of biological diversity, sustainable use of its components and the fair and equitable sharing of benefits from resource exploitation genetic (UNCBD, 1992). The fragility of forest ecosystems, wetlands, lakes dry up, the disappearance of animal species and desertification in Africa opened a major scheme for investments. The reorientation of development policies on the continent, as part of mitigation strategies and adaptation to climate change comes down to promoting the green economy and sustainable development. Indeed, the preservation and restoration of biodiversity in many African countries offer tremendous investment opportunities that can allow the sustainable generation of income namely in the tourism sector.

Investments in ecosystem services as an engine of sustainable development

The role of forests in the binding and sequestration of carbon is well known today. Africa's forests contribute significantly to the recycling of the atmosphere and therefore the well being of humanity. Indeed, the implementation of REDD and REDD + can be seen as an asset offered by climate change to African countries with forest lands. By passing the process, they increase their exchange benefit from a number of funding to cope with the vulnerabilities of forest ecosystems. Faced with the loss of many animal species, Africa has much to gain by investing in the domestication of wild animals in order to safeguard the diversity of animals found on the continent but also of domestic trees that can be a source of household income. These projects, developed with local communities are an effective strategy to protect against climate change and a better way to fight against poaching. Private enterprises in this area should be supported as they create employment in rural areas and ensure the generation of income in the long run from various ecosystem services.

It should also be noted that ecosystems and the biodiversity of arid areas of Africa are often overlooked by investors namely because data are lacking on species that are disappearing (Bonkoungou, 2001). The project of the Great Green Wall is in this context. It contributes to the reconstruction of the plant and

animal biodiversity, but also to the improvement of agricultural production made possible by the agro meteorological conditions of arid regions. Ecosystem services that offer investment opportunities also include flowering plants for bees, caterpillar host trees, ecosystems conducive to the emergence of snails and other edible insects in Africa.

Box 6.2: NAMAs – framing mitigation actions as investment opportunities?

- UN-REDD Programme: United Nations Collaborative Programme on Reducing Emissions from Deforestation and Forest Degradation in Developing Countries (UN-REDD) is a joint initiative of the Food and Agriculture Organization of the United Nations (FAO), the United Nations Development Programme (UNDP) and the United Nations Environment Programme (UNEP). The UN-REDD website (http://un-redd.org/)contains information on all UN-REDD country activities, meetings, resources and background documents.
- World Bank Forest Carbon Partnership Facility (FCPF): The FCPF is a global partnership focused on REDD+. The FCPF assists tropical and subtropical forest countries develop the systems and policies for REDD+ and provides them with performance-based payments for emission reductions. The FCPF website contains information on all FCPF country activities, background information and all relevant Readiness Preparation Proposals (R-PPs).
- Congo Basin Forest Partnership (CBFP): Launched in 2002, the CBFP is based on a voluntary agreement between governments, the private sector, civil society and development organisations. CBFP works in close relationship with the Central African Forests Commission (COMIFAC), with the objective to promote the conservation and sustainable management of the Congo Basin's forest ecosystems
- Congo Basin Forest Fund (CBFF): The CBFF was launched in June 2008 to complement existing REDD activities, as well as to: support capacity building in the Congo Basin region; support effective forest management and sustainable livelihoods; and reduce the rate of deforestation.
- The African Forest Forum (AFF): The AFF is an association of individuals committed to the sustainable management, use and conservation of the forest and tree resources in Africa. The purpose of the forum is to provide a platform and create an enabling environment for independent and objective analysis, advocacy and advice on relevant policy and technical issues. The African Forest Forum has published a series of lessons learned in sustainable forest management in Africa.
- Central African Forests Commission (COMIFAC): COMIFAC is the primary authority for decision-making and coordination of subregional actions and initiatives pertaining to the conservation and sustainable management of the Congo Basin forests.
- Common Market for Eastern and Southern Africa (COMESA): COMESA is promoting climate change strategies through the Africa Biocarbon Initiative, which takes into account the key role African agriculture can play in reducing emissions and increasing carbon stocks across the whole continent.
- Central African Regional Program for the Environment (CARPE): CARPE is a United States Agency for International Development (USAID) initiative aimed at promoting sustainable natural resource management in the Congo Basin.

Source: ISSD website, 2011

6.3.4: Agriculture, fisheries, and food security

Addressing under investment in agriculture, rural infrastructure and human capital

A 2009 study by IFPRI has shown that African countries, particularly in SSA, suffer from low crop yields, a lack of effective irrigation techniques and low access to fertilizers. The direct consequence is a lack of self-sufficiency in agricultural production while the continent has the potential to become a net exporter of agricultural products and that agriculture and rural development are found to drive economic growth in Africa. Furthermore, climate change is increasingly hampering agricultural development. Despite this dramatic situation, the governments of the region are under performing in terms of allocated public spending and private investments in the sector even though agricultural growth rates in the region have increased modestly from 2.4 percent a year in 1980-89 to 2.7 per in 1990-99 and 3.3 per cent a year since 2000. In aggregate, African countries spent 5 to 7 per cent of their national budget from 1980 to 2005 on

agriculture which is much less than their counterparts in other developing countries whereas for Asia the equivalent figure has been 6–15 percent. The share ranges considerably from country to country. Only a few African countries—Burkina Faso, Ethiopia, Malawi, and Mali—have surpassed the comprehensive Africa Agriculture Development Programme(CAADP) threshold of 10 percent of budgetary spending on agriculture in recent years. In fact, nearly half of African countries reduced their spending on the sector in this period(.Furthermore, aid to agricultural development has declined even though aid to developing countries grew by about 5 percent a year from US 7 billion in 1980 to US$27 billion in 2006 with African countries spending only 3 to 6 percent of their aid budgets on agriculture. For instance,Botswana and Nigeria spent less than 1 percent of all aid received on agriculture(Fan, Mogues, Benin, 2009).

Priority investments and success criteria of a national agricultural investment plan

IFPRI studies have shown the following in terms of how different types of public spending affect growth and poverty reduction:

- Agricultural spending generally has the largest positive effects on growth and poverty reduction
- Spending on rural roads and rural education also has significant effects on growth and poverty reduction
- Different types of spending across different geographic areas deliver substantially different returns
- Governments and municipalities need to spend on rural human capital such as rural education which is a factor that contributes substantially to growth in agricultural productivity.
- Public spending must be carefully targeted geographically especially in light of climate change impact (increased drought, increased rains, temperature variability, etc)

The NEPAD has defined the main quality criteria of national agricultural investment Plan/Programmes as follows (CAADP, 2010):

- Technical viability (best returns on investment)
- Compelling case also politically motivated objectives, hence attractive to Governments
- Clear link of the budget to results
- Able to “use” the power of public financing to leverage private financing
- Clarify elements of agricultural budget beyond Ministry of Agriculture

An analysis conducted by the NEPAD and AU in 2011 showed that African government allocated only 1% of their agricultural sub-sector budget to creating an enabling environment, the same share was allocated to science and technology applied in food and agriculture and only 5 % to institutional development coordination and strengthening.

Investing in sustainable fishing

Investing to achieve sustainable levels of fishing will secure a vital stream of income in the long run. The fisheries sector is essential for economic development, employment, food security and livelihood of millions of people in Africa.

Greening the sector requires reorienting this public spending to strengthen fisheries management, and financing a reduction of excess capacity through decommissioning vessels and equitably relocating employment in the short term, all in order to rebuild overfished and depleted fish stocks. The present value of benefits from greening the fishing sector is estimated to be about 3 to 5 times the value of the

necessary investment. The alternative business as usual scenario is continued decline and contraction of the fishery sector, resulting from increased scarcity and collapse of stocks (UNEP, 2011).

6.3.5: Energy

The energy sector is the strategic catalyst for other sectors due to the substantial potential of multiplier effects in other sectors like agriculture, transportation, health, water etc. Thus, limited access to energy or "energy poverty" is one of the greatest challenges to achieving the MDGs in Africa. African firms lose an estimated 5 per cent of their sales due to power outages, a figure that rises to 20 per cent for informal firms unable to afford backup generation. The aggregate economic costs of power shortages are 1–2 per cent of GDP (Foster and Briceño-Garmendia, 2010). Yet, Africa has the world's largest technical potential for renewable energy power generation, through its vast solar, biomass and wind resources. Realizing this potential would drive economic growth, with significant job creation and environmental gains. Transformative strategies are critical here to illustrate the co-benefits of investing in these alternative sources and how they link to the other sectors.

Ensuring access to energy

Bringing sustainable electricity to the rural poor is one of the most important contributions that a green economy can make to African economies. Lack of modern electricity infrastructure in rural regions and access to the development options that electricity opens are frequent impediments to economic development in sub-Saharan Africa, where 74 per cent of the population is without access to electricity. The worst affected are the 83 per cent of the population of sub-Saharan Africa that lack access to modern fuel, and those that rely on biomass burning as the only source of energy (UNDP, WHO, 2009). In Africa therefore, rural electricity is critical to improving environmental health conditions, lighting up homes and schools, running information and communication systems, refrigerating food and medicines and powering rural businesses and industry. Extending rural electrification can also help to enhance linkages between rural farming and non-farming activities, which will be a powerful mechanism for growth and poverty reduction.

Chronic under investment in electricity infrastructure

The energy sector in Africa is characterized by chronic-under investment in capacity expansion and operations and maintenance in energy sector (Veit, 2010). Nevertheless the situation is a little bit different between the Northern part of the continent and sub Saharan countries. In the northern part of the continent public investment had been able to increase the availability of electricity. The challenge is on the maintenance of the investment and connection between North African states and Europe. In sub-Saharan countries, the main source of power is hydro, but the investment in hydropower installations was not followed by high maintenance and the reliance on wood resources is thus still an important issue. Because of this dependency on wood biomass, indoor air pollution & deforestation are leading to 400 000 death per year in sub-Saharan Africa (Veit, 2010).

Global investments in renewable energy jumped by 32 per cent, between 2009 and 2010, to a record $US211 billion. Countries in Africa posted the highest percentage increase of all developing regions (excluding the emerging economies of Brazil, China and India). In Egypt, renewable energy investment rose over the same period by $US800 million to $US1.3 billion as a result of the solar thermal project in Kom Ombo and a 220MW onshore wind farm in the Gulf of Zayt. In Kenya, investment climbed from virtually zero in 2009 to $1.3 billion in 2010 across technologies such as wind, geothermal, small-scale hydro and biofuels. Small but significant advances were also made in Cape Verde, Morocco and Zambia (UNEP, Bloomberg New Energy Finance, 2011). In relative terms, however, investments in clean energy remain negligible in Africa, and concentrated in a very small number of very large projects (UNEP,

Bloomberg, 2010), pointing to the need to enhance the capacity of institutions and people and to significantly leverage increased financing.

Much of the credit for the "mainstreaming" of renewable energy goes to governments that have policies, at the national, State and local levels, driving investment in renewables forward (UNEP, Bloomberg New Energy Finance, 2011).

Developing an integrated regional investment approach

Due to the high potential of Hydropower on the continent, it would be good for countries to have an integrated approach investment that do not take into consideration only energy but also consider other use of water. Other strategically important investments will be on interconnecting countries for energy. The West African Power Pool (WAPP) agreement initiated within ECOWAS in 2000 fall in this type of initiative. Within the initiative it is estimated that $11.8 bn will be needed to put in place the 5,600 kilometers (km) of electricity lines useful to connect segments of national grids . Beside major investments such as in WAPP, there is a need to promote sustainable energy production particularly for rural areas. This is where the initiative such as the solar loan program and African Rural Energy Enterprise Development (AREED) of UNEP can be useful[1]. In 2007, it was estimated that the $2.6 million invested in the AREED project were able to help more than 400,000 people getting clean energy while contributing to job creation and reduction of 400,000 tons of carbon emissions annually in Africa[2] (UNEP, 2009).

Investing in clean energy technologies

Technologies such as efficient lights offer significant potential to cut back energy consumption. Nigeria, for example, could lower its electricity consumption by over 15 per cent this way, while reducing carbon dioxide emissions (from fuel combustion) by close to 5 per cent. South Africa could save $US280 million a year and remove CO2 emissions, equal to 625,000 cars annually by following a similar path.

It is estimated that in a country such as Senegal, a 100-per cent replacement of installed incandescent lamps with compact fluorescent lamps (CFL) would lead to annual energy and cost savings of 73 per cent (nearly $US30 million per year). This would save the country from investing in a new coal-fired power plant with a generating capacity of 50 MW, which costs approximately $US50 million. Other benefits are annual energy savings of 0.24 TWh, equivalent to the electricity generation of one coal-fired power plant with a capacity of 50 MW and annual savings of 0.2 Mt CO2, equivalent to CO2 emissions of 50,000 mid-size cars. The estimated cost of a transition to energy-efficient lighting is a one-time investment of $US52 million.[15]

Enhancing energy efficiency

Policies aimed at increasing energy efficiency are often the easiest and cheapest means to achieving greater energy security, particularly, in countries with diminishing marginal reserve capacity in electricity generation, where short-term demand-side management is often quicker and cheaper than investing in new energy supply capacity. Such policies include targets for reducing energy consumption, flexible financing mechanisms, energy labelling, performance standards, and awareness-raising campaigns among potential investors and consumers.

15 en.lighten is a UNEP initiative supported by the GEF Earth Fund, OSRAM GmbH, Phillips Lighting, and the French Environment Energy Management Efficiency Agency (ADEME).

6.3.6: Tourism

A highly sensitive economic sector

Disruption of a wide range of different ecosystems is reported as a result of climate change; including coastal areas (where coral reefs and mangroves are affected), with declining biological diversity in terrestrial ecosystems. Deteriorating ecosystems will have a significant negative impact on tourism, an important source of revenue and employment in many African countries, and lower the level of services from ecosystems. Strengthening the diversity of plant and animal life will be an important mean of reducing vulnerability of the tourism sector to climate change (Africa Commission, 2009).

The Sustainable Tourism for Eliminating Poverty (ST-EP) Initiative

The Sustainable Tourism for Eliminating Poverty (ST-EP) is one of the initiatives that through the UNWTO had covered several countries in Africa by trying to promote sustainable tourism. It is true that the tourism sector contributes to climate change and will be affected from climate change while the sector in Africa is not generally taken into consideration when developing climate change initiatives by Governments.

Priority investments in sustainable tourism

Adaptation to climate change needs to be mainstreamed in investments in the tourism industry. Indeed, the tourism sector is at risk because in Africa as it strongly rely on weather conditions and on natural resources. The three components of the tourism sector, the destination, the infrastructure, and facilities (hotels, banks, resource centers, etc) are highly vulnerable when it comes to weather hazards, temperature change and climate related natural disasters.

African states may consider utilizing climate change funds from various sources including the proposed but not yet approved international travel climate levy on airline passengers to finance the adaptation of their tourism sectors. This sector can also be presented as a strategic investment area with multiplier effects on agriculture both in terms of encouraging production through release of pressure on land and attracting excess fertility from the agrarian population but also increasing production for the tourism sector.

Furthermore, Nature-based tourism is an important economic component of the entire tourism market,(UNWTO, 2010). About 14 per cent of international visitors to South Africa in 1997 engaged in an “adventure activity” during their stay. Of the 826,000 tourists to Kenya in 1993, 23 percent visited national parks and reserves for wildlife safari tourism (Sindiga, 1995).

The UNEP Green economy Report (UNEP, 2011) finds that investments in sustainable tourism can greatly contribute to poverty alleviation, namely by creating stronger linkages with the local economy and increasing local development potential. Of particular and recognized importance (Hall and Coles, 2008) are: purchasing directly from local businesses, recruiting and training local unskilled and semi-skilled staff, entering into neighbourhood partnerships to make the local social environment a better place to live, work and visit for all; as well as the ability to improve the local natural environment within its areas of direct and indirect influence (Ashley et al., 2006). The move toward more sustainable tourism has been shown in a number of destinations to enhance this local development potential through several mechanisms:

- Its ability to harness biodiversity, landscape and cultural heritage available in developing countries
- can play a major role in enhancing incomes and employment opportunities;
- Tourism is a relatively labour-intensive sector traditionally dominated by micro and small enterprises with activities particularly suited for women and disadvantaged groups;
- As a tourism product is a combination of different activities and inputs produced by many sectors,enhanced spending by tourists can benefit a wide range of sectors such as agriculture,

handicrafts,transport, water and waste management, energy efficiency and other services;

- As tourism development at destinations requires investment in facilities such as roads, water supply, and energy, it improves the basic common infrastructure facilities required for development of other sectors and improvement of quality of life (Bata 2010); and
- Tourism employs more women and young people than most other sectors; providing economic benefits and independence to women is very important in terms of supporting child development and breaking the cycle of poverty.

6.3.7: Health

Emergence of climate change related deceases

With climate change, some pathologies will became important and will thus need good planning in public health prevention as well as health service. There is a need to assess the magnitude of the impact of climate change caused events and patters on human and animal health in African counties. Investments in sectors that directly impact human and animal health such as urban and rural infrastructure, agriculture are key in order to address emerging health issues on the continent and drive growth thanks to a healthy workforce. Furthermore, declining rainfall and water scarcity will have significant negative impact on agricultural production and on food security. Women and children are at particular risk.

Addressing the under investment in the health sector

Despite the importance of health investment, Africa countries did not do enough efforts in investing in this important sector. Despite the 2000 Abuja commitment that 15% of national budgets should be on health, only six countries out of 52 were able to achieve this target in 2010. And 32 African countries where investing the WHO recommendation of $40 per person, with 5 of them investing a mere $5 or less per capita. The weaknesses of investment thus have an implication as poor health infrastructure as well as on lack of technical staffs.

6.3.8 Human settlements

Impact of climate change on human settlements

Over the coming decades, the effects of climate change will be progressively felt across the African continent. Climate change, urbanization and human settlements development will interact. The IPCC concludes that: “Climate change is almost certain to affect human settlements, large and small, in a variety of significant ways”. They point out that settlements “…are important because they are where most of the world’s population live, often in concentrations that imply vulnerability to location-specific events and processes”. Likewise they are distinctive for “… the presence of physical capital (buildings, infrastructures) that may be slow to change”.

Three of the five global regions most at risk from flooding are located in Africa: the Nile delta, the Gulf of Guinea and the Maputo-Beira region of East Africa. Tens of million people will be at risk. The costs of adaptation in these areas are significant; in terms of improved and more resilient transport infrastructure, better flood protection, etc. There is also a toxic and dangerous combination of more flooding, inadequate sanitation, insufficient health care and rapidly growing large-scale, concentrated, informal settlements in many African countries. Urban slums are affected by water-borne diseases and cholera outbreaks. The combination of climate change and rapid urbanization is a major challenge for city planning, infrastructure development and service delivery (Africa Commission, 2009). For example, more than 70% of flood deaths in the Mozambique floods of 2000 occurred in urban areas. The Luis Cabral slum neighbourhood in the capital city of Maputo was completely destroyed and water

and sanitation services were disrupted causing outbreaks of dysentery and cholera.

There is already some evidence of changes in the distribution (geographical spread) of disease vectors such as mosquitoes causing malaria. Climate variability will also interact with other vulnerabilities including HIV/AIDS and poor access to water, resulting in greater susceptibility to diseases and further malnutrition. Heat stress caused by increasing temperatures is also a serious health problem.

Investment priorities to address the human settlement challenges facing the continent

Given the many challenges that towns and cities currently face, can local governments politically and financially afford to divert their attention to climate change? The answer is they must and they can. If they do not act now, the costs for future generations will be extremely difficult to shoulder – the Stern report on the economics of climate change concluded that unabated climate change could cost the world at least five percent of its GDP each year . But addressing climate change should not only be associated with high costs but also with the opportunities that the required adjustments can bring – the Stern report also concluded that the benefits of strong, early action considerably outweigh the costs. Africa can take the opportunity of investments in the settlement as one way to revisit the way this infrastructure or settlement had been developed. The opportunities also lie in urban areas and human settlements leading n green economy and growth by adapting technologies, strategies and human settlement systems. The possible outcomes in tapping into these opportunities; green jobs, green technology transfers, promoting rural Africa.

6.4 Institutional Mechanisms, Tools and Instruments for climate Change Related Investments

6.4.1: Key funding mechanisms with an Africa focus

6.4.1.1: African Development Bank climate initiatives

Addressing climate change issues in Africa is critical to achieving the mandate of the AfDB and so it is expected to play a key role in developing the needed new regional financing mechanisms such as the Africa Green Fund (AGF). Moreover, AfDB will launch its first Africa Carbon Facility (ACF) with donor support to strengthen Africa's access to carbon markets and maintain private sector confidence. The ACF will be set up as a revolving mechanism with initial seed capital provided by contributors to fund CDM project development costs of eligible African CDM projects (from within and outside the Bank's pipeline). The Bank is currently implementing several small funds that address climate-change related issues (ClimDev, CBFF, etc.), which came as a result of valuable efforts undertaken by different departments to increase the resource envelope available to climate change activities.

Climate Change Action Plan (CCAP)

The bank has also developed a Climate Change Action Plan (CCAP) for the 2011-2015 to respond to the challenge of developing adaptive capacity, building climate resilience and fostering a low carbon intensive development in Africa. Moreover, it supports the Bank in increasing its effectiveness and delivering on its core mission of poverty reduction and economic growth, while recognizing the risks and opportunities to address the challenges of climate change. It is organized around three pillars with several actions to achieve the desired outcomes (Figure 1). These pillars are: (i) Low Carbon Development, (ii) Adaptation (Climate-resilient Development & building adaptive capacity), and (iii) the establishment of a climate change Funding Platform to be implemented through a mix of several financing options. The provision of advisory services, support to policy reform, knowledge generation and competency building will be a

central cross-cutting component in delivering the actions included in the three response categories and ensuring their sustainability. An amount equivalent to USD 7 billion worth of investments have been identified over the period of 2011-2015 to reach the targets set in this Action Plan.

African Green Development Strategy (GDS):

The Bank is currently developing a GDS, which will guide the development of a low carbon economy for the continent. The GDS will address urgent and long term challenges in the fight against climate change and environmental degradation, the enhancement of energy security, and the creation of new engines for economic growth. It emphasizes natural resources as economic assets, the potential multiple benefits of developing green industries as well as the need for different environmental policies which include (or which make use of) economic instruments. A Green Development model for Africa will adopt a more sustainable development path by increasing the share of its Gross Domestic Product (GDP) devoted to renewable energies, clean transportation, clean technologies, green (energy efficient) buildings, waste management, water services, and sustainable management of natural resources. It also will seek to reduce energy use per unit of production, as well as carbon emissions per unit of GDP, while minimising wasteful consumption in various sectors of the economy.

New financial instruments

The AfDB has embarked on efforts to catalyze low-carbon investments through new financial instruments that can mobilize additional funding, promote innovation, and help fund the incremental costs of these projects. These efforts include a number of carbon funds and facilities administered by the Bank such as :

- The Congo Basin Forest Fund,
- African Water Facility (AWF)
- ClimDev-Africa Special Fund (CDSF),
- Sustainable Energy Fund for Africa (SEFA)
- L'Aquila Food Security Initiative (AFSI)
- Africa Green Fund (AGF)
- Clean Technology Fund (CTF)
- Pilot Program for Climate Resilience (PPCR)
- Forest Investment Program (FIP)
- The Scaling up Renewable Energy Program in Low Income Countries (SREP).

A full list of these instruments can be found on the bank's website.

6.4.1.3: Cooperation and aid agencies

Integrating climate change factors in development assistance

Climate change constitutes a serious constraint to economic development. Cost of adaptation could be 5-10 per cent of GDP (AfDB, 2008). Other studies indicate that, for example, improving African water infrastructure to adapt to climate change would cost between 1 and 3 billion USD annually. There is considerable uncertainty related to available estimates of adaptation costs. But what is generally recognized is that the poorest people in the least developed countries are likely to be hardest hit – and have contributed the least. (Africa commission, 2009)

The World Bank has estimated that 20-40 percent of overseas development assistance financed investments are at risk from climate change, including infrastructure investment as well as investment in productive sectors (notably agriculture). Thus climate "proofing" of development assistance is on the

agenda (Africa commission 2009).

Development aid and climate finance

Capital flows to Africa tracked by the World Resource Institute (2011) indicate that by 2010 the European Union (bi and multilateral) USA, Canada, Japan, Norway have committed $ 6.6 billion to climate change for the developing countries [8]. The funds are split disproportionately between adaptation, mitigation, REDD+ and other specific mitigation activities such as clean energy. Although, the figures are not disaggregated by region, Africa will in the near future start receiving considerable financial resources to address climate change challenges. According to OECD, the development aid stream has increased form $ 2.1 to $ 2.7 billions in the region [OECD, 2011]. With climate change high on agenda, this aid resources will be coupled to mitigation and adaptation.

6.4.1.4 Regional frameworks

The current climate change-financing arrangements in Africa are inadequate and need to be strengthened. Africa has a number of regional and sub region-specific concerns of climate change that should be addressed by means of regional programs including shared basins and lakes, degraded forest ecosystems melting glaciers of Kenya and Kilimanjaro mountains, land degradation, sea level rise, and climate refugees. As yet, there is no current regional institutional framework or financing arrangement in Africa to cope with such region-specific climate change impacts. Adaptation to these regional impacts should involve wide-ranging socioeconomic issues and new approaches for investments.

6.4.2 Macroeconomic performance

Estimated economic and social costs of climate change in Africa

The UNEP AdaptCost programme has estimated that climate change in Africa may result in economic costs equivalent to 1.7 per cent of Africa's GDP for a 1.5° average increase in temperature. If the mean temperature increase exceeds 2°C by 2060, economic costs will be over of 3 per cent of Africa's GDP (see Table 6.2 for annual costs of climate change in Africa for different climate change scenarios). By the end of the century, with a mean temperature rise of 4.1°C, the economic costs will almost equal 10 per cent of the continent's GDP (PAC, 2009). Figure 6.2 provides further cost assessment and an overview of GDP costs per country.

Table 6.2: Annual costs of climate change in Africa, as an equivalent percentage of GDP (AdaptCost, 2009)

Temperature rise	Year reached	Economic costs (per cent of GDP)
1.5°C	2040	1.7 per cent
2°C	2060	3.4 per cent
4.1°C	2100	10 per cent

As seen in previous section climate change carries its burden of economic coast to African countries such as health costs, energy, and in some regions, increased risks to infrastructure, reduced water availability, reduced agricultural yields and loss of ecosystem services. There is likely to be a strong distributional pattern of effects, with some regions in Africa affected more than others, and some groups within countries particularly affected. In the longer-term (after 2050), the economic costs could be even more significant than the ones estimated by UNEP, with upper estimates that would be unsustainable for a functioning economy. Such high impacts are beyond the limits of adaptation. There is a pressing need for

increase public spending and private investments to prevent and adapt climate change.

Mobilizing resources

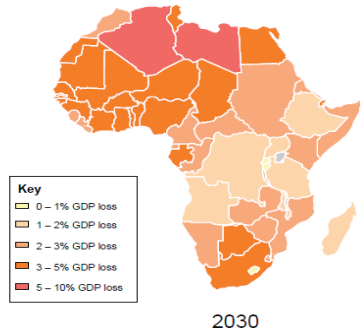
Domestically*:* Given the scale of impacts, and the large finance flows involved, it is essential that finance ministries get involved in shaping the architecture of any future international deal, and of specific financing instruments and funds, to ensure these work for Africa and entitlement of African countries to adaptation and other funds such as the Green Fund being put in place must be assured. However, this will require the development of effective mechanisms and institutions. For governments, main sources of investments that can help level the playing field for sustainable development include phasing out harmful and costly subsidies, reforming policies and providing new incentives, strengthening market infrastructure and market-based mechanisms, redirecting public investment, and greening public procurement (UNEP, 2011).

Externally: There is a need to agree on early next steps, including common negotiating positions, and a future focus. In that context, commitments of developed countries under the various sustainable development agenda (Agenda 21, JPoI, Brussels declaration, Paris and Accra declarations etc) in relation to aid volumes, aid effectiveness, debt relief and innovative financing mechanisms need to be urgently fulfilled. There are also existing financing mechanisms for encouraging low carbon development, which could provide large investment flows ($billions/yr) for Africa and provide many wider benefits. It is important for African institutions to ensure that those funds are access equally across the continent and that aid reaches those countries that need it the most. This could be addressed through reforms of the current mechanisms such as the CDM, the appropriate design of the emerging new mechanisms and the integration of environmental governance in aid programmes.

Fig 6.2: Annual costs from Climate change as a fraction of GDP in Africa in 2009

Integrated assessment models results of the economic costs of climate change in Africa

- The PAGE model, used in the Stern review, estimates[iii] that climate change could lead to an equivalent annual loss in GDP in Africa of just under 2% by 2040 (central mean value, including market and non-market sectors, with no adaptation). The upper value (95%) from the model is an estimated 4% GDP annual loss by 2040.
- The FUND model, another global IAM, estimates[iv] that climate change could lead to an equivalent annual loss in GDP in Africa of 2.7% by 2025 (central value, including market and non-market sectors). The model reports large economic costs from change in water resources, health impacts, and energy costs for cooling, but some potential benefits for agriculture. The effects vary strongly with region – as shown (right) in the estimated values for each country in Africa from the FUND model (national version) for the year 2030.
- Note these models reflect a partial coverage of the effects of climate change, and neither captures extreme events (including flooding), cross-sectoral links and socially contingent effects, or the cumulative effects on adaptive capacity.



Annual Costs from Climate Change as a Faction of GDP in Africa in 2030.

Source: UNEP AdapCost (2009)

Economic and social growth opportunities from climate investments

Preserving existing employment

While both the industrial and service sectors have recorded non-negligible rates of growth during the past years, a closer look at employment in Africa indicates that natural resource-based sectors such as agriculture, the mineral sector, forestry and fisheries continue to remain the largest job providers.

Together, these sectors account for 80 per cent of employment. Tourism, which relies primarily on the continent's natural wealth, employs 6.3 million people (World Travel & Tourism Council, 2006). The effects of climate change on these sectors, and more generally environmental risks, will pose new and serious challenges to growth and prosperity. The economic costs of climate change could be as high as 10% of GDP in Africa (UNECA, 2010). From a social and employment perspective, climate change will have negative effects on productive sectors such as agriculture, tourism and fisheries, which are among the largest sources of employment in Africa. An economic transformation of Africa must therefore address the fundamental challenges of employment and environmental sustainability. Such a transformation will entail a reconfiguration of the structure of production, distribution and consumption of goods and services in ways that can build a new and solid foundation for future growth and development over the medium to long-term. It must result in massive employment creation, while enhancing the natural capital that is source of jobs, income and livelihoods for the vast majority of the African people (UNECA, UNEP, 2011).

Creating new and decent green jobs

Investments in climate mitigation and initiatives that can co-benefit adaptation can generate massive employment for African countries and help save substantial costs. In the UNEP/ILO/ITUC Preliminary Report "Green Jobs: Towards Sustainable Work in a Low Carbon World" (referred to as "Green Jobs report"), Green Jobs are defined as positions in agriculture, manufacturing, R&D, administrative, and service activities aimed at alleviating the myriad of environmental threats faced by humanity. Specifically, but not exclusively, this includes jobs that help to protect and restore ecosystems and biodiversity, reduce energy consumption, decarbonizes the economy, and minimize or altogether avoid the generation of all forms of waste and pollution. A successful strategy to green the economy involves environmental and social full-cost pricing of energy and materials inputs, in order to discourage unsustainable patterns of production and consumption.

6.5 The Investment Climate

6.5.1 The role of the investment climate for climate change investment in Africa

Addressing the impacts of climate change requires substantial investment in new technologies, processes and services. Global New Investment in Clean Energy is a good example for the high relevance of a favorable investment climate for climate change: New investment in the sustainable energy sector reached $117bn in 2007, an increase of 41% over 2006 and a 400% increase from 2004 (UNEP, 2008). Generating and allocating the investment and financial flows needed to attain the levels of growth necessary for job creation and poverty reduction and thus to meet the Millennium Development Goals (MDGs) and at the same time to finance significant climate change mitigation is not an easy task. Taking that the private sector is the major investor in renewable energy and energy efficiency worldwide and in developing countries (World Bank, 2008), a countries' investment climate is one essential factor for increased climate investment. A favorable investment climate is pivotal for investments particularly from the private sector in clean and climate-resilient technologies and renewable energy. Innovative solutions and technologies can however only be implemented, if adequate framework conditions for inclusive climate investment, leveraging private sector resources, and seizing opportunities for innovation exist.

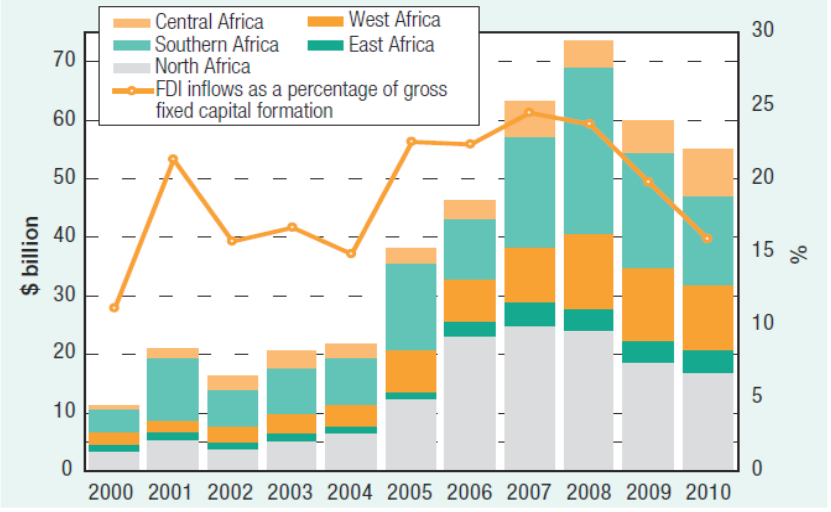
A number of instruments to improve the investment climate have emerged at global, regional, national and sub-national levels. the World Bank's Doing Business Report is one of the instruments to analyse the business climate by tracking a set indicators, for ranking purposes combined in 9 topics, namely starting a business, dealing with construction permits, registering property, getting credit, protecting

investors, paying taxes, trading across borders, enforcing contracts, and closing a business. In the past five years, about 85 percent of the world's economies have made it easier for local entrepreneurs to operate, through improvements to business regulation. The rankings for 2011, however, reveal that only 11 out of 51 African (worldwide 183) countries contained in the index– namely Mauritius (20th), South Africa (34th), Botswana (52nd), Tunisia (55th) Rwanda (58th), Ghana (67th), Namibia (69th), Zambia (76th), Egypt (94th), Seychelles (95th), and Kenya (98th) - appear in the top 100 countries. Of the 50 lowest ranking countries, 32 are in Africa.

Various factors, including poor governance, institutional failures, macroeconomic policy imperfections and inadequate infrastructure, as well as rampant corruption, bureaucratic red tape, weak legal systems and a lack of transparency in government departments have resulted in unfavourable investment climate in Africa(Nnadozie, et al., 2007). When comparing the World Bank's African 'Ease of Doing Business' ranks of 2011 and the previous year, it can be observed that 10 African countries remained on the same rank than in 2010, 24 African countries have been downgraded, while 17 African countries could obtain a higher rank due to policy reforms and initiatives with positive impact on the investment climate.

The above figures correspond to those on Foreign Direct Investment (FDI) in Africa as contained in the World Investment Report (UNCTAD, 2010). Having reached a peak in 2008, in 2010, the FDI inflows to Africa continued to decline, with divergent trends among subregions (UNCTAD, 2011).

Figure 6.3: FDI Flows 2000 - 2010



Source: UNCTAD (2011)

6.5.2 National and sub-national level

Although it remains difficult for the African continent to attract foreign capital and mobilise adequate and sustained levels of domestic private investment, some African countries including Mauritius, Botswana, Ghana and Tunisia have made progress and could achieve higher levels of investment (Nnadozie, et al., 2007). Rwanda can particularly be mentioned as one positive example in terms of investment climate reforms. See Box 6.4 below.

Box 6.4: Investment Climate Reform in Rwanda

Rwanda has steadily reformed its commercial laws and institutions since 2001 with support from the World Bank Group. Rwanda was named the top reformer in Doing Business 2010, having jumped 76 places from 143 to 67 in the annual ranking of 183 countries, the biggest improvement ever by any country. In Doing Business 2011 Rwanda jumped again to rank 58. As a result of the government's commitment to reform, it is now easier, faster and less expensive to do business in Rwanda. Some of the instruments to improve the investment climate include the following:

- **Dealing with Construction Permits:** Rwanda made dealing with construction permits easier by passing new building regulations at the end of April 2010 and implementing new time limits for the issuance of various permits.
- **Trading Across Borders:** By implementing administrative changes—such as increased operating hours and enhanced cooperation at the border, along with the removal of some documentation requirements for importers and exporters—Rwanda has improved trading times. Furthermore, Rwanda reduced the number of trade documents required and enhanced its joint border management procedures with Uganda and other neighbours, leading to an improvement in the trade logistics environment.
- **Starting a Business:** Business start-up was eased by eliminating a notarization requirement; introducing standardized memorandums of association; enabling online publication; consolidating name checking, registration fee payment, tax registration, and company registration procedures; and shortening the time required to process completed applications.
- **Registering Property:** Property registration was simplified by decreasing the number of days required to transfer a property.
- **Getting Credit:** Getting credit was made easier with a new secured transactions act and insolvency act to make secured lending more flexible, allowing a wider range of assets to be used as collateral and a general description of debts and obligations. In addition, out of court enforcement of collateral has become available to secured creditors, who also now have top priority within bankruptcy.
- **Protecting Investors:** A new company law has strengthened investor protections by requiring greater corporate disclosure, director liability, and shareholder access to information.
- **Closing a Business:** The process for dealing with distressed companies was improved with a new law aimed at streamlining reorganization.

Source: World Bank (2011)

Differences in business regulations and their enforcement exist across many locations in a single country. Thus, sub-national assessments of business regulations are essential in terms of determining the investment climate for climate change investment. The World Bank has issued four sub-national Doing Business reports for African countries, namely for Egypt, Kenya, Morocco, and Nigeria[3]. Other national assessments reports regarding the investment climate have been drafted, containing information on differences in investment climate indicators among regions (e.g. Assessment of the Investment Climate in South Africa, Investment Climate Assessment for Tanzania).

6.5.3 Relevant factors for the investment climate

6.5.3.1: Tax rates and administration

Tax rates and tax administration are leading concerns in terms of a favorable investment climate. Concern over tax rates may have negative impacts on the investment climate. Tax administration, tax rates, and customs and trade regulations are some of the top obstacles to doing business. The revenue administration system influences the investment climate and private sector development. A revenue administration that is considered to be arbitrary discourages investment.

6.5.3.2: Infrastructure

Infrastructure is one further factor influencing an investor's decision to choose or not to choose a specific country or region for investment. Better infrastructure improves the quality of life for Africa's citizens and competitiveness and business environments. The performances of the power and telecommunications sectors are of particular relevance in this regard. Other relevant sectors are transportation, and water and sanitation, all being critical for economic growth and development and important facets of attracting private investment (Foster and Briceño-Garmendia, 2010).

6.5.3.4: Business regulations and bureaucratic burden

In order to improve the investment climate for climate investment, Governments need to facilitate economic and political structures that encourage investment, wealth creation and jobs without imposing extreme regulatory burdens. High regulatory burden is considered to be one of the top obstacles to doing business and investing in a country's economy.

Chapter 7:

FINANCING FOR CLIMATE CHANGE IN AFRICA

This Chapter attempts to answer the following questions.

- *What opportunities are available to support climate change responses in African?*
- *How do you access financial and technical support to prepare for adaptation to climate change?*
- *How do you access financial and technical support to prepare for mitigation to climate change?*
- *What are funding and technical support opportunities in preparing for low carbon development?*
- *What opportunities exist for access to funding for small-scale organizations for adaptation and other climate change activities, such as for small grants, community-level projects, etc?*

7.1 Introduction

This chapter provides an introduction to funding for climate change, with emphasis on opportunities available for funding for adaptation and mitigation of Greenhouse Gases. The chapter draws on experiences with some of the well-established funds to provide insights into enhancing access to funding in the future. Information is also provided on available funding, with links to appropriate web sites for more information and procedures for applying for funding. In attempting to provide information on funding sources, it sets out to provide answers to the following questions:

- What opportunities are available to support climate change responses in African?
- How do you access financial and technical support to prepare for adaptation to climate change?
- How do you access financial and technical support to prepare for mitigation to climate change?
- What are funding and technical support opportunities in preparing for low carbon development?
- What opportunities exist for access to funding for small-scale organizations for adaptation and other climate change activities, such as for small grants, community-level projects, etc?

7.1.1 The context for funding for climate change

Countries contribution to climate change mitigation and their capacity to deal with it and cope with its consequences vary enormously. The United Nations Framework Convention on Climate Change and the Kyoto Protocol mandates financial and technological transfers from Parties with more resources to those less well endowed and more vulnerable. The rules contained in the Convention and the Protocol on financial and technological flows divide Parties into two groups of countries: those that provide resources listed in the Annex II (developed country Parties and other developed country Parties)of the Convention and those that receive resources, (non-Anne1/developing countries).Article 4.3 of the UNFCCC covers financial resources to cover implementation of general commitments and reporting,4.4 on adaptation costs and 4.5 on technology transfer).

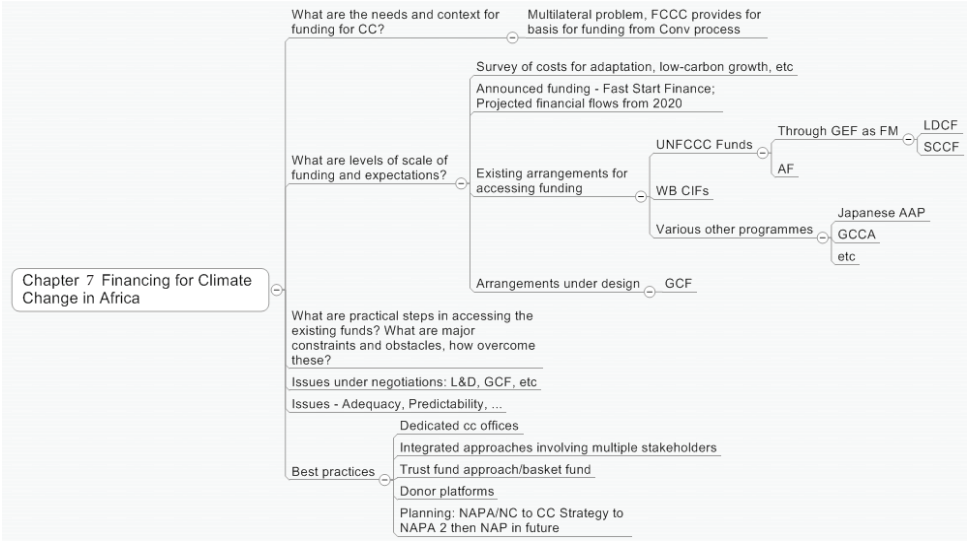
There is no specification on the level of resources to be provided or the burden-sharing. Article 4.3 of the Convention and 11.2 of the Protocol refer to “the need for adequacy and predictability in the flow of funds and the importance of appropriate burden-sharing among developed country Parties”.

Article 11.3(d) requires the COP to work with the GEF to allow determination in a predictable and identifiable manner of the amount of funding necessary and the conditions under which that amount shall be periodically reviewed'(Yamin and Depledge, 2004).

While Article 11.5 of the Convention states that the developed country Parties may also provide and developing country Parties avail themselves of, financial resources related to the implementation of the Convention through bilateral, regional and other multilateral channels

The financial provisions of the Kyoto Protocol are covered in Article 11. Article 12 of the Protocol mandate the collection of a share of proceeds from CERs towards the cost of adaptation of developing countries which are particularly vulnerable to the adverse effects of climate change. This shows a broadening of the group to provide resources to deal with climate change

Figure 7.1: Current and future climate change finance scheme.



7.1.2 Current climate change funding avenues

Developing countries have a number of funding avenues (see Figure 7.1, 7.2 and Table 7.1 below) available to them to support their responses to climate change and the number of funding channels is growing. The process that led to these funds being began with the Rio Earth Summit in 1992. Since then, lessons are being learnt on what is entailed in dealing with sustainable development issues including meeting the climate change challenge. In parallel experience is being built on how to make external finance for international development work (whether in the form of bilateral or multilateral assistance, or as private investment, or through other forms).

Figure 7.2: Climate Change Finance for response to Climate Change (adopted from A. Atteridge et al., 2009)

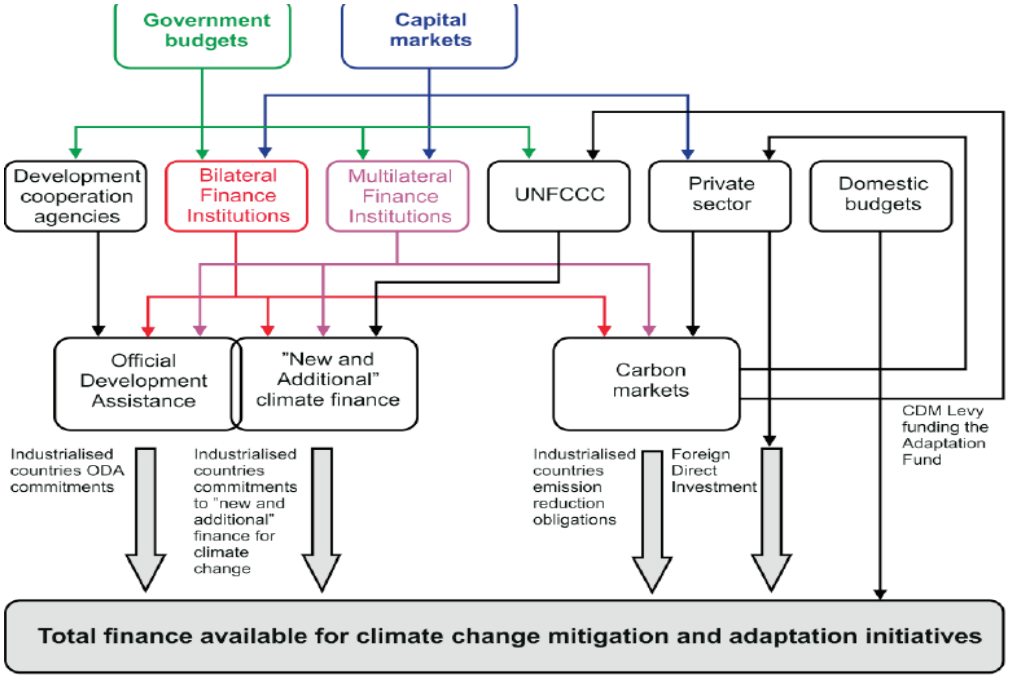
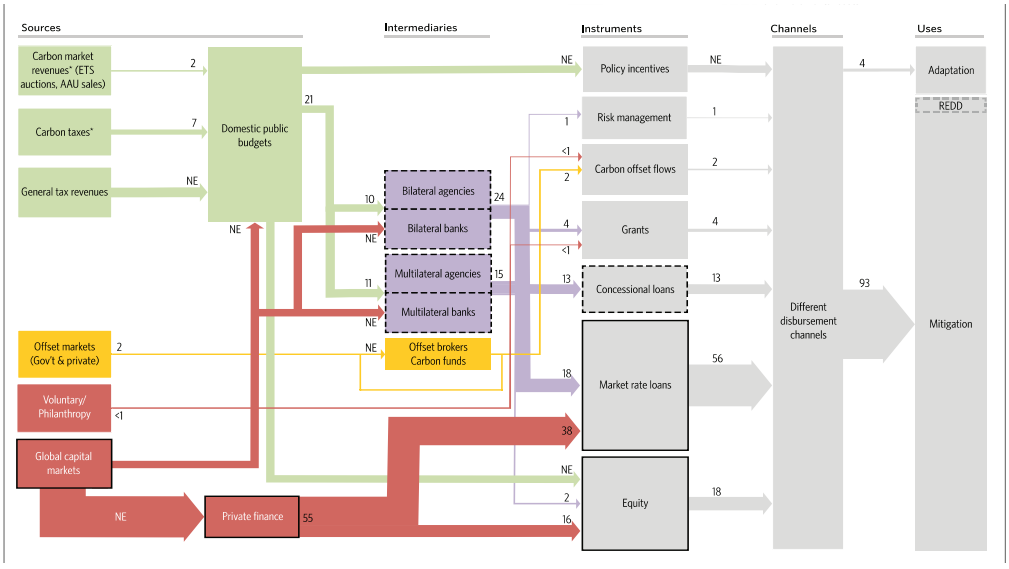


Fig 7.3: The landscape of Climate Finance



Source: Buchner, B., Falconer, A., Herve-Mignucci, M., Trabacchi, C., Brinkman, M., 2001. The Landscape of Climate Finance. A CPI Report.Venice: Climate Policy Initiative.

Notes: Figures presented are indicative estimates of annual flows for the latest year available, 2009/2010 (variable according to the data source). Figures are expressed in USD billion and are rounded to produce whole numbers. Estimates spanning multiple years are adjusted to produce annual-equivalent estimates. Where ranges of estimates are available, the mid-point is presented. All flows are incremental except for those identified as full or partial 'capital investment'. Most data presented relate to commitments in a given year, due to limited availability of disbursement data. *Estimated carbon pricing revenues indicated are not necessarily wholly hypothecated for climate finance.

According to Buchner et al., (2011), Climate finance (sometimes referred to as 'climate-specific finance') refers to capital flows that target low-carbon or climate resilient development. The same authors also define Climate-relevant finance to be a much broader set of capital flows (public or private) from developed to developing countries that will influence emissions and/or vulnerability to climate change in developing countries. These are flows going to support development and economic growth in key emitting sectors to sectors affecting vulnerability to climate change (i.e. water, health, energy, forestry and agriculture). Climate-relevant flows will influence climate change outcomes but possibly in a negative manner (i.e. by increasing emissions) unless the capital is supporting low-emission or climate-resilient investments.

An important component in private climate finance is the flows which are leveraged by the public finance or investment, and it may be particularly helpful in any tracking system to estimate these private flows separately.

Table 7.1: Global Climate Change Funds

Administrator	Fund	Adaptation	Mitigation	Global Pledge US$m	*Approved Funds to Africa to date US$m*
The Global Environment Facility (GEF)	GEF Trust Fund – Climate Change focal area (GEF 4)	✓	✓	$1,030	*$135*
	GEF Trust Fund – Climate Change focal area (GEF 5)	✓	✓	$1,150	*No data*
	Least Developed Countries Fund (LDCF)	✓		$262	*$95*
	Special Climate Change Fund	✓	✓	$149	*$28*
	Strategic Priority on Adaptation (SPA): Piloting an Operational Approach to Adaptation	✓		N/A ($50 deposited via GEF Trust Fund)	*$9*
World Bank	Clean Technology Fund (CTF)		✓	$4,400	*$601*
	Forest Carbon Partnership Facility (FCPF)		✓	$221	*$1*
	Forest Investment Programme (FIP)		✓	$558	*No data*
	Pilot Program for Climate Resilience (PPCR)	✓		$971	*$113*
	Scaling-Up Renewable Energy Program for Low Income Countries (SREP)		✓	$307	*No data*
	Strategic Climate Fund (SCF)	✓	✓	$1,800	*No data*
UNDP	Indonesia Climate Change Trust Fund (ICCTF)	✓	✓	$18	*$0*
	MDG Achievement Fund – Environment and Climate Change Thematic Window	✓	✓	$89+[7]	*$24*
	UN-REDD Programme		✓	$126	*$16*
African Development Bank	Congo Basin Forest Fund		✓	$165	*$17*
European Investment Bank (EIB)	The Global Energy Efficiency and Renewable Energy Fund (GEEREF)		✓	$169	*No data*
European Commission	Global Climate Change Alliance	✓	✓	$226	*$114*
UK	Environmental Transformation Fund – International Window (ETF-IW) (2008/09 – 2010/11)	✓	✓	$1,298*	*No data*
	International Climate Fund (ICF) (2011/12 – 2014/15)	✓	✓	$4,705	*No data*
Germany	International Climate Initiative (ICI)	✓	✓	$618	*$67*
Australia	International Forest Carbon Initiative		✓	$216	*$0*
Brazilian Development Bank (BNDES)	Amazon Fund		✓	$1,027	*$0*
Japan	Hatoyama Initiative	✓	✓	$15,000	*No data*
Asian Development Bank (ADB)	Climate Change Fund (Clean Energy Component)	✓	✓	$40	
Adaptation Fund Board	Adaptation Fund	✓		$216	*$80*
			Total	**$34,750**	***$1,228***

Source: Nigel Thornton (2011): **Making the most of climate change finance in Africa - A synthesis report from six country studies:** *Cameroon, Ghana, Kenya, Morocco, South Africa and Tanzania: Prepared by Nigel Thornton for the African Development Bank & OECD using case study material written by Catherine Cameron, Peter Grant, Gemma Norrington-Davies, Jeff Zingel & Nigel Thornton.*

As a whole, investment in adaptation may be more difficult to disentangle from investment in development. See discussion section 3.1.1.

The Cancún Agreements formalise a collective commitment by developed countries to provide new and additional funding for action on climate change in developing countries both in the short- and longer-term. The funding will aim to help developing countries adapt to and address the impacts of climate change and to pursue actions that will bring them towards a low-carbon future. Beyond committing to the goal of mobilising jointly USD 100 billion per year by 2020, the Cancún Agreements note that "… *funds provided to developing countries may come from a wide variety of sources, public and private, bilateral and multilateral, including alternative sources.*"

7.2 Opportunities to Support Climate Change Responses (Adaptation and Mitigation) in Africa

The Climate Change UNFCC instruments on Capacity Building, Finance and Technology Transfer have presented the main opportunities for the participation of developing countries, particularly Africa with its 33 LDC members, in the implementation of the Climate Change Convention.

From **the Marrakech Accords,** developing countries including Africa can access funding, for the implementation of the Convention. The funding is provided by Annex II, and other Parties included in Annex I that are in a position to do so, through the following channels:

i. Increased Global Environment Facility replenishment;

ii. The special climate change fund to be established under this decision;

iii. The least developed countries fund to be established under this decision;

iv. Bilateral and multilateral sources;

The funding is to finance activities, programmes and measures, relating to climate change, that are complementary to those funded by the resources allocated to the climate change focal area of Global Environment Facility and by bilateral and multilateral funding. These activities include adaptation (para. 8 Dec 5/CP.7); transfer of technologies (Dec. 4/CP.7); energy, transport, industry, agriculture, forestry and waste management; activities that promote economic (Art 4.8, Dec. 5/CP.7); and to support a Work Programme for the Least Developed Countries that includes but is not limited to the National Adaptation Programmes of Action in accordance with Section II, "Implementation of Article 4, paragraph 9, of the convention", of decision 5/CP.7;

Under **the Bali Action Plan**, developing countries including Africa are opportune to participate in the consultations between the GEF, interested Parties, international financial institutions, other relevant multilateral institutions and representatives of the private financial community with the objective to elaborate a strategic programme to scale up the level of investment for technology transfer to help developing countries address their needs for environmentally sound technologies. The consultation also specifically considered how such a strategic programme might be implemented along with its relationship to existing and emerging activities and initiatives regarding technology transfer.

Developing countries also benefit from technical support through coaching and training programmes for project developers provided by relevant international organizations and initiatives, such as CTI, in collaboration with the EGTT and the secretariat. The outcome of this technical support is the transformation project ideas resulting from TNAs into project proposals that meet the standards of the international financial providers. Parties are encourage to scale up and/or develop innovative public/private financing mechanisms and instruments that increase access to developing country project and business developers that play a role in the transfer, development and/or deployment of ESTs, focusing in particular on:

- Increasing the potential of public funds to leverage private sector capital;
- Increasing options for sharing and mitigating risks and for bundling small-scale projects to bridge the distance between large-scale infrastructure investors and small-scale project and business developers;
- The role that small and medium-sized enterprises, particularly joint ventures, can play in transferring, deploying and developing ESTs;
- Providing options for integrated technical assistance to help developing, managing and operating EST projects and businesses;
- Promoting enterprise and corporate-driven R&D, innovation, and cost reductions;
- Strengthening the dialogue between government and industry to encourage discussions between relevant ministries in recipient countries and private sector organizations to enhance the investment conditions for climate-friendly technologies;

The **Copenhagen Accord** provides opportunities for developing countries particular Africa to access financial support, capacity building and technology transfer from developed country Parties. Under the Fast Track Initiative, developing countries will access new and additional resources, including forestry and investments through international institutions, approaching USD 30 billion for the period 2010–2012 with balanced allocation between adaptation and mitigation. Funding for adaptation is prioritized for the most vulnerable developing countries, such as the least developed countries, Small Island Developing States and Africa. In the context of meaningful mitigation actions and transparency on implementation, developing countries will benefit from developed countries commitment to a goal of mobilizing jointly USD 100 billion dollars a year by 2020 to address the needs of developing countries.

Under the **Cancun Agreement** a significant portion of the funding arising from and after the Copenhagen Accord should flow through the Green Climate Fund which is to be designated as an operating entity of the financial mechanism of the Convention under Article 11, with governance and other arrangements being negotiated.

On t**echnology development and transfer,** the objective of the Bali Action Plan is to enhance action on technology development and transfer is to support action on mitigation and adaptation in order to achieve the full implementation of the Convention. Based on the Cancun Agreements, developing countries are further opportune to determine their national technology needs based on national circumstances and priorities. In the context of Articles 4.1(c) and 5 of the Convention and consistent with their respective capabilities and national circumstances and priorities, developing countries also have the opportunity to cooperate with developed countries to undertake domestic actions identified through country-driven approaches, to engage in bilateral and multilateral cooperative activities on technology development and transfer and to increase private and public research, development and demonstration in relation to technologies for mitigation and adaptation.

Capacity-building is essential to enable developing country Parties to participate fully in addressing the challenges of climate change and to implement effectively their commitments under the Convention. Decision 2/CP 7 contains provisions, scope and related needs of capacity building that developing country Parties can take advantage of under the Convention as an integral part of enhanced action on mitigation, adaptation, technology development and transfer, and access to financial resources.

Under the provisions and scope of Decision 2CP7, the Bali Action Plan, The Copenhagen Accord and the Cancun Agreements, developing country Parties, including Africa with its 33 LDC members have the opportunity to receive enhanced capacity-building support with a view to strengthening endogenous capacities at the sub-national, national or regional levels, taking into account gender aspects, to contribute to the achievement of the full, effective and sustained implementation of the Convention. Specifically, the developing countries have the opportunity to:

- Strengthen relevant institutions at various levels, including focal points and national coordinating bodies and organizations;
- Strengthen networks for the generation, sharing and management of information and knowledge, including through North–South, South–South and triangular cooperation;
- Strengthen climate change communication, education, training and public awareness at all levels;
- Strengthen integrated approaches and the participation of various stakeholders in relevant social, economic and environmental policies and actions; and
- Support existing and emerging capacity-building needs identified in the areas of mitigation, adaptation, technology development and transfer, and access to financial resources;
- Access financial resources for enhanced action on capacity-building that is provided by Annex II Parties and other Parties of the Convention that are in a position to do so through the current and any future operating entities of the financial mechanism, as well as through various bilateral, regional and other multilateral channels, as appropriate;

Through implementation of climate change projects and programmes, especially GEF projects, developing countries have the opportunities to develop their capacities and access financial and technology resources. Specifically, development and implementation of climate change projects and programmes have enabled developing countries to:

- Promote the adoption of modern and sustainable practices in biomass production, conversion, and use as energy, while avoiding the undermining of food security and enhancing respect for the sustainability principles relating to biodiversity conservation or sustainable land and water management.
- Contribute to the development of market conditions and enabling policies and regulatory frameworks, standards and certification, information and awareness, and capacity building, for example, by developing road maps and drafting or revising relevant national action plans and strategies. Awareness raising activities mostly include development and distribution of promotional materials and production of audiovisual tools that help build community trust and acceptance of technologies and tools;
- Build technical and institutional capacity by organizing workshops and training government officials, local engineers, and other technical staff;

The GEF is a financial mechanism for implementing the international convention on climate change and specifically manages the funds listed in Figure 7.4 below.

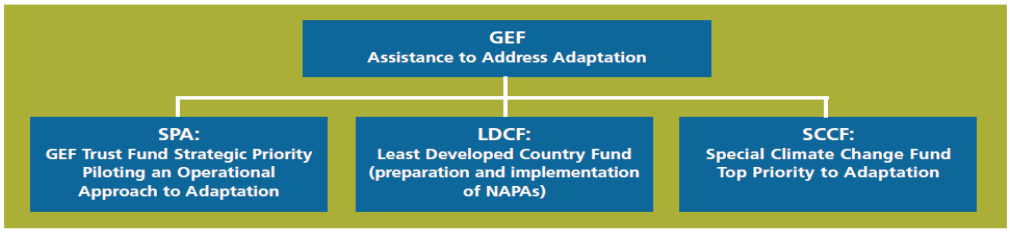


Figure 7.4: The GEF Managed Funds under the Climate Change Conventions:

Source: Bonizella Biagini, Lars Christiansen and Rawleston Moore, 2007: GEF Financing adaptation action

Table 7.2: Examples of the financial opportunities received from the Global Environment Facility

Country	Project	GEF Agency	Funding (Million U$)
Global	Assessments of Impacts of and Adaptation to Climate Change in Multiple Regions and Sectors (AIACC)	UNEP	7.500
Global	Adaptation Learning Mechanism: Learning By Doing	UNDP	0.724
Kenya, Madagascar, Mozambique, Rwanda, Tanzania	Integrating Vulnerability and Adaptation to Climate Change into Sustainable Development Policy Planning and Implementation in Southern and Eastern Africa Southern and Eastern Africa	UNEP	1.000
Mozambique	Zambezi Valley Market Led Smallholder Development	World Bank	1.520
Namibia	Adapting to Climate Change through the Improvement of Traditional Crops and Livestock Farming	UNDP	0.960
Senegal, Gambia, Guinea-Bissau, Mauritania, Cape Verde	Adaptation to Climate Change – Responding to Coastline Change and its Human Dimensions in West Africa through Integrated Coastal Area Management	UNDP	3.300
Eritrea	Integrating Climate Change Risks into Community Based Livestock Management in the Northwestern Lowlands of Eritrea	UNDP	3.000
Niger	Implementing NAPA Priority Interventions to Build Resilience and Adaptive Capacity of the Agriculture Sector to Climate Change in Niger	UNDP	1.900
Malawi	Climate Adaptation for Rural Livelihoods and Agriculture (CARLA)	AfDB	3.000
Mauritania	Reducing Vulnerability of Arid Oasian Zones to Climate Change and Variability through Improved Watershed Management	UNEP	1.630
Tanzania	**Mainstreaming Climate Change in Integrated Water Resources Management in Pangani River Basin**	**UNDP**	**1.000**
Ethiopia	**Coping with Drought and Climate Change**	**UNDP**	**0.995**
Mozambique	**Coping with Drought and Climate Change**	**UNDP**	**0.960**
Zimbabwe	**Coping with Drought and Climate Change**	**UNDP**	**0.983**
Kenya	**Adaptation to Climate Change in Arid Lands (KACCAL)**	**World Bank/ UNDP**	**6.500**

Source: Bonizella Biagini, Lars Christiansen and Rawleston Moore (2007): GEF Financing adaptation action

The following few examples represent opportunities provided by GEF financial support from the Funds indicated in Figure 7.4

- Millions of rural households are powered by solar home systems using photovoltaic technology and wind-power generation. Millions of energy efficient lights have been installed and the number of households using compact fluorescent lighting has increased. These activities have contributed to reduction of emissions of greenhouse gases;
- Developing countries also have financial opportunities available to support national efforts in adaptation to climate change;
- The GEF has financed enabling activities that include vulnerability and adaptation assessments through its support of National Communications and the LDC NAPA process under the UNFCCC;
- Capacities of developing countries, and especially small island states, to gather and process data have been built;
- Institutional and local capacities have been developed to formulate and implementing adaptation projects on the ground.

Table 7.2 provides examples of climate change projects that the GEF has financed since 2001 under SPA I and II, SCCF and the LDCF.

7.3 Cost of addressing climate change in Africa

Africa contributes less than four percent of the total global greenhouse gas emissions, but it is among the most vulnerable to climate change and has a very low capacity to adapt to its effects. Voluntary contributions by developed countries will not be enough to meet Africa's adaptation needs. This makes climate change financing a critical issue. Africa's estimated adaptation financing needs is presented below from which a comparison can be made to the resources that have been promised and those that are currently available.

7.3.1 Cost of adaptation

The glossary of the IPCC 4th Assessment Report (IPCC, 2007) defines adaptation costs as the costs of planning, preparing for, facilitating, and implementing adaptation measures, including transaction costs. However, this definition does not explicitly conceptualize development from adaptation which is needed to decide if the costs of development initiatives that enhance climate resilience ought to be counted as part of adaptation costs. The operational definition cost of adaptation should consider issues on adaptation deficit, uncertainties in climate projections and impacts and specify how potential benefits from climate change in some sectors and countries offset, if at all, adaptation costs in another sector or country. Putting all these into consideration and the fact that the Bali Action Plan calls for "new and additional" resources to meet adaptation costs, WB (2007) ***report defines adaptation costs as additional to the costs of development.***

As adaptation is considered as a development issue, it's costing must involve economic assessment in which the assessor provided results and information that inform the economists and planners at the national as to how to allocate a share of the national budget to adapting to climate change while also meeting other socioeconomic needs of society and the country.

Estimates of the costs of the likely impacts of climate change and the needed adaptation measures at the national level in developing countries are presently based on a limited evidence base. Concrete action on climate change adaptation is at an early stage and the economics of adaptation to climate change is still in its infancy. Robust estimates must rely on multiple lines of evidence: no single methodology to assess overall costs is adequate to capture the range of conditions. There is inadequate expertise particularly in developing countries to conduct economic assessments even at the sectoral or sub-national levels

and aggregate the results at the national level. Understanding of the full array of adaptation options, including institutional and policy changes and the budget implications of implementing climate proofed or climate resilient development are crucial to the prioritization of the most effective adaptation and national development strategies. This understanding is inadequate at the national level in developing countries but particularly absent in Least Developed Countries and Small Island Developing States amongst them.

Box 7.1: Methodology to estimate costs of adaptation for a country

Step 1: Determine from various global climate (Hadley Centre, IPCC, NCAR, GFDL, GCCC, GISS, etc) and socioeconomic data sets (the UN, World Bank, etc) about three of the data sets that most closely estimate the current and projected climate and economy of the country.

Step 2: Downscale these climate and economic projections to the national, sub-national and sectoral levels of the country

Step 3: Assess the potential impacts of climate change at the sectoral, sub-national levels and the national levels.

Step 4: Assess the potential adaptation measures needed to response to the impacts of climate change assessed in Step 3. This should include costs of adaptation measures.

Step 5: Conducted an integrated and macro-economic assessment of adaptation to climate change at the national level. This step should use top down economic modeling to provide information on potential economic costs using a framework that links emissions, climate change and impacts on the economy and based on nationally appropriate assumptions and simplifications

Step 6: Write the Report on the Cost of Adaptation

Note: The Hadley Centre is one of the climate and climate change analysis Centre in the United Kingdom; GFDL is the Geophysical Fluid Dynamics Laboratory in the United State of America, CCC is the Canadian Climate Centre in Canada, GISS is the Goddard Institute of Space Studies in the United States of America.

A common methodological approach to conduct economic assessment of cost of adaptation consists of the steps illustrated in BOX 7.1. However, this approach takes a very narrow view of adaptation, as a reduction in potential future impacts of climate change. Given the deep uncertainty of future projections—of baseline development, socio-economic vulnerability and climate risks—approaches that rely on solely on climate impacts models are not reliable. In contrast, the AdaptCost project supported by UNEP developed multiple lines of evidence in an Africa-wide review while studies in East Africa supported by DFID showed the range of results at a national level (see box 7.1 on page 102).

Most of the global studies, for example UNFCCC (2007) and WB EACC (2010) followed the simplistic impacts-prediction methodology, with the further step further of generalization of the results obtained from steps 1 to 5 above to all developing countries. The schematic illustration of the methodology used in the WB EACC Study of 2010 is presented in Figure 7.5.

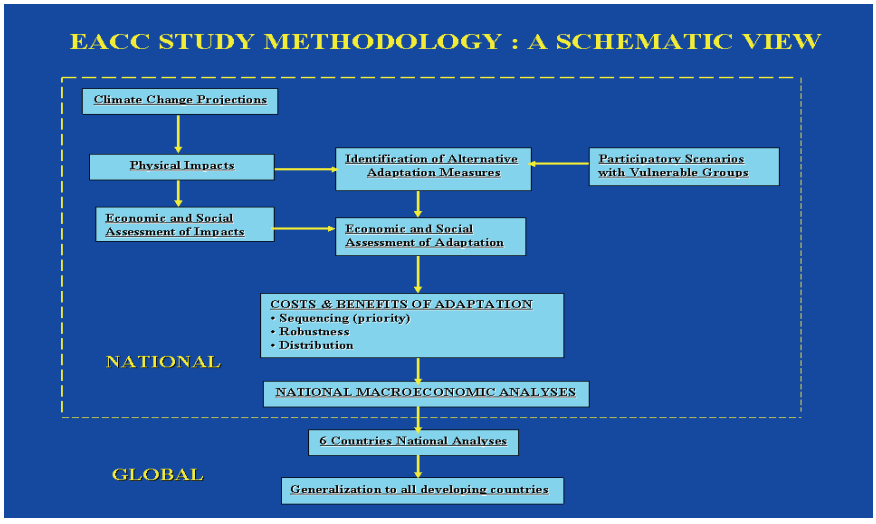


Figure 7.5: Schematic representation of the methodological approache used in the WB EACC Study in 2010.

The results of the various studies are shown in Tables 7.3a – b. Table 7.4 shows the projections of the costs of adaptation provided by some other studies

Table 7.3a: Total annual costs of adaptation for all sectors, by region and climate change scenario, 2010 – 50 ($ billions at 2005 prices, no discounting (source The World Bank, 2010)

Period	East Asia and Pacific	Europe and Central Asia	Latin America and Caribbean	Middle East and North Africa	South Asia	Sub-Saharan Africa	Total
National Centre for Atmospheric Research (NCAR, wettest scenario							
2010–19	22.7	6.5	18.9	1.9	10.1	12.8	72.9
2020–29	26.7	7.8	22.7	2.0	12.7	17.2	89.1
2030–39	23.3	10.8	20.7	3.0	13.5	19.2	90.5
2040–49	27.3	12.7	23.7	5.0	14.3	23.2	106.2
Commonwealth Scientific and Industrial Research Organization (CSIRO), driest scenario							
2010–19	16.4	3.9	11.6	2.4	11.9	10.3	56.5
2020–29	20.1	4.7	13.1	2.6	17.5	13.3	71.3
2030–39	20.9	6.4	20.2	3.0	17.7	20.0	88.2
2040–49	21.0	7.6	22.8	3.9	15.3	24.1	94.7

Source: Economics of Adaptation to Climate Change study team.

Table 7.3(b): Comparison od adaptation cost estimates by the United Nations Framework Convention on Climate Change study (2007), Parry and others (2009), and the Economics of Adaptation to Climate Change study, by sector ($ billions (source The World Bank, 2010)

Sector	United Nations Framework Convention on Climate Change (2007)	Parry and others (2009)	Economics of Adaptation to Climate Change study (in 2005 prices, no discounting)	
			National Centre for Atmospheric Research (NCAR), wettest scenario	Commonwealth Scientific and Industrial Research Organization (CSIRO), driest scenario
Infrastructure	2–41	18–104	29.5	13.5
Coastal zones	5	15	30.1	29.6
Water supply and flood protection	9	>9	13.7	19.2
Agriculture,[a] forestry, fisheries	7	>7	7.6	7.3
Human health	5	>5	2	1.6
Extreme weather events	—	—	6.7	6.5
Total	28–67	—	89.6	77.7

Source: UNFCCC (2007), Parry and others (2009), and Economics of Adaptation to Climate Change study team.

[a] The baseline provision of rural roads up to 2050 used to estimate costs of adaptation is adjusted to account for the additional length of rural roads consistent with the baseline projections for road investment. This adjustment reduces the investment in rural roads included in the cost of adaptation for agriculture by about 80–85 percent for the two climate scenarios. The adjustment for these overlaps amounts to $2.0–$2.2 billion a year averaged over the full period.

Table 7.4: Projected Cost of Climate Change Adaptation

Adaptation ($bn per annum)						
	2010-2012	2010-2015	2010-2020	2020	2030	assumptions
European Commission (2009)	3-4			13-30		in 2005 prices ($1.25 to €1 exchange rate), total net additional ('incremental') costs, assuming successful agreement - 30% reduction for developed countries by 2020 compared to 1990, and NAMAs by developing countries
World Bank (2006)		9-41				450 ppm stabilization; information gathered from secondary data
Stern Review (2006)		4-37				450 ppm stabilization
UNDP HDR (2007)		83-105				450 ppm stabilization; information gathered from secondary data
UNFCCC (2007)					28-67	
World Bank EACC (2010)					70-100	in 2005 prices, average annual costs between 2010-2050. Additional public sector (budgetary) costs imposed by CC, not costs incurred by private agents
Project Catalyst (2009)			13-25			assumes 450 stabilization, $1.25 to €1 exchange rate
G77 + China* (2009)				200-400		* Estimate incudes both: Adaptation and Mitigation. Proposed at: 0.5% to 1% of GNP
African Group (2009)				>67		Estimate based on the Programme for Adaptation Action under the AWG-LCA
Oxfam (2007)	>50					Based on World Bank (2006), plus extrapolation of costs from NAPAs and NGO projects
IIED (2009)	no specific figures cited					Costs estimated to be 2 or 3 times higher than UNFCC figures

Box 7.2: Economic Cost of Adaptation in Africa (AdaptCost)

The AdaptCost project, funded by United Nations Environment Programme (UNEP) under the Climate Change – Norway Partnership, investigated the costs of adaptation, producing a range of estimates for climate adaptation in Africa using different lines of evidence, from case studies of projects and plans through to global scale assessments.

The economic impacts of climate change in Africa are likely to be significantly higher than in many other world regions and they could be significant in the short-term. Costs could be equivalent to 1.5-3% of GDP/year by 2030. Impacts (and benefits) will be unevenly distributed across countries and between sectors.

Adaptation can reduce these costs, but it cannot remove them completely, particularly under a business as usual scenario. Global mitigation is needed as well as African adaptation.

Available estimates of the costs of adaptation for include different categories of adaptation, such as capacity building and immediate priorities, enhancing climate resilience in new investment (anticipatory adaptation) and social adaptation to protect livelihoods. There are also major financing needs to enhance the capacity to cope with the current climate adequately (the adaptation deficit), which are essential in enhancing resilience for the future, although these needs are associated more closely with development than future climate change.

The various studies provide a large range of estimates due to differences in approach but also due to what is included or excluded in the analysis. There is a large range ($5-30 billion a year) around these numbers. Estimates at the lower end of the range only include immediate needs. Estimates in the central and upper range include social adaptation and some accelerated development. A key conclusion is that the numbers are defined by the categories of adaptation and development included.

The cost of adaptation is likely to increase in future years. Adding the adaptation components together leads to a range of estimates that vary from $10-60 billion a year (see figure below). Again the variation depends on what is included, notably in relation to the categories of capacity building, enhancing climate resilience, social adaptation and accelerated development.

The AdaptCost estimates (below) show what is needed urgently (programmed from 2012) and what should be available in medium term investment plans (circa 2030). The first category of costs, in pink at the top of the figure, is the specific actions to tackle future climate risks (the marginal action specific to future climate change), i.e. enhancing climate resilience, such as infrastructure design and flood protection measures.

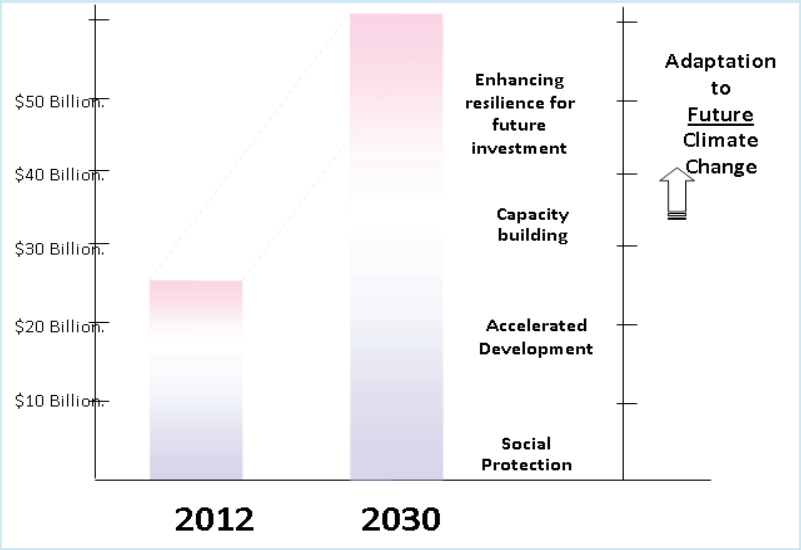
The second category comprises building adaptive capacity and institutional strengthening, for example developing meteorological forecasting capability, information provision and education. While this is primarily needed to provide the necessary information and data to allow adaptation to future climate change, it also has strong benefits in providing coping capacity against current climate variability.

The third category represents accelerating development to cope with existing impacts, for example integrated water management, electricity sector diversity, natural resources and environmental management, but these also provide the necessary investment to build future resilience, i.e. they are key to ensuring effective future adaptation, and without this, future investment may well be wasted.

Finally, there are other categories, primarily associated with existing climate variability, and categorised in terms of increasing social protection, for example cash transfers to the most vulnerable following disasters, safety nets for the most vulnerable.

The overall costs of adaptation vary according to which of these categories is included. Sources of finance and the balance of public and private costs of adaptation differ between these four categories, but the overall finance needs are dominated by which categories are included.

Most of the categories involve difficult attribution issues between future climate change and existing climate variability (some of which may be a result of observed climate change), and also difficult attribution issues between what is climate change adaptation and what is development. Understanding these issues and the linkages and conditionality is a priority for future work.



Source:Watkiss, P., Downing, T., Dyszynski, J.: 2010 AdaptCost Project; Analysis of the Economic Costs of Climate Change Adaptation in Africa, UNEP, Nairobi.

7.3.2 Cost of mitigation (low carbon growth)

ESMAP initiated country-specific studies[1] to assess their development goals and priorities, in conjunction with greenhouse gas (GHG) mitigation opportunities, and examine the additional costs and benefits of lower carbon growth. Most of these studies looked at the additional investment needs and compared them with national investment plans. The studies highlighted the need for increased public (national and international) and private investment support to implement the reference and low carbon scenarios. Private sector investment was identified as particularly important for sectors, such as transport, industry, and power.

They also demonstrate that low carbon interventions have positive net present values but still require new sources of financing for the substantial initial investments required.http://sdwebx.worldbank.org/climateportal/doc/ESMAP/KnowledgeProducts/Low_Carbon_Growth_Country_Studies_Getting_Started.pdf

7.3.3 Cost of capacity building and technology needs funding under the GEF

As an operating entity of the financial mechanism of the UNFCCC, the GEF finances eligible enabling, mitigation, and adaptation activities in the climate change focal area. Since the GEF strategy on adaptation to climate change is undertaken on a separate track, the present climate change focal strategy covers only mitigation and enabling activities.

The overall goal of the GEF in climate change mitigation is to provide developing countries and economies in transition toward a low-carbon development path.

With the strategy for the current GEF replenishment consisting of six objectives. The first objective focuses on technologies at the stage of market demonstration or commercialization where technology push is still critical. The second through fifth objectives focus on technologies that are commercially available but face barriers and require market pull to achieve widespread adoption and diffusion. The last objective is devoted to supporting enabling activities and capacity building under the Convention. Options to be explored by the GEF to support the carbon markets may include: (i) capacity building to help create enabling legal and regulatory environment; (ii) support of programmatic carbon finance and other activities under the post-2012 climate regime; (iii) demonstration of technical and financial viabilities of technologies; (iv) partial risk guarantees and contingent financing for carbon finance projects; and (v) co-financing of innovative projects, with credits to be retained in the recipient country for further project replication. GEF engagement in carbon finance activities will complement other programs and reforms in the current replenishment (GEF-5).

7.4 Access to Financial and Technical Support for Climate Change Adaptation

The United Nations Framework Convention on Climate Change (UNFCCC) lays the background for funding for adaptation to climate change in the context of a multilateral environment. Agreements on funding continue to be developed, both in terms of funds overseen directly by the Convention process, as well as in requests to donor country Parties to provide funding, through contributions to the multilateral funds as well as through bilateral arrangements with developing countries

Figure 7.6 below shows the current climate change finance architecture populated by multilateral, bilateral and multi-donor trust funds.

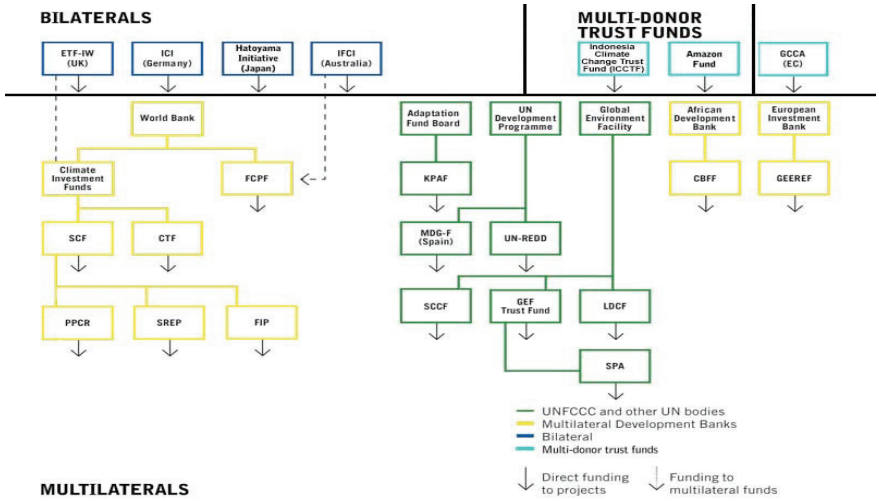


Figure 7.6: Sources of Funding for Adaptation (Source: www.climatefundsupdate.org, accessed on 25 July 2011).

From Figure 7.6 above, there are four main constituencies in the current architecture of international funding for adaptation, and these are:

- The UNFCCC (www.unfccc.int) – The Global Environment Facility (GEF), (www.thegef.org), through the Least Developed Countries Fund (LDCF), the Special Climate Change Fund (SCCF) and Adaptation Fund, www.adaptation-fund.org;
- The Multilateral Development Banks, including the World Bank, through the Climate Investment Funds, in particular the Pilot Programme on Climate Resilience www.wbgroup.org, the African Development Bank (see Box 7.2 on page 117) and the European Investment Bank;
- The Bilateral Funds; and
- The Multi-donor Trust Funds, Initiatives and Projects/Programmes.

Note that the Multilateral Development Banks are increasingly active in promoting climate resilient development using their own funds as well as implementing projects from other sources. Several banks (but not so far the AfDB) have set targets for the percentage of their portfolio that is driven by climate change concerns.

The UNFCCC GEF-administered funds

The Global Environment Facility (GEF) as an operating entity of the financial mechanism of the UNFCCC, since its inception in 1991, the Global Environment Facility (GEF) has invested $3 billion in financing climate change mitigation, adaption, and enabling activities, and has leveraged almost $20 billion additional investment. The GEF has become the largest public-sector funding source to support the transfer of environmentally sound technologies to developing countries and economies in transition.

Though a priority for most developing countries, resources for adaptation are just being mobilised in modest proportion, mostly through bi- and multi-lateral donor funds, such as the UNFCCC GEF-administered Least Developed Country Fund (LDCF), the Special Climate Change Fund (SCCF), the Pilot Program for Climate Resilience (PPCR, under the CIF) and through the UNFCCC Adaptation Fund Funding sources for adaptation under the UNFCCC (source: https://cms.unfccc.int/preview.php?id=5919, http://www.climatefinanceoptions.org/)

The GEF serves as an entity entrusted with the operation of the financial mechanism, to manage the the Least Developed Countries Fund (LDCF) and the Special Climate Change Fund (SCCF) established under the UNFCCC and provides secretariat services to the Adaptation Fund under the Kyoto Protocol. In operating the funds, the operational policies and procedures and governance structure of the GEF applies to the operation of all the funds, unless the Conference of the Parties determines through guidance concerning the modalities for operating the funds that other arrangements should be made.

To date, USD 400 million has been allocated for adaptation projects. In most cases, projects are supported through providing grants and leveraging co-financing. However, many GEF projects include a range of components such as investment, technical assistance, establishment of funds and risk management.

To access the LDCF and SCCF - eligible country

Identifies one of the GEF Agencies (ADB, AfDB, EBRD (doesn't participate in LDCF),FAO, IADB,IFAD,UNEP, UNDP, UNIDO, WB)

1. Develops and submits an application in the form of a Project Identification Form (PIF) to the GEF secretariat through the identified GEF Agency(s) with an endorsement letter of the Operational Focal Point of the host country.
2. For full-sized projects (>$1 million), decision-taking include the following three steps before

implementation;

a. The GEF CEO clearance of the PIF,

b. The Council approval, and

c. The GEF CEO endorsement of the project within 22 months from the date of Council approval;.

3. For Medium-sized projects ($1 million or under) and enabling activities, approval authority is delegated to the GEF CEO and the approval of the final project document is within 12 months from the PIF approval.

The following sub-sections provide information on the three UNFCCC GEF-operated funds and more information can be obtained from the UNFCCC and GEF websites www.unfccc.int and www.thegef.org respectively.

Special Climate Change Fund (SCCF)

The SCCF finances activities, programs and measures relating to climate change in adaptation; transfer of technologies; energy, transport, industry, agriculture, forestry and waste management; and activities to assist developing country Parties whose economies are highly dependent on income generated from the production, processing and export, and/or on consumption of fossil fuels and associated energy-intensive products in diversifying their economies.

Least Developed Countries Fund (LDCF)

The LDCF supports the implementation of the Work Program for the least developed countries that includes the development and implementation of National Adaptation Programs of Action (NAPAs). The Fund has simplified procedures and arrange for expedited access to the Fund by the least developed countries, while ensuring sound financial management.

Kyoto Protocol Adaptation Fund (AF)

The Adaptation Fund finances concrete adaptation projects and programs as well as adaptation activities:

- identified in national documents in the areas of water resources management, land management, agriculture, health, infrastructure development, fragile ecosystems, including mountainous ecosystems, and integrated coastal zone management;
- that will improve the monitoring of diseases and vectors affected by climate change, and related forecasting and early-warning systems, and in this context improving disease control and prevention;
- that support capacity building, including institutional capacity, for preventive measures, planning, preparedness and management of disasters relating to climate change, including contingency planning, in particular, for droughts and floods in areas prone to extreme weather events;
- that strengthen existing and, where needed, establishing national and regional centers and information networks for rapid response to extreme weather events, utilizing information technology as much as possible.

The AF is financed from the share of proceeds on the clean development mechanism project activities and other sources of funding including from Annex I Parties that have ratified the Kyoto Protocol. The Fund operates on the principle of funding the full adaptation cost of projects and programs to address the adverse effects of climate change (in contrast to the adaptation funds already managed by the GEF, which fund only part of the total costs of projects). All developing countries that are Parties to the Protocol are eligible to access funds from the Adaptation Fund. The CDM Executive Board (EB) with a developing countries majority makes decisions on which adaptation projects to fund.

The World Bank Pilot Program for Climate Resilience (PPCR)

The World Bank PPCR is designed to provide programmatic finance for country-led national climate resilient development plans. The PPCR aims to provide transformational and scaled-up support for both the development and implementation of such plans. Furthermore, its purpose is to provide lessons over the next few years that might be taken up by countries, the development community, and the future climate change regime, including the Adaptation Fund. This experience will be gained through scaled-up interventions covering the full range of sectors and sources of financing, and with sufficient resources to move quickly from planning to action. The PPCR is implemented in a manner consistent with the Paris Declaration of Aid Effectiveness, and complements the existing adaptation funds which continue to serve essential roles in tackling climate change.

The PPRC demonstrates a sector development risk management approach to climate adaptation. It shows how climate risk and resilience can be integrated into core development planning, so that the lessons learned can be applied in designing national adaptation programs. It selected 5 –10 countries from those eligible for MDB concessional funding for scaled-up support to integrate climate resilience into development planning and budgets. The countries are chosen on the basis of the advice of an Experts Group and include SIDs. The PPCR supports in-depth studies of particular sectors to determine how development planning needs to be revamped to take into account anticipated climate impacts.

The rationale for the PPCR is that the greatest need of the most vulnerable countries in coping with climate change is not specific projects but a rethinking of their development strategies at the sector level. Hence, priority is given to highly vulnerable LDCs eligible for MDB concessional funds, including the SIDS among them. Final selection of pilot countries is the decision of the PPCR-Sub Committee, based on advice of the Experts Group. The impacts of climate change, according to this rationale, will be so pervasive in most developing countries that their needs for adaptation transcend the level of project. Country selection is based on (i) transparent vulnerability criteria; (ii) preparedness to move to a strategic approach in integrating climate resilience into development; and (iii) country distribution across regions and types of hazards.

The Copenhagen and Cancun Agreements on Climate Change Financing

Fast track financing

Current international funding dedicated to climate action in developing countries covers only perhaps five percent of their anticipated needs. In this regard, the commitment by developed countries in December 2009 in Copenhagen to provide new and additional resources approaching $30 billion for the period 2010–12 (Fast-Start Finance, or FSF) was encouraging. Projects funded in part by FSF dollars are expected to leverage additional financing, a trend that should accelerate in 2011, as new financing partnerships develop.

The Cancun Agreement reached in 2010 formalises the long-term commitment from developed countries to mobilise $100 billion per year by 2020 (including through carbon markets) for developing country actions in climate mitigation and adaptation efforts.

Box 7.3 Climate Safeguards System in the African Development Bank

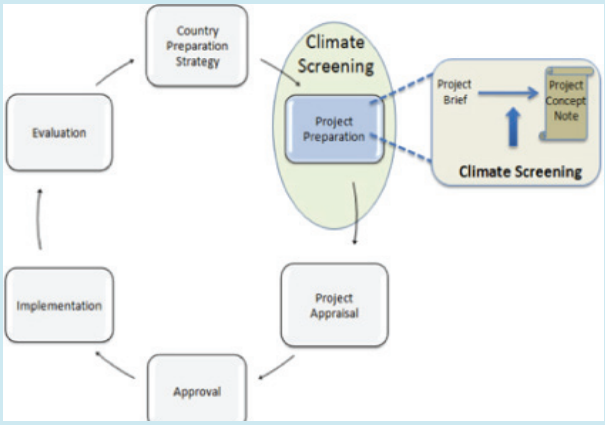
To ensure successful mainstreaming, there need for sound climate screening tools and methods that help project managers and practitioners to incorporate in climate change considerations and information into the design of projects. In 2009, the African Development Bank approved the Climate Risk Management and Adaptation (CRMA) strategy which seeks to address the looming impacts associated with climate change by mainstreaming climate concerns and adaptation responses into relevant policies, plans, programs, and projects at the national, sub-national, and local scales.

The Bank is developing a Climate Safeguards System (CSS) as a set of decision-making tools and guides that enable the Bank to screen projects in vulnerable sectors for climate change risks and identify appropriate adaptation measures to reduce vulnerability. The system is being developed by the AfDB,with the Global Climate Adaptation Partnership (GCAP), University of Cape Town and Atkins.

The CSS targets different stages in the project cycle (see figure) is to assess climate vulnerabilities and identify adaptation measures to be mainstreamed into project cycle. The process of mainstreaming climate change adaptation into development faces several challenges:

- Lack of awareness on the relevance of mainstreaming;
- The role of different types of information for adaptation decision making, especially the limitations in the availability of climate change projections at a scale that is relevant for decision making at national and community levels.
- The lack of resources combined to the limited capacities to invest on climate-resilient interventions;
- The competition between climate change and other development priorities;
- Complicated and unresolved institutional conflicts may present a barrier to the integration of adaptation into decision-making process.
- Lack of a proactive, targeted and cost effective strategy that increases the long-term resilience of the population and economy of the country under the changing climate is a serious barrier.

The mainstreaming approach provides a starting point to help countries successfully integrate climate change adaptation into development planning processes. The mainstreaming approach can be used as a framework for adaptation planning and financing.



The CSS involves modules targeted to country strategies, project preparation and project appraisal. The first step at the project level is to screen projects into one of three categories. This is followed by steps to develop an adaptation action plan.

Source: African Development Bank. 2011. Climate Screening and Adaptation Review & Evaluation Procedures: Booklet. Tunis: AfDB.

Cancun adaptation framework

The 2010 Climate Change Conference in Cancun, Mexico, (COP16) established the Cancun Adaptation Framework with the objective of enhancing action on adaptation, including through international cooperation and coherent consideration of matters relating to adaptation under the Convention. Ultimately enhanced action on adaptation seeks to reduce vulnerability and build resilience in developing country Parties, taking into account the urgent and immediate needs of those developing countries that are particularly vulnerable. As a part of the framework, developed country Parties are requested to provide developing country Parties, taking into account the needs of those that are particularly vulnerable, with long-term, scaled-up, predictable, new and additional finance, technology and capacity-building to implement adaptation actions, plans, programmes and projects at local, national, sub-regional and regional levels, including activities under the Cancun Adaptation Framework(CAF).

Cluster 2 of the CAF, calls on developed country Parties to provide developing country Parties, taking into account the needs of those that are particularly vulnerable, with long-term, scaled-up, predictable, new and additional finance, technology and capacity building to implement adaptation actions, plans, programmes and projects at local, national, sub-regional and regional levels, including activities under the Cancun Adaptation Framework

Cluster 5 defines stakeholder involvement and invites relevant multilateral, international, regional and national organizations, the public and private sectors, civil society and other relevant stakeholders to undertake and support enhanced action on adaptation at all levels

Financial support for adaptation agreed in Cancun includes fast-start finance up to 2012 and new long-term funding arrangements. Developed country Parties agreed to make the provision of USD 30 billion fast-start finance for developing countries up to 2012 more transparent by regularly making information available on these funds, including on access modalities. In order to scale up the provision of long-term financing for developing countries, the COP at its sixteenth session decided to establish a Green Climate Fund. The new fund will support projects, programmes, policies and other activities in developing countries using thematic funding windows, including on adaptation. Developed country Parties further committed themselves to a goal of mobilizing jointly USD 100 billion per year by 2020 to address the needs of developing countries. A significant share of the new multilateral funding for adaptation should flow through the Green Climate Fund.

Besides the three institutions mentioned above, there are several projects and programmes, developed by one or teams of several agencies, with funding from donors, such as the EU-supported Global Climate Change Alliance (GCCA), and the Japanese funded UNDP-run Africa Adaptation Programme. Many bilateral donor programmes are increasingly supporting adaptation activities directly in countries where they work. Throughout the chapter, some examples are given, however, an exhaustive survey of available programmes and windows for funding is not feasible.

Table 7.5: Summary of Developed Country Fast-Start Climate Finance Pledges February 18, 2010, updated May 9, 2011 (www.wri.org)

Party	Pledged (2010-2012		Requested/Committed (mn US$			Funding Objective	New and Additional	Channeling Institution(s)
	(mn US$)	(mn in original currency)	2010	2011	2012			
European Commission	215	€ 150	72	n/a	n/a	2010:Adaptation: €25mn Mitigation: €18 mn REDD+: €7mn	This is on top of existing programmed support for climate-relevant actions in developing countries in the period 2010-12 in the order of €900mn.	Channels for 2010: Bilateral:- Ethiopia GCCA: €8 mn- Increasing climate resilience of Pacific Small Islands States through the GCCA : €10 mn- Building climate resilience in Nepal: €7 mn- EU-UNDP Climate Change Capacity Building Programme: €8 mn- Africa-EU Renewable Energy Cooperation Programme (RECP): €5 mn - World Bank Partnership for Market Readiness: €5 mn- FCPF's Readiness Fund: €4 mn- EU REDD Facility: €3 mn
EU Member State Individual Pledges								
Belgium	215	€ 150	57	n/a	n/a	2010: Adaptation: €10mn Capacity building bilateral projects: €2mn Expansion of the renewable energy investment program: €20mn Sustainable forest management/ REDD+: €10mn	"The contribution of the Belgian Development Cooperation (DGD) for fast start finance in 2010 comes out of the rising ODA budget and covers only commitments taken after Copenhagen," (DGD 2010).	Channels for 2010: - LDCF: €10mn- Sustainable Forest Management program (SMF/REDD+ under the GEF, which is over and above the Belgian contribution to the 5th replenishment of the GEF): €10mn- Belgian Investment Company for Developing Countries: €20mn

Party	Pledged (2010-2012		Requested/Committed (mn US$			Funding Objective	New and Additional	Channeling Institution(s)
Denmark	231	DKK 1,200	53	n/a	n/a	Expected for 2010:Adaptation and Capacity Building: 48%Mitigation: 52%	All of the financial resources will be labeled as ODA. However, Denmark argues that everything above 0.8% of BNI is additional since Denmark has already lived up to its ODA target.	Expected channels for 2010-2012: Multilateral:-LDCF: €80mn-Pilot projects to promote investments in renewable energy: €61mn- Technology and capacity development: €40mn-CIF-PPCR: €30mn-CIF-FIP: €27mn-FCPF/UN-REDD: €33mn Bilateral:-Pilot Program on adaptation -- securing of coasts and water resources:€5 mnFor a more complete list of projects and programs please visit: http://www.faststartfinance.org/contributing_country/Denmark
Finland	157	€ 110	35	n/a	n/a	2010: Adaptation: 35.2%Mitigation: 53.2%REDD+: 11.6%	Finland is financing its commitment through a net increase of climate funding in 2010-12 compared to 2009, which will be used as its baseline. This Finnish climate funding as a whole continues to form a part of Finnish ODA also in these years. The net increase of climate funding will be a part of the overall increase of Finnish ODA in the years 2010-12. Finland remains committed to reaching the 0,7 % target of its GNP for ODA by 2015.	Channels for 2010: Bilateral: 62.7% including:- Adaptation Learning Programme for Africa: €1.65mn- Increased capacity of hydro meteorological services, Nepal: €0.49mn- Study on clean development mechanism & gender: €.03mn- Indonesia Energy and Environment Partnership: €4mn Multilateral: 37.3% including: - GEF-5: €11.6mn- Making agriculture part of the solution to climate change – Building capacities for Agriculture Mitigation: €2.58mn- Support for GGCA - Gender Mainstreaming in Global Climate: €2.6mn

Box 7.5. Funding Portals

Details and links to funding sources can be found in several portals, most of which provide up-to-date information on available funding and status of disbursement, etc.

The Adaptation Funding Interface
The Adaptation Funding Interface provides an interactive platform to search for adaptation funding options available worldwide. The adaptation funding interface was mandated by the Subsidiary Body for Implementation (SBI) at its twenty-eighth session under the further implementation of Decision 1/CP.10 (see FCCC/SBI/2008/8, para. 38), as a means to improve information on accessing existing funds for adaptation, including for the implementation of national adaptation programmes of action (NAPAs).

Climate Funds Update
Climate Funds Update is an independent website that provides information on the growing number of international funding initiatives designed to help developing countries address the challenges of climate change. The site aims to detail what type of activities the funds support and in what regions; the scale of the proposed funding; how the funds are being disbursed; and what has been achieved so far. The website is managed by the Overseas Development Institute and the Heinrich Boell Foundation.

Climate Finance Options
The Climate Finance Options platform addresses the need for developing country finance information by providing a web-based platform. It is envisioned to be the main website for information on climate finance, including for adaptation. Within the framework of global negotiations on climate change, the United Nations Development Programme (UNDP) and the World Bank Group have jointly developed this web-based knowledge platform in close cooperation with the UNFCCC secretariat. It is the first platform which a number of UN agencies and multilateral development banks (MDBs) use as a joint conduit of information on investment finance. It also builds on an interactive community of practice to share South - South experience and best practices in climate action for an enhanced development impact.

Eldis Funding Sources
Eldis presents a dossier on climate change adaptation that intends to provide a summary of current thinking on climate adaptation issues with access to relevant and up to date resources and publications for researchers, practitioners, and policy formers. Eldis Donor Orgnisations is a database that lists donor organisations and funding sources for climate change adaptation. Eldis is one of a family of knowledge services from Institute of Development Studies.

Terra Viva Grants
The Terra Viva Grants Directory provides information about international grant funding for agriculture, energy, environment, and natural resources in the developing world.

7.5 Challenges and Opportunities in Funding for Adaptation in Africa

Africa has the lowest GHG emissions, yet it is the most vulnerable to climate change. Even if global emissions are stabilized now, climate change and its effects will last many years, and adaptation is necessary. Climate change adaptation is especially important for African countries since the since they are already suffering the effects of climate change in line with the scientific predictions. These countries also have low adaptive capacity due to the level of their socioeconomic development. The institutional and technological capacity are weak and need to be enhanced, including the lack of reliable climate information, the early warning facilities so as to improve forecasts and planning and to develop new coping strategies. Major support is therefore required from the international community and the involvement all stakeholders including the private sector.

Key areas that need urgent attention are:-

i. The gap in raising awareness for broad ownership, support and communication to adapting to climate variability and change;

ii. The gap in climate risk management for strategic planning and disaster risk reduction;

iii. Climate-based services support to governments, the private sector and civil society; and

iv. Observations, data management and infrastructure to provide essential data to cover the first three gaps

v. The transfer of low-carbon technologies to Africa where very limited engagement by the private sector and continuing concerns about intellectual property rights that have severely restricted technology transfer.

In spite of the recognition of the continents vulnerability, support from the international community has not been commensurate with the level of support need to build the resilience of the African countries.

7.5.1 Difficulties in identifying, accessing and disbursing of funds

There are a number of studies estimating the costs of adaptation in Africa and other regions. An issue that needs to be dealt with is the 'absorptive capacity' to receive and spend this money in a cost effective manner in order to build the adaptive capacity of vulnerable communities on the ground. Many of the most vulnerable developing countries – including the Least Developed Countries (LDCs), Small Island Developing States (SIDS), and African nations– do not have or are at several different stages of developing their comprehensive climate change strategies, policies or putting in place mechanisms to deal with the receipt and disbursement of adaptation funds and the implementation of climate change actions.

7.5.2 Coordination of the many funding sources into countries

So that African countries can fully take advantage of the funding opportunities under the funding opportunities under climate change and in cognizance of the country calls for direct access to the funds the right institutional and financial mechanisms must be in place so that resources are directed efficiently toward national climate and development priorities.

It is to be noted though that there are now increasingly more sources for climate finance introducing complexities in the way of eligibility, reporting etc. An is example the Adaptation Fund that was established under the Kyoto Protocol with the mandate to finance concrete adaptation projects and programmes in developing countries that are Parties to the Kyoto Protocol. This mechanism is also mandated to allow direct access to the Fund by those Parties. Among the principles established for the Adaptation Fund (Decision 5/CMP.2) is "sound financial management, including the use of international fiduciary standards."Five National Implementing Entities (NIEs) have been accredited, with countries still at various stages of presenting their applications for accreditation with the support of UNEP, UNDP and the World Bank

Given the diversity of funds, it is critical that countries build on existing institutions and programmes to manage resources at the national level to support country driven objectives. At the same time there are increasingly questions being raised on the effectiveness of these funds.

In trying to respond to these challenges amongst others, African countries may need to consider the application of key principles for development aid included in the Paris and Accra agreements .This suggestion is made while being fully cognizant of the fact that climate finance may not be considered as aid. The principles include:

- **Country ownership,** by integrating climate funding into national development strategies;
- **Alignment with national and community priorities**, for example, through budget support

mechanisms and a greater use of in-country systems and institutions;

- **Harmonization of donor practices**, by coordinating actions and simplifying procedures; and
- **Mutual accountability and managing for results.**
- Besides these principles, a number of other factors contribute to effectiveness:
- **The timing**, certainty and predictability of funding;
- **Less fragmentation,** to reduce transaction and administration costs and allow greater impact and more strategic activities.
- **Greater transparency,** knowledge sharing, management and dissemination of results (Climate Policy Initiative, 2011). These principles would greatly enhance country ownership and efficacy of the mechanisms developed by African countries for direct access to climate change funds. One tool that has been proposed and could embody these principles that will help ensure the funds are effective is a National Climate Fund (NCF). An NCF is a mechanism that supports countries to manage their engagement with climate finance by facilitating the collection, blending, coordination of, and accounting for climate finance. NCFs provide a country driven system that can support climate change goal setting and strategic programming, oversee climate change project approval, measure project implementation and performance, offer policy assurance and financial control of climate change funds and assist with partnership management.

UNDP has developed a guidebook to assist countries in designing National Climate Funds: (Flynn Cassie, 2011: Blending Climate Finance through national Climate Funds; A guidebook for the design and establishment of national funds to achieve climate change priorities, United Nations Development Programme, New York, NY, USA.)

7.6 Case study: Support to LDCs for Adaptation

7.6.1 Country experiences with the LDCF for NAPAs

Box 7.6: Case Study: Malawi country experience with the NAPA and the LDCF

A landlocked country located in southeast Africa, Malawi has abundant natural resources, including good soils and abundant water, wildlife, fisheries and forests, but the dependence of the population on these resources makes them highly vulnerable to climate variability and change. More than 90% of the people of Malawi, mainly resource-poor rural communities, are predominantly engaged in subsistence rain-fed agriculture. Malawi has experienced a number of adverse climatic hazards over the last several decades, the most serious of which have been dry spells, seasonal droughts, intense rainfall, riverine floods and flush floods. Some of these, especially droughts and floods, have increased in frequency, intensity and magnitude over the last two decades, and have adversely impacted on food and water security, water quality, energy and the sustainable livelihoods of rural and peri-urban resource poor communities

Key timelines of the NAPA preparation process	
Funding for preparing NAPA approved	May 2003
GEF Agency approval date	June 2003
NAPA preparation start	December 2003
Submission of NAPA to UNFCCC	March 2006
First submission of the 1st project concept note (PIF) under the LDCF	April 2007
GEF CEO endorsement of full size 1st project:	October 2010

NAPA projects under implementation

Malawi listed 15 priority activities in its NAPA, which were then clustered into five project profiles. Due to the importance of agriculture in the country, the first project submitted under the LDCF is aimed at improving resilience to current climate variability and future climate change by developing and implementing adaptation strategies and measures that will improve agriculture production and rural livelihoods. The project is supporting 6 communities across Malawi.

Project Title: **Climate adaptation for rural livelihoods and agriculture (CARLA)**	
Implementing Agency	AfDB
National executing agency	The Environmental Affairs Department (EAD) in the Ministry of Mines, Natural Resources and Environment; the Department of Irrigation (DoI) in the Ministry of Irrigation and Water Development (MIWD)
Cost in US$ million (LDCF component/ Co-financing/total cost):	3.255/ 27.649 (Co-financing = 24.394)
First submission of the concept note (PIF) under the LDCF	April 2007
GEF CEO endorsement of project:	October 2010
Update on latest progress: Implementation on the ground has not yet started as of 25 July 2011	

Box 7.7: Case Study: Case Study: Malawi country experience with the NAPA and the LDCF (continued)

NAPA PROCESS

Preparation and implementation strategy: Malawi's NAPA was developed throughout 2004 and 2005, based on a multi-stakeholder approach and with the assistance of UNDP. Eight important economic sectors were analyzed (agriculture, water, human health, energy, fisheries, wildlife, forestry and gender) with regard to the impacts of adverse climatic conditions, and fifteen priority activities were identified out of thirty-one adaptation options through a consultative process involving public and private sector organizations, including media, NGOs and civil society. Emphasis was given to vulnerable rural communities of Malawi.

The LDCF project was designed so as to build on baseline activities planned under the existing African Development Bank's Smallholder Crop Production and Marketing Project (SCPMP), which is aimed at contributing to poverty reduction and food security in rural Malawi. The SCPMP has a component on Irrigation Development and another on Farmer Support Programme, as well as one component focusing on Project Coordination and Management.

Although the SCPMP will indirectly contribute to reduce the overall vulnerability to current climate variability and climate change, it is not meant at addressing the urgent and immediate adaptation challenges faced in the country. As such, the aim of the LDCF project was to "climate proof" the SCPMP by implementing adaptation interventions, fostering adaptation of individuals, communities and the private sector, on one hand, and by creating an enabling environment for climate risk management to maximize positive impacts of investments, sustain their impacts in the long term, and lay the foundation for replication of best practices beyond the direct project activities, on the other.

The government of Malawi views the NAPA as a national planning document and, as such, the information provided is used in other initiatives in the country, such as UNDP's work on sustainable land management and the Green Belt Initiative developed by the government, research work in tertiary academic institutions and civil society activities.

Institutional arrangements in the country: The country has established a national climate change committee, and it is currently developing a climate investment plan, within which an adaptation programme carries priority.

Experience with project implementation: The government of Malawi started working with AfDB on the development of an adaptation project based on two of its NAPA priority activities right after submission of the document, in 2006. Although Malawi had not had any previous experience in working with the AfDB on a GEF project, the government selected the Bank to implement the project based on their expertise in projects related to adaptation to climate change in the agricultural sector in other countries. The project received GEF CEO endorsement in October 2010 after several delays related to the agency. Project implementation has not started yet because the AfDB is reviewing the project internally to ensure its alignment with the Bank's work plan. The project had already suffered delays from the change in template for project submission by the GEF from a 'PDF' to 'PIF/PPG', so the whole process from project development to actual implementation has taken over four years.

Attempts to switch to another GEF agency were unsuccessful, as it is not possible to simply carry on with a project with a different agency. GEF procedures require a project to be cancelled and then restarting the whole process (endorsement of a new agency, development of a concept note, a PIF/PPG etc) with the new agency, effectively resetting the clock on the project. This is necessary given the financial agreements for project implementation.

Malawi is implementing other adaptation activities in the vulnerable areas identified by NAPA through the Africa Adaptation Programme (AAP), a UNDP programme financed by the government of Japan, to complement the CARLA project. UNDP is also currently working with the Government of Malawi to develop an LDCF programme focusing on adaptation and land degradation

Revision and update: Malawi has already initiated a NAPA revision to integrate emerging issues.

Malawi's experience shows how some of the constraints imposed by changing procedures or sometimes rigid procedures for accessing resources can result in major delays in the implementation of project on the ground.

Box 7.8: Case Study: São Tomé and Príncipe Country Experience

The archipelago of São Tomé and Príncipe is located off the western coast of Guinea, and it is comprised of two main islands and four islets. The country's economy revolves mostly around agriculture and fishing, sectors which are highly vulnerable to climate change. São Tomé and Príncipe is considered very vulnerable to climate change, with a low capacity to absorb and adapt to ecosystem disturbances. Fisheries seem to be more affected due to the use of traditional practices often unable to cope with recurrence of storms and floods and extensive coastal erosion. The fishing industry is considered key in São Tomé and Príncipe, as artisanal fisheries are estimated to employ 20% of the nation's workforce and represent one of the main employment opportunities in rural areas. The agricultural and forest sectors are also vulnerable to harsher environmental conditions such as drought, soil erosion leading to desertification and flood-induced landfalls.

Key timelines of the NAPA preparation process

Funding for preparing NAPA approved	March 2004
GEF Agency approval date	October 2004
NAPA preparation start	June 2004
Submission of NAPA to UNFCCC	November 2007

NAPA projects under implementation

São Tomé and Príncipe listed 22 priority activities in its NAPA, and two projects were already submitted under the LDCF. The first, as shown below, is aimed at increasing the adaptive capacity of vulnerable coastal communities in São Tomé and Príncipe to the adverse impacts of climate variability and change.

The first São Tomé and Príncipe project under the LDCF is designed as an integral part of the country's National Adaptation to Climate Change Programme, which prioritises three major areas:

- Land-based Adaptation in Vulnerable Areas - to be funded by the UNDP/Japan Adaptation Programme.
- Coastal Adaptation for Vulnerable Communities - to be funded by the LDCF.
- Strengthened Adaptation Capacity - also to be funded by the UNDP/Japan Adaptation Programme.

Project Title: **São Tomé and Príncipe adaptation to climate change**	
Implementing Agency	The World Bank (IBRD)
National executing agency	Ministry of Natural Resources, Energy and Environment
No. of NAPA priority activities addressed	6/ 22
Cost in US$ million (LDCF component/ total cost):	4.873/ 18.332
First submission of the concept note (PIF) under the LDCF	May 2009
GEF CEO endorsement of project:	May 2011
Update on latest progress: the project concept note was already approved by the Council.	

The second project is aimed at improving resilience of the livestock systems in support of the productivity of stock-breeding.

Project Title: **Strengthening the adaptive capacity of most vulnerable Sao Tomean's livestock-keeping households**	
Implementing Agency	AfDB
National executing agency	Directorate of animal husbandry
Cost in US$ million (LDCF component/ total cost):	2.320/ 10.087
First submission of the concept note (PIF) under the LDCF	June 2010
GEF CEO endorsement of project:	Not CEO endorsed yet
Update on latest progress: the PPG was already approved.	

Box 7.9: Case Study: São Tomé and Príncipe Country Experience(Continued)

NAPA PROCESS

Preparation and implementation strategy: Community participation played a key role in the methodology and characterization of the main vulnerabilities used in the São Tomé and Príncipe NAPA. Public consultations (interviews and surveys) were carried out all over the country with the poorer populations residing in vulnerable areas. Six sectors were analysed to assess the vulnerability: agriculture, forests and livestock; fisheries; public works, infrastructure and tourism; energy and water; health; public safety and civil protection. Adequate solutions were then found in a participatory manner through interaction with the communities and based on the six sectors mentioned. Information from the country's existing plans such as its First National Communication to the UNFCCC, from 2004, the Poverty Reduction Strategy Paper and documents related to the other Rio Conventions (Desertification and Biodiversity) were also reviewed for the NAPA.

With the aim to implement the top priorities identified in the NAPA, the Government of São Tomé and Príncipe requested the World Bank's assistance in preparing a project through the LDCF to address the most immediate adaptation needs in its vulnerable coastal zone, most specifically, the top two NAPA priorities and three additional associated sector priorities listed in the top tier of São Tomé and Príncipe's NAPA.

Institutional arrangements in the country: The General Directorate of Environment (GDE) within the Ministry of Public Works and Natural Resources (MPWNR) is the overall agency responsible for the National Adaptation Programme. To monitor and coordinate project activities with others under this programme, MPWNR/GDE would rely on existing inter-sectoral mechanisms: at the highest level, the National Sustainable Development Committee chaired by the Minister Secretary General of the Government would formally oversee programme implementation.

Experience with project implementation: Both the project components funded by UNDP/Japan and the one funded under the LDCF are expected to share the same Programme Implementation Unit to ensure maximum harmonization, capitalize on existing synergies, minimize costs, ensure cross-sector coordination, and build institutional capacity.

The LDCF project component targets the priority activities related to Training and Equipment for Artisanal Fishermen and Early Warning Climate Alert System, and link them to a Reinforcement of Capacity of Civil Protection Agencies, in order to reinforce STP's preparedness against extreme weather events.

São Tomé and Príncipe's experience shows that focusing on the most affected development-related sectors is a good way to link the NAPA activities to national development plans.

7.7. Access to Financial and Technical Support for Mitigation Actions

The bulk of available and emerging resources relates to mitigation, mainly through transactions under the Clean Development Mechanism (CDM) in the carbon market and through World Bank administered carbon funds and facilities, including Climate Investment Fund (CIF) programmes like the Clean Technology Fund (CTF) and the Scaling Up Renewable Energy Program in Low Income Countries (SREP). The Global Environment Facility (GEF) has been the largest source of grant financing for energy efficiency and renewable energy projects. Reducing emissions from deforestation and forest degradation (REDD) as well as through sustainable forest management (REDD-Plus) is gaining considerable momentum. Major multilateral initiatives include the Forest Investment Program (FIP, under the CIF), the Forest Carbon Partnership Facility (FCPF), the UN-REDD Programme and the recently established Interim REDD+ Partnership.

The Multilateral Development Bank MDB) Funds: The Climate Investment Funds (CIF) are a collaborative effort between the multilateral development banks (MDBs) and countries to help developing countries transform to low-emissions and climate-resilient development. They aim to do this by bridging the financing and learning gap between now and a potential post-2012 global climate change agreement. They are channeled through the African Development Bank, Asian Development Bank, European Bank for Reconstruction and Development, Inter-American Development Bank, and the World Bank Group

The Clean Technology Fund (CTF) provides scaled-up financing for demonstration, deployment and transfer of low-emissions technologies that have significant potential for long-term greenhouse gas (GHG) emissions savings, principally to emerging economies and to regional groups.

The Strategic Climate Fund (SCF) is designed to support developing countries in their efforts to achieve climate-resilient, low-emissions development through three targeted programs with dedicated funding to pilot new approaches to climate action:

- Pilot Program for Climate Resilience (PPCR): Supports countries as they undertake scaled-up climate action and initiate steps toward transformational change by integrating climate resilience in their national development planning.
- Forest Investment Program (FIP): Provides financial and knowledge support for country-led initiatives to reduce GHG emissions from deforestation and forest degradation and to promote improved sustainable management of forests.
- Scaling Up Renewable Energy Program in Low Income Countries (SREP):

Helps low-income countries adopt renewable energy solutions through a programmatic approach that involves government support for market creation, private sector implementation and efficient energy use.

The Clean Technology Fund (CTF)

The Clean Technology Fund (CTF) amounts of USD 4.5 billion and covers co-financing, grants, loans and Overseas Development Assistance (ODA). The governance and organizational structure of the CTF includes a CTF Trust Fund Committee, an MDB Committee, a Partnership Forum, an Administrative Unit and a Trustee.

The main objectives of the Fund are:

- Utilizing MDB capabilities to leverage private and public resources for low carbon investments;
- Promoting environmental and development co-benefits to demonstrate how low carbon

technologies can contribute to national development goals and strategies; and

- Providing concessional financing with a grant element tailored to cover the identifiable additional costs of the investment necessary to make the project viable.

The CTF supports country/regional investment plans that meet the criteria of significant GHG emissions savings, demonstrate potential at scale, development impact and implementation readiness. Mitigation activities qualified under the CIF are in the areas of agriculture, energy, energy efficiency, fuel switching, industry, infrastructures and transport. These activities must constitute a dominant part of countries' low carbon development strategies, shape the course of markets for technology deployment, and/or transcend GHG emissions savings objectives by providing broader development and environmental benefits. Eligible countries are those that are eligible for official development assistance and have an active MDB country program (World Bank and Regional Development Banks). Current beneficiary countries in Africa include Nigeria (US$ 250 Million), South Africa (US $ 500 Million) and the Middle East and North Africa (MENA) Regional CTF Investment Plan (US$ 750 million including Algeria, Egypt, Morocco and Tunisia in Africa).

African countries can access CTF funds by:

- Providing expression of interest in accessing the CTF financing to a Multilateral Development Bank, e.g., the World Bank and African Development Bank
- The MDB concerned conducts a joint mission with other development partners to discuss with the government, private industry and other stakeholders on how the fund may help finance scaled-up low carbon activities.
- The Joint Mission develops an Investment Plan under the recipient country's leadership for use of CTF resources in major sectors of the economy through a joint MDB program. The investment plan should build on existing country-owned strategies or action plans and demonstrate how it is complementary to activities under other available programs.

A Trust Fund Committee reviews the investment plan, endorses further development of activities for CTF financing, and facilitates prioritization of projects according to agreed criteria such as potential GHG emission savings, demonstration potential, development impact and implementation potential.

Scaling-Up Renewable Energy Program for Low-Income Countries (SREP)

Scaling-up Renewable Energy Program (SREP) for low income countries is established within the Strategic Climate Fund. Its principal objective is to help low income countries make a transformational change to low carbon energy pathways by optimally exploiting their renewable energy potential to offset fossil-based energy supply. SREP helps capture other co-benefits such as reduced local air pollution, improve climate resilience and the diffusion of low carbon technologies and industries, while reducing greenhouse gas emissions. SREP fund amounts to USD 318 million for mitigation actions in energy, forestry, natural resources management, renewable energy and sustainable land management. The fund is administered through co-financing, equity, grants and loans.

SREP supports a host of renewable energy projects implemented to achieve transformation change within developing countries. Sectoral mitigation activities eligible for SREP support include wind and solar projects, small hydro and biomass, and geothermal. The program also considers cooking and heating projects based on biogas and other renewable-based fuels. SREP resources are leveraged significantly to achieve transformational change – change that creates greater public and private confidence in renewable energy, and improves market and financial conditions and lead to large scale replication. Transformational change occurs when renewable energy is adopted as mainstream options in increasing energy supply rather than undertaking pilot-scale or single projects. SREP aims to achieve this through programmatic, country-led interventions that build on national policies and complement other energy initiatives, to achieve lasting and financially sustainable outcomes.

The SREP co-finances MDB investments, with the aim of shifting generation of energy to renewables in place of conventional fuels such as oil and coal. To be eligible, low-income countries must be qualified for MDB concessional financing (IDA or its equivalent). Other factors include institutional capacity to undertake a large scale SREP-funded program and the in-country renewable energy resource potential. SREP pilot countries in Africa include Ethiopia, Kenya and Mali.

For decision making, the SCF Trust Fund Committee establishes a sub-committee to approve programming priorities, operational criteria and financing modalities for the SREP, as well as financing for programs and projects. The Sub-Committee comprises of representatives from donor countries and a matching number of representatives from SREP recipient countries. The subcommittee of the SREP may invite ad hoc Group of technical experts to advise the sub-committee on issues such as project selection, guidelines, etc.

Preference is given to projects with strong poverty alleviation benefits, through increased economic growth, enhanced generation capacity or improved services to poorer communities that have limited or no access to modern energy to meet household, community service and productive use needs. Economic and/or social development as well as environmental benefits will be key criteria for project selection. Proposals for SREP co-financing will need to demonstrate how they scale-up from lessons learned in pilot and demonstration projects and programs (such as those supported by the GEF). A key criterion will be the potential of the proposal for demonstration and replication, particularly the potential for removing barriers in the enabling environment beyond the immediate project boundary so as to facilitate scaling up through private sector investments.

For information on the MDB funds please follow the link -http://www.climateinvestmentfunds.org/cif/

The Global Environment Facility (GEF)

The GEF serves as an operating entity of the financial mechanism of the UNFCCC and is working under the guidance of the GEF Council and the UNFCCC COP. To date, a total of USD 3 billion has been allocated for mitigation and enabling activities and cover mitigation and capacity building activities in the areas of agriculture, climate-resilient, energy, energy efficiency, forestry, low-carbon, renewable energy, sustainable land management, transport and water. Countries that are non-Annex I Parties, or countries eligible to borrow from the World Bank (IBRD and/or IDA) or recipients of UNDP technical assistance are eligible for GEF funds.

In most cases, GEF support is through providing grants and leveraging co-financing but in some cases projects include investment, technical assistance, establishment of funds, risk management, PES and others. To access GEF funds, an eligible country:

- Identifies one of GEF Agencies (WB, UNDP, UNEP, AfDB, FAO, IFAD, UNIDO, ADB, WFP and EBRD (doesn't participate in LDCF)).
- Develops and submits an application in the form of a Project Identification Form (PIF) to the GEF secretariat through the identified GEF Agency(s) with an endorsement letter of the Operational Focal Point of the host country.
- For full-sized projects (>$1 million), decision-taking include the following three steps before implementation;
    1. The GEF CEO clearance of the PIF,
    2. The Council approval, and
    3. The GEF CEO endorsement of the project within 22 months from the date of Council approval;.

For Medium-sized projects ($1 million or under) and enabling activities, approval authority is delegated to the GEF CEO and the approval of the final project document is within 12 months from the PIF approval.

Examples of GEF funded mitigation projects in Africa include:

- Barrier removal to encourage and secure market transformation for refrigerators in Tunisia at a cost of USD 0.7 million)
- Solar thermal hybrid project in Egypt at a cost of USD 50 million); and
- Enhancing institutional capacities on REDD issues for sustainable forest management in the Congo Basin at a cost of USD 15 million.

Forest Investment Program (FIP)

The Forest Investment Program (FIP) is a program under the Strategic Climate Fund which aims to significantly increase investments to reduce deforestation and forest degradation, and promote improved sustainable forest management, leading to emission reductions and the protection of carbon reservoirs. Its main purpose is to support developing countries' effort to reduce emissions from deforestation and forest degradation (REDD), providing up-front bridge financing for readiness reforms and public and private investments identified through national REDD readiness strategy building efforts. The program aims to help them adapt to the impact of climate change on forests and to contribute to multiple benefits such as biodiversity conservation, protection of the rights of indigenous peoples and local communities, poverty reduction and rural livelihoods enhancements.

The Fund has and allocation of USD 578 million from Australia, Denmark, Japan, Norway, Spain, UK, US and is disbursed to recipient countries through grant and ODA for mitigation, climate-resilient, forestry, low-carbon and sustainable land management.

Country eligibility of the FIP is based on ODA-eligibility according to the Organization for Economic Co-operation and Development/Development Assistance Committee (OECD/DAC) guidelines) and a strong beneficiary of a MDB lending program and/or on-going policy dialogue with the country. Current beneficiary countries in Africa include Burkina Faso, Democratic Republic of Congo and Ghana.

The selection of country recipients and pilot programs is based on the following criteria:

Potential of the Plan or Programme to contribute to objectives and adherence to the principles of FIP;

Country preparedness and ability to undertake REDD initiatives, taking into account government efforts to date and government willingness to move to a strategic approach to REDD and to integrate the role of forests into development.

Provision of a REDD investment note, demonstrating that a REDD strategy and investment portfolio is at an advanced stage of development;

Country distribution across regions and biomes, ensuring that pilot programs generate lessons on how to go to scale with respect to immediate action to curb high rates of deforestation, maintenance of existing carbon stocks within pristine forests, enhancement of carbon stocks on degraded forest lands and building effective capacities for sustainable forest management.

An Expert Group is established by the FIP Sub-Committee to make recommendations on selection of country or regional pilots for the FIP and consideration should be made of the following.

- Potential to significantly reduced greenhouse gas emissions (GHG) from REDD, or to lead to further conservation, sustainable forest management or enhanced forest carbon stocks;
- Potential to contribute to transformational change of policies and the reduction of REDD;
- Demonstrates linkages between the forest-related investments, policies and measures; and, the long-term reduction of emissions, sustainable management of forests, and the enhancement of forest carbon stocks;
- Preparedness and ability to move towards REDD initiatives and addressing its direct and underlying

drivers;

- Distribution across regions and biomes;
- Ensuring that pilot programs generate lessons learned and show potential for scaling-up.
- The Expert Group should include members from both developed and developing countries, indigenous people and local communities, and be gender balanced.

Forest Carbon Partnership Facility (FCPF)

The FCPF is a Global partnership housed at the World Bank between 13 Donors and Carbon Fund Participants and 37 tropical and sub-tropical countries selected into the FCPF. Fourteen (14) of the 37 countries are from Africa (Cameroon, Central African Republic, Democratic Republic of Congo, Republic of Congo, Equatorial Guinea, Ethiopia, Gabon, Ghana, Kenya, Liberia, Madagascar, Mozambique, Tanzania and Uganda).

The Forest Carbon Partnership Facility (FCPF) has the dual objectives of building capacity of tropical and sub-tropical developing countries in their efforts to reduce emissions from deforestation and forest degradation (REDD), and testing a program of performance-based incentive payments in some pilot countries, on a relatively small scale, in order to set the stage for a much larger system of positive incentives and financing flows in the future. The FCPF thus seeks to create an enabling environment and garner a body of knowledge and experiences that can facilitate development of a much larger global program of incentives for REDD over the medium term.

The FCPF has an allocation of about USD 160 million so far (USD 110 million under the Readiness Mechanism and USD 51 million under the Carbon Finance Mechanism) and disbursement is in the form of carbon finance and grant for mitigation activities in forestry.

Countries eligible are members of the International Development Association (IDA) or International Bank for Reconstruction and Development (IBRD) of the World Bank), located between the 35th parallel of latitude north and 35th parallel of latitude south.

Participation in the Readiness Mechanism is in the following steps:

1. **Step 1**: Interested countries submit a Readiness Plan Idea Note (R-PIN) to the FCPF for review by the Participants Committee (PC) – based on which 37 countries were selected into the partnership.
2. **Step 2:** The selected countries prepare their Readiness Preparation Proposal (R-PP) using a US$ 200,000 grant that is available upon request. The R-PP provides a framework for a country to set a clear plan, budget and schedule to achieve “REDD Readiness” to undertake REDD activities, in the specific country context. The Plan enables the country to develop and implement a common vision of the role of REDD in national development, which is shared by high levels of national and sub-national government, civil society, land users and other stakeholders.
3. **Step 3**: The partnership’s governing body reviews and assesses Readiness Plans, and on that basis decides on the allocation of FCPF readiness grant of US$ 3.4 or 3.6 million if a preparation grant of US$ 0.2 million is included.

More information can be found at the link http://www.forestcarbonpartnership.org/fcp/

UN-REDD Programme (Reduced Emissions from Deforestation and Forest Degradation)

The UN-REDD Programme has both a country-level and global focus. The global programme seeks to achieve the following objectives:

- Improved guidance on Measurement, Reporting and Verification (MRV) approaches;
- Increased engagement of stakeholders in the REDD agenda;
- Improved analytical and technical framework of social and environmental benefits maximising the contribution of REDD to sustainable development;
- Increased confidence in REDD amongst decision-makers on the feasibility of methodologies and the implementation of REDD, through coordination, knowledge management and sharing within agencies and with partners.

The country-level support is aimed at a select group of pilot countries who develop unique REDD programmes in concert with UNDP, UNEP, and FAO support. Priority is given to developing sustainable national multi-sectoral approaches with broad stakeholder engagement that promote equitable outcomes and to ensuring that countries use reliable methodologies to assess emission reductions. In some countries, key elements of delivering emission reductions – such as REDD payment structuring and distribution options - will also be tested.

Assistance for forestry projects through the UN-REDD Programme is made by possible by grants through the Government of Norway for a total amount US $97 million as grant, technical assistance and capacity building. The mitigation actions are in the forestry, natural resource management and sustainable land management.

For this UN-REDD Phase nine countries as pilot for the programme. These were selected based on the following set of common criteria:

- Request for quick start action;
- Existing collaboration with UN partners in related areas for rapid progress;
- Emission reduction potential;
- Degree of REDD readiness potential;
- Regional, biome and socio-economic representation;
- Coordination with international REDD initiatives;
- Leadership potential in sub-regional experience sharing;
- Ability to contribute experiences to UNFCCC negotiations and development of REDD mechanisms.

Among these nine countries are three African countries; Democratic Republic of Congo, Tanzania and Zambia.

Table 7.6: World Bank Carbon Finance – Windows for Funding Mitigation

Fund Name	Description	Resources
The Prototype Carbon Fund (PCF) Launched 2000	A partnership created in 1999 between six governments and 16 companies, and launched in 2000,closed its portfolio to new projects in 2007 and now focuses on implementation. The PCF portfolio consists of 24 projects in different sectors (energy, industrial, waste management, land rehabilitation, and renewable energy), located around the globe in developing countries and countries with economies in transition.	$219.8m
The Community Development Carbon Fund (CDCF) Launched 2003	The CDCF strives to expand the reach of the carbon market and extend the benefits of carbon finance to countries and communities which may find it difficult to attract carbon finance because of country and financial risk. The CDCF purchases carbon credits compliant under the Kyoto Protocol's Clean Development Mechanism (CDM), with a preference for credits from small-scale projects in least developed countries and in other developing countries with a population of less than 75 million. The Fund became operational in 2003 and is comprised of contributions from nine governments and 16 private firms.	$128.6m
The BioCarbon Fund (BioCF) Launched 2004	The BioCF is focused on land-use projects that sequester or conserve carbon in forest and agro-ecosystems while promoting biodiversity conservation and poverty reduction. Its main activities are afforestation and reforestation projects, but also projects to sequester soil carbon and reduce emissions from deforestation and forest degradation (REDD). A second tranche was opened in 2007.	T1: $53.8m T2: $36.6m
The Netherlands Clean Development Mechanism Facility (NCDMF) Launched 2002	The NCDMF supports projects in developing countries that generate credits under the CDM.	Not public information
The Netherlands European Carbon Facility (NECF) Launched 2004	The NECF is a Joint Implementation (JI) facility operating primarily in Ukraine, Russia, and Poland.	Not public information
The Italian Carbon Fund (ICF) Launched 2004	The ICF supports Kyoto CDM and JI projects that generate cost-effective emission reductions and clean technology transfer, such as hydropower and waste management and energy efficiency.	$155.6m

Fund Name	Description	Resources
The Danish Carbon Fund (DCF) Launched 2005	The DCF considers all types of projects eligible under the Kyoto Protocol's CDM and JI, except forestry projects for which credits are not eligible under the EU ETS. The fund seeks a diversified portfolio and prefers projects in the wind power, combined heat and power (co-generation), hydropower, biomass, and landfills.	€90m
The Spanish Carbon Fund (SCF) Launched 2005	The SCF includes projects and programs of activities in the East Asia and Pacific, Latin America and Caribbean, Africa, Europe and Central Asia, and the Middle East and North Africa regions. The fund covers a wide range of technologies, including HFC-23 destruction, waste management, wind, hydropower, and transportation, and energy efficiency. A second tranche was opened in mid-2008, generating opportunities for investments in green investment schemes.	T1: €220m T2: €70m
The Umbrella Carbon Facility (UCF) Launched 2006	The UCF is an aggregating facility that pools funds from World Bank-managed carbon funds and other participants to purchase emission reductions. The first tranche of the UCF was capitalized with € 800 million in 2006 to purchase CERs from two HFC-23 projects in China. Its participants include five World Bank Carbon Funds and 11 companies. The second tranche of the Umbrella Carbon Facility (UCFT2) became operational in January 2011 and reached full capitalization on February 7, 2011. These funds will be used to extend the purchase period for projects in the portfolio of existing carbon funds.	T1: € 799.1m (includes € 224.54m participation of other carbon funds) T2: €112.5
The Carbon Fund for Europe (CFE) Launched 2007	The CFE is co-managed by the World Bank and the European Investment Bank. It is designed to help European member states and the European private sector meet their commitments to the Kyoto Protocol and the EU ETS. The Fund purchases credits from projects eligible under the Kyoto Protocol's CDM and JI mechanisms with a preference for projects with relatively short lead times.	€ 50m

Fund Name	Description	Resources
Forest Carbon Partnership facility (FCPF) Launched 2008	The FCPF is designed to set the stage for a system of incentives for REDD+ by building capacity and developing systems for the thirty-seven 'REDD countries' (14 in Africa, 15 in Latin America and the Caribbean, and eight in Asia and the Pacific) which have been selected into the partnership; 19 of these have received grant allocations for readiness work. The governance structure of the FCPF includes REDD countries, donors, carbon fund participants, and observers from indigenous peoples, civil society, international organizations, the private sector, UN-REDD and UNFCCC. The World Bank carries out the functions of trustee, secretariat, and delivery partner.	Total pledges of $447m; $232 million for the Readiness Fund and $215 million for the Carbon Fund
Carbon Partnership Facility (CPF) Launched 2010	The CPF is designed to develop emission reductions and support their purchase on a larger scale through programmatic approaches that support partner country initiatives for low-carbon growth. The Facility will also target areas that have not been reached effectively by CDM in the past, such as energy efficiency, and will pilot city-wide carbon finance programs. The CPF's Carbon Fund (a carbon transaction facility) became operational on May 15, 2010. The Carbon Asset Development Fund (the program preparation facility of the CPF) has been operational since early 2009.	€132.5m in CPF Carbon Fund; €11m in donor contributions to the Carbon Asset Development Fund
Partnership for Market Readiness (PMR) Launched 2010	The PMR, with a fund for capacity-building of a target size of $100 million, was launched at the United Nations Climate Change Conference in Cancun in December 2010. It brings together developed and developing countries to foster new and innovative market instruments to lower greenhouse gas emissions, harness financial flows, build market readiness capacity for countries to scale up their climate change mitigation efforts and pilot market instruments, including domestic trading schemes and new crediting mechanisms for nationally appropriate mitigation actions (NAMAs).	$70m in pledges

African Development Bank Suite of Funds for Mitigation of GHGs

Tackling climate change issues in Africa is critical to achieving the African Development Bank's mandate. To this end, the Bank addresses climate change as a crosscutting corporate issue and has adopted an integrated results oriented Climate Change Action Plan that permeates all Bank operations to address mitigation, adaptation and financing. For more information on AfDB's response to climate change, particularly on the African continent readers may visit http://www.afdb.org/en/topics-and-sectors/sectors/climate-change/ and on the following climate finance windows visit http://www.afdb.org/en/topics-and-sectors/initiatives-partnerships/.

Africa Carbon Facility (ACF)

The Africa Carbon Facility (ACF) is an innovative, risk-bearing guarantee for investments that can benefit from carbon finance. ACF aims to help build Africa's carbon markets and attract more green investments to the continent. While global carbon markets are growing on other continents, Africa lags far behind with only 7 percent of the Clean Development Mechanism (CDM) global market share. ACF would address demand-side barriers by providing guarantees for African projects in the event there is no functioning or limited post-2012 carbon market. Carbon assets are riskier and more costly to develop in Africa than in other regions. This is due to fewer concrete project successes to use as role models and the more limited number of large-scale opportunities. Recent surveys have shown carbon project transaction costs incurred during CDM project cycles can grow as high as US$ 300,000. Carbon assets are riskier and more costly to develop in Africa than in other regions. This is due to fewer concrete project successes to use as role models and the more limited number of large-scale opportunities. Recent surveys have shown carbon project transaction costs incurred during CDM project cycles can grow as high as US$ 300,000. ACF would address debt financing barriers by leveraging the AfDB's existing debt financing role and overall capacity to support CDM projects coming through the Bank's lending pipeline, as well as ACF.

ACF will provide seed capital to African CDM project developers to help cover the prohibitive development costs. Hopefully this incentive will encourage more investment in African CDM projects which, although small, provide real sustainable development benefits for local communities. Primary CER buyers and investors will be able to benefit from the post-2012 purchase guarantee. It is being designed as a bankable product to overcome the post-2012 market risk in a time of ongoing regulatory uncertainty. It will strive to give CER buyers and investors increased access to the pipeline of CDM projects in Africa and a stream of CERs out to 2020. Contributors will also be able to benefit from ACF's innovative, self-replenishing design. And, of course, Africa will be able to benefit from increased CDM opportunities and a bigger piece of the global carbon market.

Sustainable Energy Fund for Africa

The Sustainable Energy Fund for Africa (SEFA) is aimed at exploiting the potential of the emerging "clean energy" market in Africa as a source of growth and innovation for SMEs as producers, distributors, suppliers, and consumers of climate-friendly energy. It is aimed to leverage USD 400 million through upstream support to RE generation projects and USD 40 million additional equity investment by grant and equity support to SMEs. The volume of funds committed is approximately US$ 58 million (DKK 300 million) by the Government of Denmark

SEFA will provide two financing windows. The first will support the development and design of renewable energy generation and distribution projects with a total investment between USD 30 and 75 million on a grant basis. The second will support SMEs all along the renewable energy and energy efficiency value chain with a total investment of under USD 30 million on a mixed grant and equity investment basis.

The thematic area covered by SEFA is the promotion of clean, low-carbon energy production and use. The Target Beneficiaries will include rural and peri-urban communities currently with inconsistent or no access to energy, sustainable energy production projects and PPPs that are currently unbankable and African sustainable energy/energy efficiency SMEs and entrepreneurs. The governance and administrative structure will be composed of a Coordinator, a Technical Review Committee and an Oversight Committee. The Oversight Committee (OC) will be composed by a Bank representative and representatives of the financing partners and will be responsible for approving the operational guidelines of the Fund as well as verifying the conformity of the use of resources in accordance with the objectives of the Fund.

Africa Carbon Support Program

The African Carbon Support Program is a two-year technical assistance program launched by the African Development Bank (AfDB) and is geared toward assisting Bank clients in regional member countries to

access carbon finance in order to ensure the commercial viability of their investments. Essentially, the program involves a screening process whereby the carbon finance potential of investment proposals received by the Bank is identified and assessed. At the same time, capacity building activities will be undertaken for host country government agencies – the Designated National Authorities (DNAs) in particular, where such carbon- finance eligible projects are going to be developed.

The program will also seek to highlight research findings in the area of climate change vulnerability and adaptation options. On the issue of functional capacity of country DNAs, the approach for the program is to provide a perfect opportunity for "learning by doing" for the DNA staff. This will work towards ensuring that the DNAs in those countries where identified potential Clean Development Mechanism (CDM) projects are operational and can successfully process the request for host country approval. The capacity building program will highlight the policy and operational implications of outcomes from current and emerging discussions on global carbon finance frameworks.

Other key objectives of the program:

- To assist in the development of appropriate project preparation documentations including Project Information Notes (PIN) and Project Design Documents (PDD) which are requirements under the Clean Development Mechanism. This support would help to lower the transactional costs faced by project developers in realizing carbon credits for their projects.

- To support the development of regional grid emission factor(s). This has been a crucial element for projects in the power sector and will allow projects in countries with low emission factors to benefit from the fact that their project will feed into wider regional grids which have cumulative high emission factors.

- To support project owners to successfully commercialize the carbon potential of projects. This will ensure that the project owners are in a position to determine the optimum proposal for purchase of their project's carbon credits. Equally important, this component will also aim to ensure that the project owners can successfully monitor and report the emission reductions resulting from their respective CDM projects.

The Africa Carbon Support Program has benefited from a grant of US$ 1 million from the Fund for African Private Sector Assistance (FAPA) which was established by the African Development Bank in partnership with the Japanese government. The fund will be scaled up in time.

Climate for Development in Africa (ClimDev-Africa) Initiative

The Climate for Development in African Programme (ClimDev-Africa) is a joint initiative of the African Union Commission (AUC), the United Nations Economic Commission for Africa (UNECA) and the AfDB. The programme responds to the urgent challenge that climate change poses to the achievement of Africa‟s development objectives. It will implement programs that strengthen national and sub-regional institutional capacities to overcome the lack of necessary climate information, analysis and options required by policy and decision makers at all levels within the context of threats of climate change.

The ClimDev-Africa Programme Special Fund (CDSF) will be implemented in two phases, the first phase has an indicative budget of about US$ 136 million for 2010-2012 while activities for the second phase until 2020 are estimated to cost about US$ 800 million. The CDSF will be continually replenished to support long term adaptation to climate change. DFID has already pledged £10 million to support ClimDev-Africa Fund. Other AfDB bilateral donor countries, including Denmark, Norway and Sweden, have also expressed interest in financially assisting the CDSF.

The CDSF targets RMCs and national and regional climate institutions in Africa and supports operations

in the following three main areas:

- Generation and wide dissemination of reliable and high quality information on climatic situation in Africa.
- Capacity enhancement of policy makers and policy support institutions to integrate information on climate change into development programs.
- Implementation of pilot adaptation practices that demonstrate the value of mainstreaming climate information into development.

ClimDev-Africa Programme CDSF will be administered and governed, according to Bank‟s procedures, in partnership with the African Union and the UNECA. The Fund is approved by the Board of Directors and the Governing Council provides technical oversight of the CDSF.

Congo Basin Forest Fund (CBFF)

The Congo Basin Forest Fund (CBFF) was established through partnership between the Central Africa Forests Commission (COMIFAC), the United Kingdom Department for International Development (DFID) and the African Development Bank (AfDB) to mobilize resources to finance activities and projects aimed at promoting the equitable and sustainable use, conservation and management of the Congo Basin forests and ecosystems for poverty alleviation, sustainable social-economic development, regional cooperation and environmental conservation.

The areas of intervention for CBFF grant funding will mainly be those that slow the rate of deforestation, reduce poverty amongst forest dwellers, and contribute to a reduction in greenhouse gas emissions while maximizing the storage of carbon. The target beneficiaries include around 80 million inhabitants of the Congo Basin and eligible institutions, including RMCs of the Bank, their central and local government institutions or agencies thereof, as well as regional agencies or institutions concerned with Congo Basin forest conservation and management issues. Eligibility is also extended to Non Governmental Organizations (NGOs) at the country or regional level; civil society organizations; community based organizations; research and training institutions; regional, sub-regional and sectoral organizations; and private sector institutions.

The Administration and Governance Structure of CBFF consists of a Governing Council, which provides strategic direction and oversight of the Fund, and ensure broad donor and stakeholder participation and a Secretariat headed by a Coordinator, to manage the Fund. The Secretariat is based at AfDB Headquarters, with technical staff located at AfDB regional offices in Yaoundé and Kinshasa.

7.8 Access to Financial and Technical Support for Low Carbon Development Strategies

Africa has so far not attracted much climate finance. Nearly two dozen climate funds exist globally into which about US$32 billion has been pledged and US$ 13 billion deposited to date. Of the total amount of project budgets approved, Africa’s share is only 15%. One of the reasons for this is that Africa has very low greenhouse gas emissions and most existing instruments target carbon reductions more than low greenhouse gases growth trajectories.

Climate finance can help Africa to take the path of low carbon growth. Africa has a vast demand for investment in the energy sector and there is a unique opportunity to build up clean energy infrastructure. But funding is needed to make clean energy competitive. There is already a huge funding gap for energy in Africa so this funding must come from elsewhere. Climate finance can lower the costs of clean energy and propel Africa on a low carbon path. While Africa has been able to obtain a relatively large share of

the Climate Investment Funds, this is not the case for other types of climate finance. How do you think that the situation can be changed? I will mention some of the ideas we have for the new energy strategy.

The Bank has indicated that will continue imbedding climate finance within its operations and blending climate finance with traditional instruments. Staff will be trained to understand these relatively new instruments and guidelines will be developed for using them. Investment projects face a variety of barriers, especially in Africa, and a range of instruments is required for success. Blending different climate finance instruments with conventional instruments provides opportunities to overcome barriers for investment projects in Africa, while moving investments towards a low-carbon development.

A lot of work is needed to ensure that future climate finance instruments are better suited to Africa. It is envisaged that the African Green Fund which will be managed by an African institution will address the specificities and needs of Africa.

Private sector investment will be the main driver of development and infrastructure change to achieve low-carbon, climate-resilient growth. It can be leveraged through well-designed domestic policy frameworks and use of innovative financial instruments, both internationally and nationally. Key instruments and areas of action include:

1. Scaling up carbon markets to put a price on carbon and green taxation;
2. Integrating sound domestic investment policies (e.g. investment in renewable energy; developing policy frameworks for low-carbon, climate-resilient infrastructure investment and enabling environments for investment with effective and economically-efficient climate policies to create a climate-friendly investment policy framework;
3. Encouraging private sector engagement in adaptation to climate change;
4. Raising incentives for pension funds and other private pools of capital to invest in low carbon and “climate proofed” development, including through the use of green bonds;
5. Greener export credits;
6. Encouraging pro-active corporate behaviour to transition to a low-carbon economy.

Market Mechanisms:

It is estimated that transitioning to a low-carbon, and climate resilient economy, will require significant scaling up of both public and private sources of finance. The use of market instruments to implement mitigation pledges may not only deliver cost-effective mitigation but also provide a stable source of public revenue that can be partly dedicated to financing action on climate change. If the Copenhagen Accord/Cancun Agreements pledges and actions for developed countries were to be implemented as a carbon tax or a cap-and-trade schemes with fully auctioned permits, the fiscal revenues would amount to more than 250 billion USD, i.e. 0.6% of their GDP in 2020 (**OECD Environmental Outlook to 2050)**.

International Finance Corporation.

The International Finance Corporation(IFC), the private sector arm of the World Bank Group, has designated climate change as one of its corporate strategic priorities. The activities covered include Promoting climate friendly investments using commercial funds, Cleaner production, Clean technology and Solar strategy. For more information please visit www.ifc.org/ifcext/sustainability.nsf/Content/ClimateChange

Fossil Fuel Subsidies:

Export Credits:

Greener export credits could provide an important opportunity to stimulate trade and private investment in developing countries to support low carbon development. The majority of the medium and long term official export credit flows from OECD governments to developing countries support the transport and industry sectors.

Pension Funds:

There are some initiatives currently under way around the world to encourage pension funds to help finance green growth projects. Transitioning to a low-carbon, climate resilient economy will require significant investment and consequently private sources of capital on a large scale. With USD 28 trillion in assets, pension funds and other institutional investors have an important potential role to play in financing such green growth initiatives. According to the OECD it is recommended to provide supportive environmental policy backdrop; create appropriate investment vehicles and foster liquid markets; support investment in green infrastructure; remove investment barriers; provide education and guidance to investors; improve pension fund governance.

An important challenge is to ensure that such climate change finance effectively contributes to the economic development objectives of recipient countries.. Source: Monitoring and Tracking Long-Term Finance to Support Climate Action (2011) citing OECD Export Credit Agency data 2010.

Micro-Finance

Much of the current policy debate on adaptation to climate change has focussed on estimation of adaptation costs, ways to raise and to scale-up funding for adaptation, and the design of the international institutional architecture for adaptation financing. There is however little or no emphasis so far on actual delivery mechanisms to channel these resources at the sub-national level, particularly to target the poor who are also often the most vulnerable to the impacts of climate change. It is in this context that microfinance merits a closer look.

One of the first empirical assessments of the linkages between microfinance supported activities and adaptation to climate change was the paper on the assessment of the lending portfolios of the 22 leading microfinance institutions in two climate vulnerable countries – Bangladesh and Nepal – analyzing the synergies and potential conflicts between microfinance and adaptation. The two countries had also been previously examined as part of an earlier OECD report on the links between macro-level Official Development Assistance and adaptation. This analysis provides a complementary “bottom-up” perspective on financing for adaptation. Insights from this analysis also have implications for OECD countries. This is because microfinance is also being increasingly tapped to reduce the vulnerability of the poor in domestic OECD contexts as well and may therefore have the potential to contribute to adaptation.

The paper identifies areas of opportunity where microfinance could be harnessed to play a greater role in fostering adaptation, as well as its limitations in this context. It also explores the linkage between the top-down *macro*-financing for adaptation through international financial mechanisms and the bottom-up activities that can be implemented through microfinance.(Agrawala Shardul and Maëlis Carraro, 2010}

7.9 Funding Opportunities for Small-Scale Initiatives

- Below are other opportunities that exist for access to funding for small-scale organizations for adaptation and other climate change activities, such as for small grants, community-level projects,

GEF Small Grants Programme

The SGP is a global and multi-focal area GEF project, approved for funding by the GEF Council on a rolling replenishment, and implemented on behalf of the GEF partnership by UNDP, and executed by UNOPS. Grants are channeled directly to CBO and NGOs, with the maximum grant amount per project being US$50,000, but averages around US$20,000. To date the program funding from the GEF is approximately US$401 million and has raised US$407 million from other partners in cash or in-kind equivalents. For information on how the SGP works and the Operational guidelines, please visit

http://sgp.undp.org/index.cfm?module=ActiveWeb&page=WebPage&s=HowdoesSGPwork

Community Based Adaptation

In recognition of the fact that small communities are often the most severely affected, yet the least equipped to deal with the impacts of climate change impacts, the GEF council proposed that 10% of the resources under the Strategic Priority on Adaptation be channeled to community-based activities through the mechanism of the GEF Small Grants Programme (SGP) (document GEF/C.23/Inf.8/Rev.1, May 11, 2004).

In response, UNDP, in collaboration with SGP, has designed the CBA project to achieve the goal of reducing vulnerability and increasing adaptive capacity to the adverse effects of climate change in the focal areas in which the GEF works, building the resilience of communities, ecosystems, and resource-dependant livelihoods in the face of climate change.

The Africa Enterprise Challenge Fund

The Africa Enterprise Challenge Fund (AECF), a Fund hosted by the Alliance for a Green Revolution in Africa (AGRA), is open to proposals from **all countries in Africa.** It has the aim of encouraging private sector companies to compete for investment support for their new and innovative business ideas. They operate from three regional hubs (Nairobi, Accra and Johannesburg).

For more information ; info@aecfafrica.org. For information regarding a particular business idea/project submission email: projects@aecfafrica.org.

Chapter 8:

INSTITUTIONAL LEGAL AND POLICY FRAMEWORKS

8.1 Introduction

Climate change is a cross-cutting issue and therefore requires special institutional and governance arrangements. Currently in many of the African countries, climate change issues are coordinated by institutions that are responsible for either the environment or agriculture. So as to take on board all concerns and to ensure climate change issues are taken on board across all sectors, most countries have set up inter-ministerial climate change coordinating committees. This has resulted in arrangements that have contributed to the dissemination of climate change information to other sectors and institutions.
Climate change is now being increasingly well linked to development planning, finance and sector institutions.

The regime enjoys one of the highest level of participation in the international environmental arena among states and stakeholder organisations, including non-governmental organisations, intergovernmental organisations, UN bodies and specialized agencies.Parties to the climate change regime are organized into a number of different groups and coalitions. The African Group of Negotiators, an active participant in the UNFCCC negotiations, speaks on behalf of the combined concerns of countries located within the African continent and is the only UN regional group serving as an active negotiating coalition, providing an important forum for African countries to pursue their specific interests, especially on issues where their perspective may differ from that of the wider G-77 and China. (Cf. UNEP *Guide for Negotiators of Multilateral Environmental Agreements, http://www.unep.org/DEC/docs/Guide%20for%20Negotiators%20of%20MEAs.pdf)*

8.1.1 Institutional framework of the UNFCCC process

International oversight and implementation of the climate regimes is only possible through an array of institutions under the UNFCCC and the Kyoto regimes (F Yamin and J Depledge, 2004). Figure 8.1 shows an overview of the Convention bodies, the supporting bodies and their respective roles. The Conference of Parties (COP) is the supreme body of UNFCCC, which keeps under regular review the implementation of the Convention and any related legal instruments that the Conference of the Parties may adopt, and shall make, within its mandate, the decisions necessary to promote the effective implementation of the Convention. In order to create a robust framework which – at least to some degree – creates legal certainty and supports the rule of law amongst nations, binding commitments appear of utmost importance.

The intergovernmental process on climate change, since 1995, revolves around the annual meetings of the COP and, since 2005, the CMP (both bodies meet in conjunction). The Subsidiary Body for Implementation (SBI) and the Subsidiary Body for Scientific and Technological Advice (SBSTA), two permanent bodies, support the COP and CMP on matters relating to implementation and on scientific and technological issues respectively. The UNFCCC Secretariat is established under Article 8 UNFCCC. Its mandate is inter alia to make arrangements for sessions of the Conference of the Parties and its subsidiary bodies established under the Convention and to provide them with services as required; to compile and transmit reports submitted to it; to facilitate assistance to the Parties, particularly developing country Parties etc. The Expert Group of Technology Transfer (EGTT) supports SBI and SBSTA on technology issues. The EGTT is made up of 19 Party-nominated experts, allowing regional balance and

three observers from relevant intergovernmental organizations.

The Global Environment Facility (GEF) is assigned by the COP to operate the financial mechanism. The GEF provides financial support to developing countries and economies in transition and manages two special funds the Least Developed Countries Fund (LDCF) and the Special Climate Change Fund (SCCF).

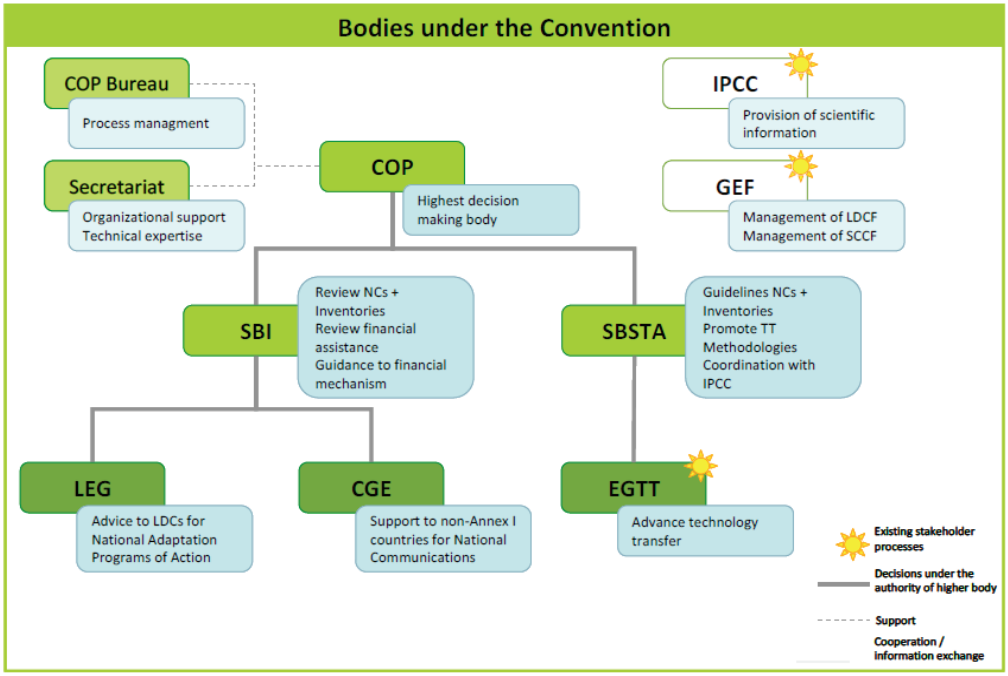


Figure 8.1: Institutional Framework of the Climate Change Convention Process (Source: Charlotte Streck et al., 2010: Private Sector and the UNFCCC Options for Institutional Engagement, Final Report, 2010)

In a note entitled *'Legal considerations relating to a possible gap between the first and subsequent commitment periods'* the UNFCCC secretariat has undertaken an assessment of the possible legal consequences (cf. http://unfccc.int/resource/docs/2010/awg13/eng/10.pdf). The rules for adopting new protocols under the UNFCCC very much correspond with the procedures for amendments to the Convention and the Kyoto Protocol. The mandate of the COP to amend the UNFCCC and the Kyoto Protocol, or adopt a new legal instrument that either supplements or replaces the Kyoto Protocol is broadly limited by the UNFCCC's objective and guiding principles. The UNFCCC, however, only provides a general framework to combat climate change. Parties have a responsibility to protect the climate system in accordance with their common but differentiated responsibilities and respective capabilities.

Access to scientific and technical information is absolutely critical for a well functioning climate change regime. The Intergovernmental Panel on Climate Change (IPCC) has become the become the most predominant source of scientific and technical information and analysis to the climate change regime, with both COP decisions and the Kyoto Protocol referring to its scientific and technical inputs (F Yamin and J Depledge 'The International Climate Change Regime. A Guide to Rules, Institutions and Procedures' (2004), 464ff.). The IPCC was established by the United Nations Environmental Programme (UNEP) and the World Meteorological Organisation (WMO) in 1988 and assesses the scientific, technical and socio-economic information relevant for the understanding of human-induced climate change, its potential impacts and options for mitigation and adaptation. In 2007 the IPCC and Albert Arnold (Al) Gore Jr. were awarded with the Nobel Peace Prize for their efforts to build up and disseminate greater knowledge about man-made climate change and to lay the foundations for the measures that are needed to

counteract such change.

The IPCC consists of three Working Groups: The IPCC Working Group I (WG I) assesses the physical scientific aspects of the climate system and climate change. The main topics assessed by WG I include: changes in greenhouse gases and aerosols in the atmosphere; observed changes in air, land and ocean temperatures, rainfall, glaciers and ice sheets, oceans and sea level; historical and paleoclimatic perspectives on climate change; biogeochemistry, carbon cycle, gases and aerosols; satellite and other data; climate models; climate projections, causes and attribution of climate change (http://www.ipcc.ch/working_groups/working_groups.shtml).

The WG I Technical Support Unit, which manages the organisational and administrative activities of the Working Group, is hosted by the University of Berne, Switzerland and funded by the Government of Switzerland (https://www.ipcc-wg1.unibe.ch/).

The IPCC Working Group II (WG II) assesses the vulnerability of socioeconomic and natural systems to climate change, negative and positive consequences of climate change, and options for adapting to it. It also considers the relationship between vulnerability, adaptation and sustainable development. The assessed information is considered by sectors (water resources; ecosystems; food and forests; coastal systems; industry; human health) and regions (Africa; Asia; Australia and New Zealand; Europe; Latin America; North America; Polar Regions; Small Islands). In its reports, Working Group II elaborates on the scientific, technical, environmental, economic and social aspects of the vulnerability (sensitivity and adaptability) to climate change of, and the negative and positive consequences for, ecological systems, socioeconomic sectors and human health, with an emphasis on regional, sectoral and cross-sectoral issues. The WG II Technical Support Unit is housed at the Carnegie Institution for Science in Stanford, California, USA (http://www.ipcc-wg2.gov/).

The IPCC Working Group III (WG III) assesses options for mitigating climate change through limiting or preventing greenhouse gas emissions and enhancing activities that remove them from the atmosphere. The main economic sectors are taken into account, both in a short-term and in a long-term perspective. The sectors include energy, transport, buildings, industry, agriculture, forestry, waste management. WG III analyses the costs and benefits of the different approaches to mitigation, considering also the available instruments and policy measures. The approach is more and more solution-oriented. The IPCC WG III Technical Support Unit is housed at the Potsdam Institute for Climate Impact Research in Potsdam, Germany (http://www.ipcc-wg3.de/).

The Task Force on National Greenhouse Gas Inventories (TFI) was established by the IPCC to oversee the IPCC National Greenhouse Gas Inventories Programme (IPCC-NGGIP). The core activity is to develop and refine an internationally-agreed methodology and software for the calculation and reporting of national GHG emissions and removals and to encourage its use by countries participating in the IPCC and by parties of the United Nations Framework Convention on Climate Change (UNFCCC). The NGGIP also established and maintains an Emission Factor Database. The IPCC National Greenhouse Gas Inventories Programme was managed from 1991 by the IPCC WG I in close collaboration with the Organisation for Economic Co-operation and Development (OECD) and the International Energy Agency (IEA) until its transfer to the IPCC's Task Force on National Greenhouse Gas Inventories (TFI) based in Japan in 1999 (http://www.ipcc-nggip.iges.or.jp/).

One of the main IPCC activities is the preparation of comprehensive assessment reports about the state of scientific, technical and socioeconomic knowledge on climate change, its causes, potential impacts and response strategies. Since its inception in 1988 the IPCC has prepared four multivolume assessment reports. The 5th IPCC Assessment Report (AR5) is expected to be published between 2013 and 2014. The Task Group on Data and Scenario Support for Impact and Climate Analysis (TGICA) facilitates distribution and application of climate change related data and scenarios (http://www.ipcc.ch/activities/activities.shtml#tabs-4).

Under the Kyoto Protocol, the highest governing body is the CMP and the Protocol provides national means to comply with the targets. The Kyoto Protocol provides for three market-based mechanisms: International Emission Trading (trading of emission rights between Annex I countries), Joint Implementation (JI) (project implementation in Annex I countries) and the Clean Development Mechanism (CDM) (project implementation in non-Annex I countries). The project based mechanisms are each governed by their own institutional setup, which is similar, but not identical in structure.

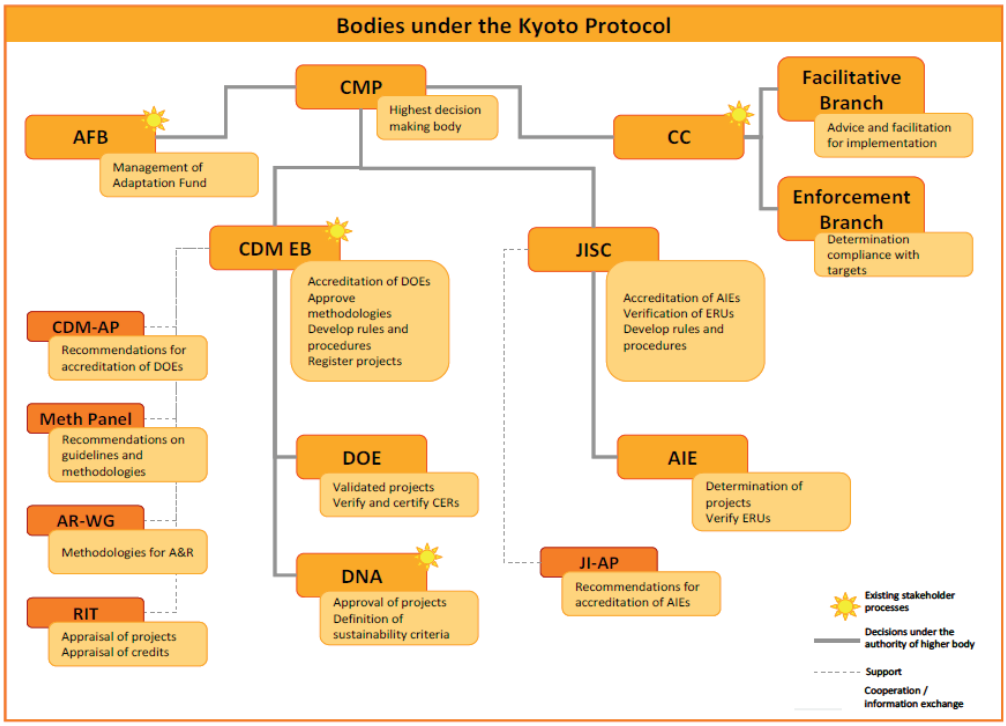


Figure 8.2: Institutional Framework of the Kyoto Protocol of the Climate Change Convention (Source: Charlotte Streck et al., 2010: Private Sector and the UNFCCC Options for Institutional Engagement, Final Report, 2010)

The CDM is supervised by the CDM Executive Board (CDM EB), which prepares reports and technical papers for review and adoption by the CMP, as well as registering projects and accrediting the Designated Operational Entities (DOE). The DOEs are independent auditors which assess whether a project is in line with the eligibility criteria (validation), whether the project has led to a reduction in greenhouse gases (verification) finally the DOE certifies the emission reduction (certification). Each country participating in the CDM mechanism creates a Designated National Authority (DNA) to approve specific projects. Different working groups and panels support the CDM EB. The Methodologies Panel (Meth Panel) assesses new methodologies for baselines and develops guidelines. The CDM Accreditation Panel (CDM-AP) prepares the decision-making of the CDM EB regarding the accreditation of DOEs. The Afforestation and Reforestation Working Group (AR WG) makes recommendations for new baselines concerning afforestation and reforestation. The Registration and Issuance Team (RIT) prepares appraisals of requests for registration and the issuance of Certified Emission Reductions (CERs). The Joint Implementation Supervisory Committee (JISC) supervises the JI, verifies Emission Reduction Units (ERUs), develops rules and procedures and accredits the Accredited Independent Entities (AIEs). The Joint Implementation Accreditation Panel (JI-AP) submits proposals to the JISC regarding the Accreditation of AIEs. Private project participations are represented through the JI Action Group and the Project Developer's Forum.

8.1.2 Future Institutional Structure of the Climate Change Convention

Governments are now negotiating a new and more ambitious international framework and take into consideration the vast experience that has been gathered since the 1990s to be reflected in any new international framework. Attempts are being made within the intergovernmental process to slowly compliment the purely top-down approach of the past by a bottom-up approach.

Copenhagen did not deliver certainty on the future architecture of the climate regime, it has a weak legal status but nonetheless provides political guidance and proposes a number of new bodies and mechanisms, which are included in the current negotiating texts. At the most recent negotiations (June 2010), the two *ad hoc* working groups negotiating a future climate change regime—the Ad Hoc Working Group on Long-term Cooperative Action under the Convention (AWG-LCA) and the Ad Hoc Working Group on Further Commitments for Annex I Parties under the Kyoto Protocol (the AWG-KP) — provided texts on the status of their discussions, which provide further information on the possible future climate regime. The potential institutional architecture, where win-win opportunities could exist, by enhancing the engagement of the private sector are summarized in the Figure 8.3. The timely and more effective engagement of the private sector will be a critical factor in achieving real and lasting success. The private sector—with its technical know-how and expertise—will be essential for any successful implementation of the mechanisms emerging in any future international climate agreement. This includes, among others, the implementation of NAMAs and REDD+ activities, the provision of finance, development and deployment of technology, assisting in MRV and certification of results, and direct participation in market-based mechanisms created by, or as a result of, the international climate regime.

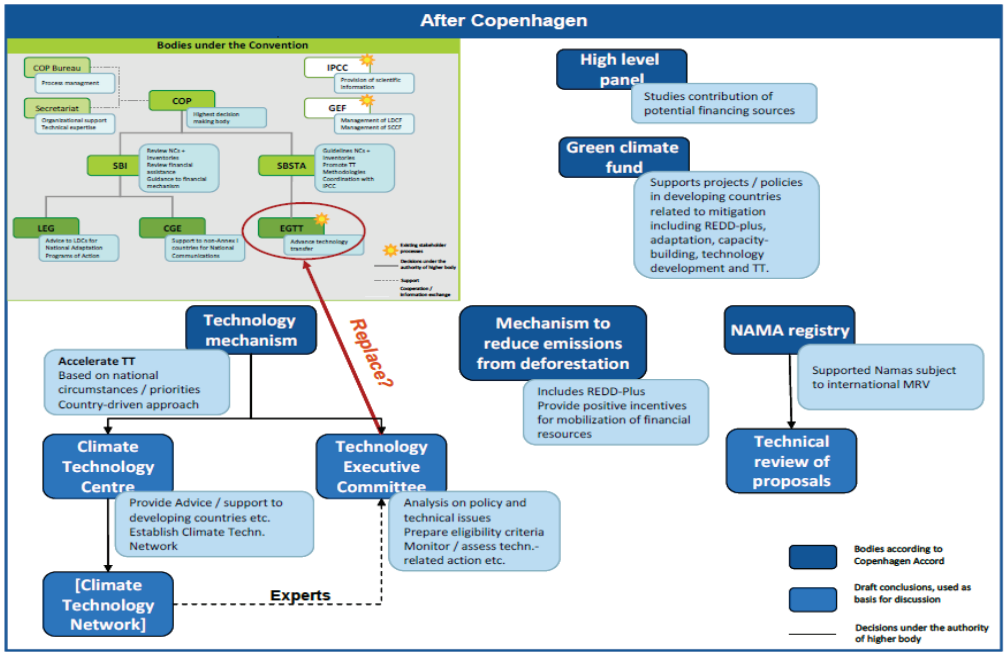


Figure 8.3: Future Potential Institutional Structure of the Climate Change Convention (Source: Charlotte Streck et al., 2010: Private Sector and the UNFCCC Options for Institutional Engagement, Final Report, 2010)

The ***High Level Panel*** may be tasked to study the contribution of the potential sources of revenue, including alternative sources of finance to meet the goal of mobilising 100 Billion USD by 2020 to address investments needs for climate mitigation and adaptation in developing countries. The Panel should therefore look at the *policy and investment conditions needed* to direct finance towards these countries.

The ***Green Climate Fund*** is likely to support projects, policies and programmes that enable developing countries to transition to a low-carbon economy. It is likely that the governance structure will be similar to those of the existing finance mechanism under the COP, the Climate Investment Funds of the World Bank, or some hybrid model.

The AWG-LCA **Technology Mechanism** has been proposed and endorsed by the Copenhagen Accord to support the objective of acceleration of clean technology development and deployment which is central to addressing climate change. The "Ad-hoc working group on long-term cooperative action" (AWG-LCA) of the UNFCCC has elaborated the functions and structure of this potential mechanism but many details require clarification and definition.

The ***Technology Executive Committee*** is expected to set strategic objectives of the Technology Mechanism and advises on technical issues.

NAMAs: Paragraph 1 (b) (ii) of the Bali Action Plan calls for "*Nationally appropriate mitigation actions' by developing country Parties in the context of sustainable development, supported and enabled by technology, financing and capacity building, in a measurable, reportable and verifiable manner*. " The Copenhagen Accord mentions both the creation of a NAMA registry and ideas on the MRV of NAMAs. The Copenhagen Accord states that supported actions are to be subject to international MRV, while unilateral actions that do not receive international support are subject to a national MRV process.

8.2 Policy and Legal Framework

This section aims to identify the policy and regulatory frameworks necessary for addressing climate change at international, regional and national levels. The complexity of climate change involves a diverse range of institutions and legal regimes (Robert Keohane and David Victor 'The Regime Complex for Climate Change' (2011) 9 Perspective on Politics). This chapter will concentrate on the UN legal regime, some Multilateral Environmental Agreements (MEAs), the regime of the World Trade Organisation as well as the African Union and some Regional Economic Communities (RECs) on the African continent.

As a point of departure it shall be stated that one of the major natural resource implications of climate change is that human populations – and law – will have to adapt to major shifts. More than three decades ago a legal expert already wrote, in the context of climate change:

> *While one function of law is to give stability to institutions and predictability to the results in action, often the strength of law will lie not in immutability but in capacity for change and flexibility in the face of new forces (Trelease, 1977).*

Also in the words of Trelease "we would be wise to plan for the unpredictable" (Trelease, 1977). It is expected that climate change will generate significant impact on national, regional and global economies; and it is not unlikely that this will result in increased local and international conflict (Scholtz, 2010). This also applies with a view to the interconnectedness and interdependence of water, energy, national welfare and international economies, as climate change progresses. In its 2007 Summary for Policymakers, IPCC Working Group II reflects on impacts, adaptation and vulnerability as follows:

> Africa is one of the most vulnerable continents to climate variability and change because of multiple stresses and low adaptive capacity (IPCC, 2007).

In view of the above, rights need to be adjusted and responsibilities distributed with greater fairness in future - among communities, both globally and domestically. In the same context political devotion, access to information and broad public participation are just as important for the improved realisation of human rights, as development of quality climate-change related education, as well as high standard interdisciplinary research. In order to become a winner - rather than a looser of climate change – African countries need to strengthen their respective policies, train more highly skilled experts in this field in order to meet future demands and to be in the position to negotiate international interests in a growing and complex, knowledge-based global economy (Ruppel, 2011b). Realistically, the challenge is one of maximising benefits and minimizing costs and burdens with a view to mitigating what can fairly be regarded as a dangerous development for Africa's prospects and future.

As a global problem, climate change calls for local and multilateral solutions. Differentiation through emissions targets and actions, and additional multilateral obligations on policies and measures in the climate sector is the key to addressing leakage and competitiveness concerns. A scientific consensus is emerging that substantial global reduction in greenhouse gas emissions will be required to prevent an extreme increase in average temperature. It is furthermore acknowledged that a 'business-as-usual scenario' would have disastrous consequences for future generations. In consequence, developed *and* developing countries will have to build low carbon economies, at least in the long run, recognizing the importance of principles such as equity and common but differentiated responsibilities and respective capabilities. This will require efforts at various levels, including substantive changes in life-style, in particular in industrial countries. No less important is, however, major investment in low carbon technology and modern technology transfer to and capacity building in Africa (Ohlendorf and Gerstetter, 2009). This in turn will require a shared vision for long-term cooperation action, as has been adopted at COP 16 in Cancún (FCCC/CP2010/7/Add.1).

8.2.1 International Law

International law has developed rapidly over the past few decades, especially since the dawn of the UN, when rules and norms regulating activities carried on outside the legal boundaries of nations were developed. Numerous international agreements – bilateral, regional or multilateral in nature – have been concluded and international customary rules, as evidence of a general practice accepted as law, have been established.

General rules of public international law include rules of customary international law, supported and accepted by a representatively large number of states. The notion of *international agreement* primarily refers to *treaty* in the traditional sense, i.e. international agreements concluded between states in written form and governed by international law, but it also includes conventions, protocols, covenants, charters, statutes, acts, declarations, concords, exchanges of notes, agreed minutes, memoranda of understanding, and agreements. Notably, not only agreements between states, but also those with the participation of other subjects of international law, e.g. international organisations, are covered by

the term *international agreement*. In general, international agreements are binding upon states if the consent to be party to a treaty is expressed by a signature followed by ratification; or by accession, where the state is not a signatory to a treaty; or by declaration of succession to a treaty concluded before such a state existed.

The sources of international law in general are listed in Article 38 of the Statute of the International Court of Justice (ICJ), the principal judicial organ of the United Nations:

1. The Court, whose function is to decide in accordance with international law such disputes as are submitted to it, shall apply:

    b. International conventions, whether general or particular, establishing rules expressly recognised by the contesting states;

    c. International custom, as evidence of a general practice accepted as law;

    d. The general principles of law recognised by civilised nations;

    e. Subject to the provisions of Article 59, judicial decisions and the teachings of the most highly qualified publicists of the various nations, as subsidiary mean for the determination of rules of law…

Considering that Article 38 of the Statute of the ICJ was first drafted in 1920, these provisions do not longer reflect all the sources of today's international law. New developments in respect of sources of law have to be considered in addition to those recognised in Article 38.

The 1992 United Nations Conference on Environment and Development (UNCED) in Rio de Janeiro reaffirmed the Declaration of the United Nations Conference on the Human Environment, adopted at Stockholm in 1972, seeking to build upon it, with the goal of establishing a new and equitable global partnership through the creation of new levels of cooperation among States, key sectors of societies and people, working towards international agreements which respect the interests of all and protect the integrity of the global environmental and developmental system, recognizing the integral and interdependent nature of the Earth. It proclaims first and foremost that human beings are at the centre of concerns for sustainable development. They are entitled to a healthy and productive life in harmony with nature (Principle 1). Moreover, states have, in accordance with the Charter of the United Nations and the principles of international law, the sovereign right to exploit their own resources pursuant to their own environmental and developmental policies, and the responsibility to ensure that activities within their jurisdiction or control do not cause damage to the environment of other States or of areas beyond the limits of national jurisdiction (Principle 2). Thirdly, the right to development must be fulfilled so as to equitably meet developmental and environmental needs of present and future generations (Principle 3).

Governments, international organizations and other bodies should promote synergies at the national level between the United Nations Framework Convention on Climate Change and its Kyoto Protocol and the Convention on Biological Diversity, when implementing climate-change activities and their relation to the conservation and sustainable use of biodiversity. Such cooperation between the Convention on Biological Diversity and all relevant international conventions, organizations and bodies, can strengthen and build on existing cooperative arrangements to enhance synergies and reduce inefficiencies in a manner consistent with their respective mandates, governance arrangements and agreed programs, within existing resources. Such synergies between international environmental instruments, and the secretariats of the Convention on Biological Diversity, the United Nations Convention to Combat Desertification and the United Nations Framework Convention on Climate Change can only be mutual beneficial.

Climate change issues are cross-sectoral and thus, a broad range of international conventions become relevant with regard to climate change. The most relevant international agreements binding upon States

and relating to climate change are those which were developed during the 1992 Rio Conference:

- United Nations Framework Convention on Climate Change (UNFCCC) – www.unfccc.int
- United Nations Convention on Biological Diversity (CBD) - www.cbd.int/
- United Nations Convention to Combat Desertification (UNCCD) - www.unccd.int/

All of the above and the Kyoto Protocol are "treaties" in terms of international law and Article 2.1(a) of the Vienna Convention on the Law of Treaties. Any treaty negotiation lies in the pre-eminence of the concept of state sovereignty. This gives states the right to govern the affairs that occur within their territorial areas. Yet, the UNFCCC and the subsequent Kyoto Protocol can, at the same time be seen as an articulation of how states balance their sovereign rights to follow their own development agenda with their overall responsibilities under international law, including those to avoid harm to areas beyond the limits of their jurisdiction. This means that the conceptuality and international nature of climate change demands that states apply some of their sovereignty by engaging into international cooperation and negotiation in the interest of 'common concern of humankind' (UNFCCC, Preamble). Strictly speaking relevant international obligations, such as those embodied in the Rio Declaration, include but are broader than the responsibility to avoid transboundary harm. They include responsibilities to protect ecosystems, eradicate poverty etc.

8.2.1.1 United Nations Framework Convention on Climate Change (UNFCCC)

The UNFCCC allows for the introduction of Protocols to the Convention. The first of these is the Kyoto Protocol. The latter agreement came into force on 16 February 2005. A number of global initiatives are being implemented to assist in the operationalisation of the UNFCCC. For example, the Global Environment Facility (GEF) serves as an operating entity of the UNFCCC financial mechanism and has been supporting the national capacity self-assessment process at national level for some time, among other things. This is aimed at providing countries with an opportunity to articulate their own capacity needs in implementing the UNFCCC, the other two Rio Conventions and other non-Rio Conventions (e.g. chemicals). The ultimate objective of the UNFCCC is to stabilise greenhouse gas concentrations "at a level that would prevent dangerous anthropogenic interference with the climate" (UNFCCC, 2009a). Such a level – and this is generally regarded by developing countries as an integral part of the aforementioned objective - should be reached within a timeframe which allows ecosystems to adapt naturally to climate change, while guaranteeing that food production is not at risk and that development occurs in a sustainable manner.

The Convention is a framework document, identifying two major areas of work required to fight climate change, Mitigation (UNFCCC, 2009b) and Adaptation (UNFCCC, 2009c). Moreover, the Convention as a legal instrument identifies a wide range of measures (see, e.g., the diversity of measures in Article 4.1) to address climate change, which includes mitigation and adaptation, but also other activities such as scientific and technical cooperation, technology transfer, finance etc. The UNFCCC allows any state to become a party, and as at 2011 has 194 Parties, thus making it a global instrument. Within this framework of global participation, actual obligations of parties differ substantially between industrialised and developing countries. The UNFCCC enshrines a number of key principles (Article 3) including the principles of "equity" and "common but differentiated responsibilities and respective capabilities", Article 3 (1) UNFCCC. Today's accumulated greenhouse gas emissions originate mainly from over 150 years of carbon-based industrial activity in developed states. Therefore UNFCCC recognizes that all countries have a common responsibility to tackle climate change, but places a heavier burden on industrialised states as fulfillment of their respective historic responsibility for the causes of climate change (Boisson de Chazourne, 2008).

These principles are reflected in the obligations established for developed and developing countries in the Convention, including those relating to mitigation, adaptation, technology transfer, finance as well as communication of information relating to the Convention. The Convention goes further to make

provision for countries in special situations, including particularly vulnerable countries, least developed countries, undergoing transition to a market economy (e.g. Articles 4(4), 4(6), 4(8), 4(9) and 4(10)). Article 4(4) UNFCCC, for instance, states:

> The developed country parties (…) shall assist the developing country parties that are particularly vulnerable to the adverse effects of climate change in meeting costs of adaptation to those adverse effects.

In light of the adaptation objective, the UNFCCC commits all members to formulate, implement and update adaptation measures. Article 4.1 sets up common commitments for all Parties. Article 4.2 sets up differentiated mitigation commitments for Annex I Parties. Article 4.3 addresses finance. Article 4.4 addresses additional support for particularly vulnerable countries, which must be read with Article 4.8 which defines vulnerable countries.

A system of grants and loans is set up through the Convention's financial mechanism and is managed by the Global Environment Facility. Industrialised countries agree to share technology with less-advanced nations (Boisson de Chazourne, 2008). Institutions and procedures of the UNFCCC are drawn from the UN system with the Conference of Parties (COP) as the ultimate policy-making body, which in turn is assisted by two subsidiary bodies. The international negotiation process on climate change revolves around the sessions of the COP, which meets every year to review the implementation of UNFCCC (UNFCCC, 2009d). Procedures are governed by the procedural rules included in the UNFCCC itself and the Draft Rules on Procedure even though the latter have never been formally adopted owing to a quarrel over the voting rules. This is why most of the decisions can only be taken by consensus (Depledge and Yamin, 2009).

All Parties have commitments under the UNFCCC (cf. Article 4). While some of these commitments are binding for all Parties, some commitments have been particularly included to address the specific needs of developing countries according to the principle of common but differentiated responsibilities. Annex I Parties are for example subject to specific requirements to demonstrate that they are taking the lead in combating climate change. To this end, Article 4.2 requires them to adopt policies and measures to mitigate climate change by limiting their GHG emissions and enhancing their GHG sinks and reservoirs. Another differentiation occurs with regard to Annex II Parties, which are required to provide financial assistance and facilitate the transfer of technologies to developing countries to help them implement their commitments under the Convention. The group of countries with economies in transition are granted some flexibility in implementing their commitments, to take into consideration recent economic and political developments in their countries.

Commitments for all Parties under the UNFCCC (Article 4.1)

- Prepare and periodically update a national inventory of greenhouse gas emissions and sinks (Article 4.1.(a)).
- Formulate and implement national and, where appropriate, regional programmes to mitigate climate change and facilitate adequate adaptation to climate change (Article 4.1.(b)).
- Promote and cooperate in the development, application and diffusion of technologies, practices and processes that control, reduce or prevent anthropogenic emissions of greenhouse gases (Article 4.1.(c)).
- Promote sustainable management, and promote and cooperate in the conservation and enhancement of sinks and reservoirs of all greenhouse gases (Article 4.1.(d)).
- Cooperate in preparing for adaptation to the impacts of climate change (Article 4.1.(e)).
- Take climate change considerations into account in the relevant social, economic and environmental policies and actions with a view to minimising adverse effects on the economy, on public health and on the quality of the environment (Article 4.1.(f)).
- Promote and cooperate in scientific, technological, technical, socio-economic and other research, systematic observation and development of data archives related to the climate system and intended to further the understanding and to reduce or eliminate uncertainties (Article 4.1.(g)).
- Promote and cooperate in the full, open and prompt exchange of relevant scientific, technological, technical, socioeconomic and legal information related to the climate system and climate change (Article 4.1.(h)).
- Promote and cooperate in education, training and public awareness related to climate change (Article 4.1.(i)).
- Communication to the Conference of the Parties (Article 4.1.(j))

Special Consideration of Developing Countries Interests:

Commitments for developed country Parties and Annex I Parties (Article 4.2)

- Requirement to adopt national policies and measures which demonstrate that developing countries are taking the lead in combating climate change, with the aim of returning emissions to their 1990 levels taking into account the differences in these Parties' starting points and approaches, economic structures and resource bases, the need to maintain strong and sustainable economic growth, available technologies and other individual circumstances, as well as the need for equitable and appropriate contributions by each of these Parties to the global effort regarding that objective (4.2.(a)).
- To this end communicate detailed information on policies and measures as well as on its resulting projected anthropogenic emissions (Article 4.2.(b),(c) and (d))

Commitments for developed country Parties and Annex II Parties (Articles 4.3, 4.4, 4.5 and 4.6)

- Obligation to provide financial resources to enable developing countries to undertake emissions reduction activities under the Convention and to help those particularly vulnerable countries adapt to adverse effects of climate change.
- Taking into account the need for adequacy and predictability in the flow of funds and the

importance of appropriate burden sharing among the developed country Parties, new and additional financial resources must be provided to meet the agreed full costs incurred by developing country Parties in preparing their communications and the agreed full incremental costs of implementing measures that are covered by Article 4.1

- Assistance for the developing country Parties that are particularly vulnerable to the adverse effects of climate change in meeting costs of adaptation to those adverse effects
- Obligation to take all practicable steps to promote, facilitate and finance, as appropriate, the transfer of, or access to, environmentally sound technologies and know-how to other Parties, particularly developing country Parties, to enable them to implement the provisions of the Convention.

Further Commitments (Article 4.9)

According to Article 4.9 "Parties shall take full account of the specific needs and special situations of the least developed countries in their actions with regard to funding and transfer of technology".

8.2.1.2 The Kyoto Protocol

"The publication of the 2nd IPCC Assessment Report in 1995 made it evident that the actions to combat climate change as outlined in the UNFCCC were insufficient. The Kyoto Protocol was negotiated subsequently. The 3rd IPCC Assessment Report in 2001 made it even further certain that climate change was, indeed, largely man-made and was an impetus to the further development of the Kyoto Protocol that finally came into force in 2005. The Kyoto Protocol shares the objectives and the institutions of the UNFCCC. The major distinction between the two is however that while the UNFCCC only encourages industrialised countries to stabilise greenhouse gas emissions, the Kyoto Protocol obliges them to do so. [...] Just like the UNFCCC, the Kyoto Protocol imposes a heavier burden on developed nations under the principle of "common but differentiated responsibilities". This group of countries must first and foremost take domestic actions against climate change, but the Kyoto Protocol allows them a certain degree of flexibility in satisfying their emission commitments" (Cf. Von Bassewitz, 2011).

The Kyoto Protocol shares the objectives and the institutions of the UNFCCC. The major distinction between the two is, however, that while the UNFCCC commits industrialised countries to stabilise greenhouse gas emissions, the Kyoto Protocol obliges them to do so. The Convention commits Annex I countries to reduce emissions; it's just that the reductions were not clearly quantified (though note that Article 4.2 does, if read carefully, require emissions to return to 1990 levels by 2000). Under the Kyoto Protocol, actual emissions have to be monitored: each party must keep a national register to show dealings carried out under the Kyoto Protocol instruments. The secretariat keeps an independent transaction log to verify that operations are consistent with the rules of the Kyoto Protocol. The most important aspect of the Kyoto Protocol is arguably the creation of an aggregate target for the developed countries (Article 3) as well as legally binding and quantified individual targets set out in Annex B. It should also be noted that there are significant commitments for reporting, review, independent assessment and compliance (Articles 5, 7, 8 and 18).

Under the adaptation objective, the Kyoto Protocol, like the UNFCCC, is designed to support countries in adapting to the inevitable effects of climate change and to facilitate the development of techniques that can help increase resilience to climate change impacts. An Adaptation Fund was set up to help with concrete adaptation projects in developing countries. The Adaptation Fund is a "solidarity fund" in which a proportion of the revenue of CDM projects in developing countries is contributed to a fund to assist adaptation projects in other developing countries.

In light of the 3rd IPCC Assessment Report and new emerging science, it became abundantly clear that the measures agreed to in the UNFCCC and the Kyoto Protocol were an inadequate international response to the threats posed by climate change. The results of the Kyoto Protocol were not as expected. It

imposed relatively high costs and generated only humble benefits, while failing to provide a real solution (Olmstead and Stavins, 2006).

Global warming needs to be addressed more efficiently in future (Helm, 2009). Not only that the world's largest greenhouse gas emitter at the time, the US, pulled out of Kyoto in 2003. It has been repeatedly stated that the largest increase in greenhouse gas emissions originates from inter alia China and India, which lack quantitative emission targets under the Kyoto Protocol. This is, however, not fully accurate. India's emissions are considerably less than some other Annex I countries. Moreover, both India and China have per-person emissions lower than the global average. The characterization of India and China as the problem is arguably part of the developed countries effort to shift focus from their failure to reduce emissions and to shift the burden to rapidly developing, but still relatively poor, developing countries.

One of the weaknesses of Kyoto is its division of countries in two annexes, which has reinforced the already existing ideological North-South divide (Beyerlin, 2006; Gosh and Woods, 2009). Annex I countries, however, agreed to quantified reductions in Annex B of the Kyoto Protocol. This is in turn regarded by developing countries as one of its strengths.

Most importantly, however, the Protocol lacks compliance incentives and enforcement mechanisms to deter non-participation and non-compliance (Barrett, 2009; Aldy and Stavins, 2009). Article 18 provides for a compliance mechanism. The efficacy of this mechanism has, however, not been tested while the first commitment period has not been finished. Although UNFCCC and the Kyoto Protocol have made provision for monitoring and compliance, especially for the emission reductions targets of Annex I countries, effective enforcement is so far lacking (Gosh and Woods, 2009), although such mechanism is, at least on paper, among the more detailed and sophisticated one's in the MEAs. Kyoto placed the burden of emission reduction on those states which produce emission-intensive goods, rather than those which import and finally consume these goods. The handicap of this methodology is that wealthier nations can relocate CO2-intensive production abroad to no-cap locations in order to meet their Kyoto targets. After all, it is the developed countries, principally, that are the importers and final consumers of the majority of emissions intensive goods (although consumption is increasing in many developing countries). The concern is about the off-shoring of emissions and that there is substantial evidence to support this.

The first commitment period in terms of the Kyoto Protocol is restricted to 2012 (Article 3(1), (9) Kyoto Protocol, Articles 15, 17 UNFCCC). It is important for the post-2012 period, that African countries articulate and strengthen their African position in the UNFCCC negotiations. Moreover, it must be ensured that developed countries honour their legally binding commitments for a second and subsequent commitment period. This has been a cornerstone of the African position. The past years have already shown that the complexity of climate change and the need for "common but differentiated responsibilities" have had impacts on the international negotiations. In fact, each negotiation round has become more complex: The 2007 COP 13 in Bali (Action Plan) was considered a leap forward, the 2009 COP 15 in Copenhagen was the culmination of two years of intense negotiations ending in the Copenhagen Accord,[15] which itself was said to be more of a political decision as opposed to a legally binding agreement. The Copenhagen Accord was a document negotiated by a small group of states outside the UN procedure (and arguably in tension with, if not in violation of, normal UN procedure) and was taken note of and not adopted by the COP. It is not formally an outcome of the UNFCCC and the UNFCCC Secretariat has clarified that it has no legal status in the UNFCCC regardless of whether Parties associated themselves with it.

The 2010 COP 16 in Cancun approved a set of decisions anchoring national mitigation pledges made under the Copenhagen Accord, and taking initial steps to strengthen finance, transparency and other elements of the multilateral climate framework. At the upcoming 2011 COP 17 in Durban, parties will have to come up with a way forward in finally setting a timeframe for the peaking of global emissions

15 Decision of the Conference of the Parties 2/CP.15. It has to be noted that the Conference of the Parties, at its fifteenth session, only "took note" of the Copenhagen Accord of 18 December 2009 by way of decision 2/CP.15. Due to the fact that the decision has not been adopted, the Copenhagen Accord is not legally binding. However, the total number of Parties that have expressed their intention to be listed as agreeing to the Accord is 141, cf < http://unfccc.int/meetings/copenhagen_dec_2009/items/5262.php> (accessed 27 October 2011).

and a global emissions goal. In order to achieve such goals, incentives for developing countries to limit their emissions need to be scaled-up and international technology cooperation between industrialised and developing countries needs to be improved (Von Bassewitz, 2011).

In the course of 2010 COP 16 in Cancun understanding has been reached, which – building on the Bali Road Map[16] and the Copenhagen Accord[17] reflects that the Members to the UNFCCC and the Kyoto Protocol respectively, have taken up the issue of climate justice. Three decisions have resulted from the Cancun Conference: One decision by the Conference of the Parties to the UNFCCC[18] and two decisions by the Conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol[19]. The reduction greenhouse gas emissions and the support for developing nations to deal with climate change are at the core of the Cancun understanding. In order to advance action regarding the aim of the reduction of greenhouse gas emissions in a mutually accountable way, national plans are formally captured at international level under the banner of the United Nations Framework Convention on Climate Change. Support for developing nations is provided for in the Cancun decisions and includes finance, technology and capacity-building support. The financial, technology and capacity-building support for developing countries decided in Cancun is to be realised through various mechanisms: Nationally appropriate mitigation actions (NAMA); reducing emissions from deforestation and forest degradation (REDD+); the Clean Development Mechanism (CDM); the Cancun Adaptation Framework (CAF); the Technology Mechanism; and the Green Climate Fund.

Already in September 2008, the UN-REDD Programme (United Nations Collaborative initiative on Reducing Emissions from Deforestation and forest Degradation in developing countries) was launched to assist developing countries prepare and implement national REDD+ strategies.

The Programme currently has 35 partner countries spanning Africa, Asia-Pacific and Latin America, of which 14 are receiving support to National Programme activities. These 14 countries are: Bolivia, Cambodia, Democratic Republic of the Congo (DRC), Ecuador, Indonesia, Nigeria, Panama, Papua New Guinea, Paraguay, the Philippines, Solomon Islands, Tanzania, Viet Nam and Zambia. To-date, the UN-REDD Programme's Policy Board has approved a total of US$59.3 million for National Programmes in these 14 partner countries. These funds help to support the development and implementation of national REDD+ strategies.

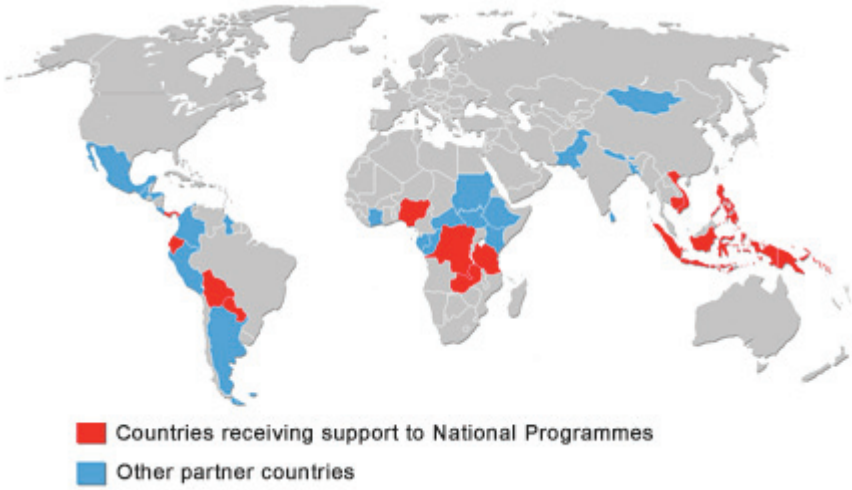
16 The Bali Road Map emerged from the 2007 Bali Climate Change Conference and includes the Bali Action Plan (Decision 1/CP.13), which launched a "comprehensive process to enable the full, effective and sustained implementation of the Convention through long-term cooperative action" along with a number of other decisions and resolutions.

17 Agreed upon by the UNFCCC Conference of the Parties, in Copenhagen on 18 December 2009 by way of Decision 2/CP.15.

18 Decision 1/CP.16 *The Cancun Agreements: Outcome of the work of the Ad Hoc Working Group on Long-term Cooperative Action under the Convention*.

19 Decision 1/CMP.6 *The Cancun Agreements: Outcome of the work of the Ad Hoc Working Group on Further Commitments for Annex I Parties under the Kyoto Protocol at its fifteenth session*; and Decision 2/CMP.6 *The Cancun Agreements: Land use, land-use change and forestry*.

Figure 8.4 UN-REDD Programme presence



Source: UN-REDD Programme

The Cancun decisions stress that national legal reform and related local development are necessary, since domestic forest management often involves various laws, regulations and stakeholder participatory processes. Competing governance structures and interests can often give rise to conflict and create barriers to REDD+ initiatives. In this regard, the Cancun requested developing countries to undertake several institutional reforms for REDD+ including national strategies or action plans; a national forest reference emission level; a transparent national forest monitoring and reporting system; and a system for providing information on prescribed safeguards (Mason-Case, 2011). REDD+ related activities must be implemented in phases beginning with the development of national action plans and capacity building. National action plans must ensure the full and effective participation of relevant stakeholders and consider land tenure and forest governance amongst others. Gender related issues and the rights of indigenous peoples must be taken into account.

Nationally appropriate mitigation actions (NAMAs) are voluntary commitments that non annex I parties have set up for proposal to the UNFCCC. These actions should include every possible activity aimed at reducing or limiting GHG emissions. NAMAs mainly provide guidance for the future mitigation policies in the countries. NAMAs are an important mechanism for developing countries to contribute to global mitigation efforts in nationally appropriate ways. The concept of NAMAs has emerged during the Bali Action Plan as part of the Bali Road Map that was agreed at the United Nations Climate Change Conference in Bali in December 2007. At the Copenhagen Climate Conference in 2009 it was agreed that the concept of NAMAs should be retained, adding that NAMAs would be subject to international measurement, reporting and verification in line with guidelines adopted by the Conference of the Parties. The Cancun decisions confirm that nationally appropriate mitigation actions are increasingly the primary vehicle for developing countries mitigation efforts. Developing countries are expected to improve the content and frequency of national communications, including inventories, and to create comprehensive low-carbon sustainable development strategies (Cf. UNFCCC, Draft decision -/CP.16 (29 Nov - 10 Dec 2010) Art. III.B.60-62, 65).

As of March 2011, 48 countries (Afghanistan, Algeria, Antigua and Barbuda, Argentina, Armenia, Benin, Bhutan, Botswana, Brazil, Cambodia, Cameroon, Central African Republic, Chad, Chile, China, Colombia, Republic of Congo, Costa Rica, Côte d'Ivoire, Ethiopia, Eritrea, Gabon, Georgia, Ghana, India, Indonesia,

Israel, Jordan, Madagascar, Maldives, Marshall Islands, Mauritius, Mauritania, Mexico, Mongolia, Morocco, Papua New Guinea, Peru, Republic of Korea, Republic of Moldova, San Marino, Sierra Leone, Singapore, South Africa, Tajikistan, Macedonia, Togo and Tunisia) have submitted NAMAs to the UNFCCC (cf. UNFCCC Document FCCC/AWGLCA/2011/INF.1).

The Clean Development Mechanism **(**CDM) was established in 1997 by Article 12 of the Kyoto Protocol to assist developing (non Annex I) countries in achieving sustainable development and in contributing to the ultimate objective of the UN Framework Convention on Climate Change (UNFCCC), and to assist the industrialized countries (Annex I) in achieving compliance with their quantified emission limitation and reduction commitments under the Kyoto Protocol.

The Cancun understanding establishes a number of substantial work programmes for ameliorative guidelines and methodologies to simplify and facilitate access and to provide for a framework for the post-2012 period. The envisaged reforms of the will have to be conducted in consultation with designated national authorities and necessitate parallel legal and institutional changes in host countries on a national and local level (Mason-Case, S., 2011: The Cancun Agreements and Legal Preparedness for Climate Change in Developing Countries, *Sustainable Development Law on Climate Change; Legal Working Paper Series* 06 http://www.idlo.int/Publications/6_MasonCaseSarah_TheCancunAgreementsandLegalPreparednessforClimateChangeinDevelopingCountries.pdf (accessed 29 October 2011)).

The Cancun Adaptation Framework (CAF) has been adopted in Cancun. The Parties emphasise that adaptation must be addressed with the same level of priority as mitigation. The CAF is the result of three years of negotiations on adaptation under the AWG-LCA (Ad hoc Working Group on Long-term Cooperative Action under the Convention) that had followed the adoption of the Bali Action Plan, which sought to enable the full, effective and sustained implementation of the Convention through long-term cooperative action, now, up to and beyond 2012.

The objective of the CAF is to enhance action on adaptation, including through international cooperation and coherent consideration of matters relating to adaptation under the UNFCCC. Ultimately enhanced action on adaptation seeks to reduce vulnerability and build resilience in developing country Parties, taking into account the urgent and immediate needs of those developing countries that are particularly vulnerable.

The Technology Mechanism has been introduced by Cancun in order to achieve increased action on technology development and transfer, including research and development, demonstration, deployment, and diffusion. This is to be realised by means of facilitating actions on those objectives through cross-sectoral and country-to-country network partnerships.

The establishment of the Green Climate Fund has been suggested by the Copenhagen Accord. This suggestion was again taken up in Cancun. The Green Climate Fund is designed as a long-term funding arrangement designated as an operating entity of the financial mechanism of the Convention under Article 11 of the UNFCCC. The Green Climate Fund will function under the guidance of, and be accountable to the Conference of the Parties (COP). Projects, programmes, policies and other activities in developing countries will be supported by the Green Climate Fund using thematic funding windows. A Transitional Committee of 40 members has been established to design the details of the fund. It is expected that the designing process of the Green Climate Fund will be concluded at the forthcoming Conference of the Parties in December 2011 in Durban.

8.2.1.3 United Nations Convention on Biological Diversity (CBD)

The Convention on Biological Diversity (CBD) entered into force on 29 December 1993. It has 3 main objectives:

1. The conservation of biological diversity
2. The sustainable use of the components of biological diversity

3. The fair and equitable sharing of the benefits arising out of the utilization of genetic resources

It is now widely recognized that climate change and biodiversity are interconnected. Biodiversity is affected by climate change, with negative consequences for human well-being, but biodiversity, through the ecosystem services it supports, also makes an important contribution to both climate-change mitigation and adaptation. Consequently, conserving and sustainably managing biodiversity is critical to addressing climate change. According to the Millennium Ecosystem Assessment, climate change is likely to become one of the most significant drivers of biodiversity loss by the end of the century. Climate change is already forcing biodiversity to adapt either through shifting habitat, changing life cycles, or the development of new physical traits. Conserving natural terrestrial, freshwater and marine ecosystems and restoring degraded ecosystems (including their genetic and species diversity) is essential for the overall goals of both the CBD and UNFCCC because ecosystems play a key role in the global carbon cycle and in adapting to climate change, while also providing a wide range of ecosystem services that are essential for human well-being and the achievement of the Millennium Development Goals (MDGs). Biodiversity can support efforts to reduce the negative effects of climate change. Ecosystem-based adaptation must integrate the use of biodiversity and ecosystem services into an overall adaptation strategy that can be cost-effective and generate social, economic and cultural co-benefits and contribute to the conservation of biodiversity (CBD, 2011)

8.2.1.4 United Nations Convention to Combat Desertification (UNCCD)

The United Nations Conference on Environment and Development (UNCED), held in Rio de Janeiro in 1992 called on the United Nations General Assembly to establish an Intergovernmental Negotiating Committee (INCD) to prepare, by June 1994, a Convention to Combat Desertification (UNCCD), particularly in Africa. Desertification is land degradation in drylands, resulting from various factors, including climatic variations and human activities. According to the Millennium Ecosystem Assessment (2005), populations in drylands live under the worst economic conditions. Drylands have the lowest GDP per capita and the highest infant mortality rates. Soil degradation in drylands exacerbates the problem even more. The decline in the fertility of land reduces crop production and additional income sources. Land degradation can also trigger a cycle of environmental degradation, impoverishment, migration and conflicts, often also putting the political stability of affected countries and regions at risk. Increased attention to the linkage of land and soil to climate change not only enriches the substantive and conceptual debates on effective means for carbon sequestration. It also provides a new and a highly interesting platform for developing countries to enter into the adaptation and mitigation agendas, considering that for many of them soil is the single most important natural resource. One concrete way forward could be to expand the coverage of the Clean Development Mechanism towards agricultural land use, to include projects focusing on carbon sequestration in soil (UNCCD, 2007).

8.2.1.5 Other climate change related regimes

Apart from the aforementioned, there are of course still other international law regimes that enfold implications of climate change. Such has the Vienna Convention on Ozone Depletion and the Montreal Protocol already in the 1980s taken a series of effective steps phase out the global production and consumption of ozone depleting substances. The complex relationship between ozone depleting substances and greenhouse gasses resulted in the fact, that both regimes (at least until recently) acted largely in independence. However, the 1987 Montreal Protocol and successor agreements are not only regarded as highly successful examples of international environmental regulatory cooperation, there are also lessons to be learned from the ozone layer experience for the case of climate change. Moreover, the Montreal Protocol has made a substantial commitment to climate goals, and there are substantial proposals on the way to increase this. “The Montreal Protocol is widely considered one of the world’s most successful multilateral environmental agreements, having phased out 97 percent of almost 100 ozone-depleting substances (“ODSs”) — placing the ozone layer on a path to recovery later this century.

Because many ODSs are also potent greenhouse gases ("GHGs"), their phase-out under the Montreal Protocol has provided an often overlooked bonus for climate mitigation: by the end of the decade, the Montreal Protocol will have done more to mitigate climate change than the initial Kyoto Protocol reduction target, reducing emissions in terms of carbon dioxide ("CO2")-equivalent by 135 billion tonnes between 1990 and 2010 and delayed climate impacts — including abrupt and irreversible impacts — by about up to 12 years" (Cf. http://www.igsd.org/montreal/index.php also for further references).

It has also been argued that Parties to the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) have several opportunities to take impacts of climate change into account, particularly when listing a species and when making non-detriment findings. It would go beyond the scope of this Chapter to make more specific reference than this and stating, that also the following regimes need at least be mentioned as having potential impacts on climate change: The Ramsar Convention on Wetlands of International Importance; the Convention on the Conservation of Migratory Species of Wild Animals, the Law of the Sea Regime (UNCLOS) and others.

Moreover, the international trade regime (GATT/WTO) is obviously strongly related to UNFCCC and Kyoto; in fact both recognise that climate change policy may provide opportunities as well as challenges for the international trading system (Wold et al., 2009). The WTO is a remarkable example of institutional evolution and its dispute settlement system is as effective as impartial. However, similar to the climate change negotiations, the so-called Doha Round of multilateral trade negotiations have been complex and so far without the aspired success. Both negotiations processes seem to be lacking the necessary consensus of the parties involved, particularly developed and developing countries. The only difference between the two negotiations processes lies in the fact that "the climate doesn't have time for a Doha-like approach" (T Houser 'Copenhagen, the Accord, and the Way Forward' (2010) PB10-5 Peterson Institute for International Economics 16).

8.2.2 International human rights conventions and climate change

The efforts that have been made so far to place rights at the centre of any future climate change regime have not been human rights-focused. In fact, most international human rights instruments were drafted before the emergence of climate change as a common concern (Shelton, 2007). However, human rights impacts are a relevant aspect when formulating a common African position in the international climate change negotiations (Scholtz, 2010). In fact, "climate change prompts significant questions about justice and distribution. There is an acute need for intelligent collective action focusing on the human suffering that climate change will cause in future. On the one hand, as a matter of law, the human rights of individuals need to be viewed in terms of state obligations: it is principally the state that is responsible for human rights fulfilment. On the other hand the assignation of such responsibility to only the state seems inadequate in the context of climate change and human security" (Cf. Ruppel & Van Wyk, 2011: The Effects of Climate Change on Human Security and Human Rights in Africa, http://www.ccs.org.za/wp-content/uploads/2011/10/China_Monitor_OCT_2011_final.pdf).

To mobilise the policy value, and indeed the legal force of human rights in the construction of a climate change regime, therefore, requires the introduction of likely human rights impacts and outcomes of climate change. The specific rights potentially affected by climate change, such as rights to food, water, shelter, and health or rights associated with gender, children and indigenous peoples must be addressed in context. In 2009, the Human Rights Council adopted Resolution 10/4 (U.N. Doc. A/HRC/10/L.11) which noted the effects of climate change on the enjoyment of human rights, and reaffirmed the potential of human rights obligations and commitments to inform and strengthen international and national policy making. In that resolution, the Council welcomed the exchange of information between the Office of the High Commissioner for Human Rights (OHCHR) and the UNFCCC Secretariat, and stated inter alia that climate change and human rights are governed by international regimes that have evolved separately, with different premises underlying the legal frameworks of multilateral environmental agreements (like the UNFCCC) and human rights treaties (McInerney-Lankford, 2009).

What is remarkable is the emphasis made by Cancun Decision 1/CP.16 on a human rights oriented approach to deal with all issues relating to climate change. By

> [r]ecognizing that climate change represents an urgent and potentially irreversible threat to human societies and the planet, and thus requires to be urgently addressed by all Parties […]

and

> [n]oting resolution 10/4 of the United Nations Human Rights Council on human rights and climate change, which recognizes that the adverse effects of climate change have a range of direct and indirect implications for the effective enjoyment of human rights and that the effects of climate change will be felt most acutely by those segments of the population that are already vulnerable owing to geography, gender, age, indigenous or minority status, or disability […]

the Conference of the Parties

> [e]mphasizes that Parties should, in all climate change related actions, fully respect human rights.

This human rights oriented approach to climate change can be seen as the core foundation to grant climate justice to all, as it takes into account the rights of all humans, including those particularly vulnerable to the negative effects of climate change. **Climate change is expected to have severe effects on poverty development. Therefore climate protection also plays an important role in the human rights discourse aiming to reduce poverty. Climate change policy, human rights protection and development policy should, no doubt, be more closely coupled in future.**

Moreover, there may be complementarity identifiable in principles, which can be found in both the UNFCCC regime and the International Covenant on Economic, Social and Cultural Rights (ICESCR), such as the duty of cooperation, "do no harm," or equity. Human rights are relevant to the design and implementation of responses to climate change, whether in relation to adaptation and mitigation. One can argue that human rights can usefully inform approaches to climate change in policy and legal terms. This dimension includes arguments based on human rights obligations of states under a variety of international law instruments. These range from the integration of human rights into country strategies in terms of priority entitlements to be protected from the impacts of climate change (e.g., right to health, housing, water, or food), or more procedural human rights that are relevant to the design and implementation of policies related to climate change (e.g., right to information, participation, or access to decision making). Under this view, human rights obligations may provide a legal baseline for how climate change is tackled and what must be protected from its impacts. From this, it may be possible to identify ways in which addressing climate change can help realize human rights and how realizing rights can help ensure greater capacity to adapt to climate change, underscoring a core compatibility of aims and outcomes between addressing climate change and realizing human rights (McInerney-Lankford, 2009).

Both the International Covenant on Civil and Political Rights (ICCPR) and the International Covenant on Economic, Social and Cultural Rights (ICESCR), together with the Universal Declaration of Human Rights (UDHR), are often referred to as the International Bill of Rights. Many if not most African countries have acceded to both the ICCPR and the ICESCR. On 10 Dec 2008, the UN General Assembly adopted, by consensus, the Optional Protocol to the ICESCR. The Optional Protocol provides a mechanism through which persons can petition the UN Committee on Economic, Social and Cultural Rights about violations of their rights. This Protocol was opened for signing on 24 September 2009. Both the ICCPR and the ICESCR call on State Parties to take steps (legislative or other measures) to give effect to the rights contained therein. Most of the rights and freedoms recognised in the ICCPR are also entrenched in national constitution's Bill of Rights. This may include, amongst others, the right to dignity, the right

to life, the right to health, the right to water, the right to legal representation, the guarantee against torture and other cruel or inhuman treatment or punishments, the protection against discrimination on any ground, and others. The ICESCR and the ICCPR provide internal protection for specific rights and freedoms. Both Covenants recognise the right of peoples to self-determination; both have provisions which prohibit all forms of discrimination in the exercise of human rights; and both have the force of law for the countries which have ratified them. States have obligations under international human rights law to address disadvantage, threats to human rights and ensure that policies aimed at limiting the effects of climate change are not implemented effectively and in ways that don't overburden or discriminate against specific vulnerable groups, e.g. women, children and indigenous people (Ruppel, 2010a; Ruppel and Ruppel-Schlichting, 2011).

The Convention on the Rights of Persons with Disabilities, establishes the principle of respect for the evolving capacities of persons with disabilities. The same applies to the Convention against Torture and Other Cruel, Inhuman or Degrading Treatment or Punishment. It becomes obvious that both Conventions also become relevant in the context of climate change, due to the special vulnerability of persons who are at risk in situations of natural disaster.

8.2.2.1 Women

Article 3 of the ICESCR encourages States Parties to ensure the equal right of men and women to the enjoyment of all economic, social and cultural rights as set forth by the Covenant. *The Convention on the Elimination of All Forms of Discrimination against Women* (CEDAW) was adopted in 1979, and came into force in 1981. CEDAW is the first legally binding instrument relating specifically to women's rights. States Parties are obliged to take all appropriate measures, including legislation and temporary special measures, to ensure that women enjoy all their human rights and fundamental freedoms. The Optional Protocol to CEDAW adopted by the United Nations General Assembly in 1999 entered into force in December 2000. Members to the Optional Protocol recognises the competence of the Convention's monitoring body, the Committee on the Elimination of Discrimination against Women, to receive and consider complaints from individuals or groups within its jurisdiction. *The Declaration on the Elimination of Violence against Women* (1993) is a further commitment by the UN. States are called on to condemn violence against women and not invoke any consideration to avoid their obligations with respect to its elimination. Two major documents that still need to be mentioned here are the *Beijing Declaration* and the *Beijing Platform for Action*, which resulted from the UN's Fourth World Conference on Women, titled "Action for Equality, Development and Peace", held in Beijing in 1995. The Beijing Declaration embodies the commitment of the international community to the advancement of women and to the implementation of the Platform for Action, ensuring that a gender perspective is reflected in all policies and programmes at national, regional and international levels. The Beijing Platform for Action, on the other hand, sets out a number of actions for national and international implementation for the advancement of women (Ruppel, 2008, 2010c).

The vulnerability of women to climate change and natural disasters is increased for a number of reasons. Women are usually at higher risk of being placed in unsafe, overcrowded shelters, due to lack of assets, such as savings, property or land. In the context of droughts, floods and other disasters that require mobility, cultural constraints on women's movements may hinder their timely escape, access to shelter or access to health care. Exacerbating this effect, women often avoid using shelters out of fear of domestic and sexual violence, and become even less mobile as primary family care-givers. Poor women and those in countries of higher gender inequality appear to be at the highest risk: a direct correlation has been observed between women's status in society and their likelihood of receiving adequate health care in times of environmental stress The UN has identified environmental degradation as a key threat to human security. All post-conflict countries face serious environmental issues that could undermine the peace building processes, if left unaddressed, and specifically affect women who are faced by a combination of hardships. It is thus important to identify gender-sensitive strategies for responding to human security

needs and environmental and humanitarian crises caused by climate change. These efforts should focus on: reducing women's vulnerability, in tandem with men's susceptibilities; promoting gender sensitive emergency responses; and enlisting women as key environmental actors in natural disaster management decision-making processes, alongside men, tapping on women's skills, resourcefulness and leadership in mitigation and adaptation efforts. Governments should thus be encouraged to incorporate gender perspectives into their national policies, action plans and other measures on sustainable development and climate change, through carrying out systematic gender analysis; collecting and utilizing sex-disaggregated data; establishing gender-sensitive benchmarks and indicators; and developing practical tools to support increased attention to gender perspectives (UN WomenWatch, 2009). The Convention to Combat Desertification specifically calls on its Member States to promote women's participation in decision-making policies and programmes that address desertification and drought (http://www.unccd.int/convention/ratif/doeif.php*)*.

8.2.2.2 Children

The impact of climate change on the realisation of child rights shows multiple effects of climate change on basic rights such as water, food and health for children in countries vulnerable to temperature and precipitation change. For example, a child may be less able to enjoy an adequate standard of living, education and health, due to loss of livelihoods and food security resulting from increased water stress and habitat changes. Where natural disasters are becoming more frequent and intense, a child is at high risk of disrupted education, injury, forced migration and death. Children are vulnerable to climate change, existing social inequalities are being further exacerbated by climate change, and will become ever more severe unless action is taken to reduce the causes (emissions) and help communities adapt to the consequences, by using economic and social policy, cultural values, and legislative frameworks. Policy-makers at the international, national and local levels need to apply a cost-benefit analysis that values future quality of life. Adherence to the Convention on the Rights of the Child could require that national government policymakers, especially those in developed countries, ensure the fair representation of children and young people and that children's specific needs are given due consideration in adaptation and mitigation policy (UNICEF, 2009)

The Universal Declaration of Human Rights, as the most prominent and fundamental UN human rights document, provides in its Article 25 that childhood is entitled to special care and assistance. Furthermore, the ICCPR, a legally binding document, contains provisions specifically referring to children (Articles 14(1), 23(4) and 24). Also the ICESCR contains several children-specific provisions (Articles 10(3) and 13), with a focus on the right to education and protection from economic and social exploitation. Moreover, the Convention on the Elimination of All Forms of Discrimination against Women contains children-protective provisions, emphasizing that the interests of children are paramount (Articles 5(b) and 16(1)(g)).

The most prominent UN initiative to advance children's rights is the Convention on the Rights of the Child (CRC). The Convention was adopted by Resolution 44/252 of 20 November 1989 at the Forty-fourth Session of the UN General Assembly, and entered into force on 2 September 1990. To date, the Convention has 193 parties. The CRC, which consists of 54 Articles, incorporates the full range of human rights – civil, cultural, economic, political and social – and creates the international foundation for the protection and promotion of human rights and fundamental freedoms of all persons under the age of 18 (Article 1). The Convention represents widespread recognition that children should be fully prepared to live an individual life in society, and be brought up in the spirit of peace, dignity, tolerance, freedom, equality and solidarity. The CRC follows a holistic approach to children's rights, recognising that the rights anchored in the Convention are indivisible and interrelated, and that equal importance must be attached to each and every right contained therein. The Convention foresees the granting of international assistance or development aid for programmes geared at children where such cooperation is needed to properly implement the provisions of the CRC and thereby advance the social, economic

and cultural rights of children (Ruppel, 2009b).

Particularly relevant to climate change are the principles contained in the CRC Articles 2, 3, 6 and 12, covering the issues of non-discrimination; the best interests of the child; the right to life, survival and development; and respect for the views of the child. No less important in the same context are the rights contained in the CRC referring to civil rights and freedoms, containing inter alia the right to access to appropriate information; and the right not to be subjected to torture or other cruel, inhuman or degrading treatment or punishment. The group of basic health and welfare summarises the Convention's Articles 6, 18(3), 23, 24, 26, and 27(1)–(3), namely the right to survival and development; the right to special protection of children with disabilities; the right to health and health services; the right to social security and child care services and facilities; and the right to an adequate standard of living. In this context, national climate change related efforts to combat HIV and AIDS and diseases such as malaria and tuberculosis, particularly among special groups of children at high risk, need to be mentioned. Special protection measures are laid down providing for, *inter alia*, children in situations of emergency; refugee children; children in conflicts; children in situations of exploitation; and children belonging to minority or indigenous groups (Ruppel, 2009b).

8.2.2.3 Indigenous People

In the UNFCCC indigenous peoples in relation to climate change are not explicitly discussed. However, Article 4 calls on developed country Parties of the Convention to consider the needs and challenges that developing country Parties are facing with regard to adverse effects arising from climate change. Indigenous peoples are among the groups that are most vulnerable to actual and potential detrimental impacts of climate change. They live in the most vulnerable ecosystems so are often the first groups to be impacted by climate change. They are highly dependent on their lands and natural resources for subsistence and their cultural identity is closely associated with the environment and the lands in which they live. Environmental migration of indigenous peoples may be caused by climate change related developments, e.g. sea level rise, extreme weather patterns, floodings etc. However, indigenous peoples are tightly connected to their land through their livelihoods and spiritual bonds.

In view of the aforementioned the Declaration on the Rights of Indigenous Peoples was adopted by the General Assembly in 2007 **(Resolution 61/295). Therein the** *General Assembly,* reaffirms that indigenous peoples, in the exercise of their rights, should be free from discrimination of any kind, r*ecognizing* the urgent need to respect and promote the inherent rights of indigenous peoples which derive from their political, economic and social structures and from their cultures, spiritual traditions, histories and philosophies, especially their rights to their lands, territories and resources. It recognizes that respect for indigenous knowledge, cultures and traditional practices contributes to sustainable and equitable development and proper management of the environment and in particular the right of indigenous families and communities to retain shared responsibility for the upbringing, training, education and well-being of their children, consistent with the rights of the child. It further a*cknowledges* that the Charter of the United Nations, the International Covenant on Economic, Social and Cultural Rights and the International Covenant on Civil and Political Rights, as well as the Vienna Declaration and Programme of Action, affirm the fundamental importance of the right to self-determination of all peoples, by virtue of which they freely determine their political status and freely pursue their economic, social and cultural development. According to **Article 1 i**ndigenous peoples have the right to the full enjoyment, as a collective or as individuals, of all human rights and fundamental freedoms as recognized in the Charter of the United Nations, the Universal Declaration of Human Rights and international human rights law. According to **Article 29 (1) i**ndigenous peoples have the right to the conservation and protection of the environment and the productive capacity of their lands or territories and resources. States shall establish and implement assistance programmes for indigenous peoples for such conservation and protection, without discrimination (http://www.un.org/esa/socdev/unpfii/en/declaration.html).

Although the Declaration does not impose binding obligations, it can be considered as a strong step in

strengthening indigenous rights of groups and individual. In order for indigenous peoples to protect their collective interests in international law they need to establish legal capacity, which requires the following criteria: (1) the will to exist, (2) the development of institutions that assist in maintaining characteristics unique to them as a minority, (3) the development of representation and the internal acceptance of such, and (4) the external recognition of the representative (Meijknecht, 2001). It is worth noting that the Cancun decision specifically recognizes indigenous people, women, workers and other vulnerable groups.

8.2.3 African Union Commission (AUC)

The impacts of climate change on human rights have been explicitly recognised by the African Commission on Human and Peoples' Rights (hereafter African Commission). In its AU Resolution (ACHPR/Res 153 XLV09) the African Commission called on the Assembly of Heads of State and Government to take all necessary measures to ensure that the African Commission is included in the African Union's negotiating team on climate change.

The 1981 African (Banjul) Charter on Human and Peoples' Rights (hereafter African Charter) is a human rights treaty that proclaims environmental rights in broadly qualitative terms. It protects the right of peoples both to the "best attainable state of physical and mental health" (Article 16) and to a "general satisfactory environment favorable to their development" (Article 24). Article 24 of the African Charter establishes a binding human-rights-based approach to environmental protection, linking the right to environment to the right to development (Van der Linde and Louw, 2003).

In the *Ogoni* case, for example, the African Commission held, inter alia, that Article 24 of the African Charter imposed an obligation on the state to take reasonable measures to "prevent pollution and ecological degradation, to promote conservation, and to secure ecologically sustainable development and use of natural resources" (*The Social and Economic Rights Action Center (SERAC) & the Center for Economic and Social Rights (CESR) v Nigeria* (27 October 2001) (Ebeku, 2003). The *Ogoni* case is considered to be a landmark decision with regard to the effective protection of economic, social and cultural rights in Africa, particularly the protection of the right of peoples to a satisfactory environment (Ruppel, 2011a).

Article 24 of the African Charter should also be viewed together with the Bamako Convention and the first Organisation of African Unity (OAU) treaty on the environment, the Convention on the Conservation of Nature and Natural Resources, which predates the African Charter (Viljoen, 2007). The Revised African Convention on the Conservation of Nature and Natural Resources was adopted by the Second Ordinary Session of the African Union (AU) Assembly of Heads of State and Government in Maputo, Mozambique, in July 2003. It has, however, not yet come into force. The recognition of a right to a satisfactory environment by the African Charter and the progressive jurisprudence by the African Commission take up the issue of environmental protection from a human rights perspective and underline the linkage between climate change and human rights, in a modern holistic approach to one of the most burning issues in our society (Ruppel, 2010d).

Article 3 of the Constitutive Act of the AU contains the objectives of the AU, including, among other things, the promotion of sustainable development, international cooperation, continental integration, and the promotion of scientific and technological research to advance development of the continent. In the Protocol relating to the Establishment of the Peace and Security Council of the African Union, member states committed themselves to various guiding principles (Article 4), including 'early responses to contain crises situations', the recognition of the 'interdependence between socio-economic development and the security of peoples and States'. Moreover, in Article 6, the functions of the PSC are outlined as, among others the promotion of peace, security and stability in Africa; early warning and preventive diplomacy; peacemaking; humanitarian action and disaster management.

The African Climate Policy Centre (ACPC) hosted the inaugural CCDA conference between 17 and 19

October 2011 at the United Nations Conference Centre in Addis Ababa, Ethiopia. The theme for the conference was Development First: Addressing Climate Change in Africa to reflect the need for integrating development and climate policies, and emphasize the importance of an African ownership of its policy formulation and decision making process. The CCDA-I conference built directly on the African Development Forum VII, and many other forums, initiatives, and activities and outcomes of initiatives including for example the African Ministerial Conference on the Environment (AMCEN); the Conference of African Heads of State and Government on Climate Change (CAHOSCC); the UNFCCC and related instruments; the United Nations Secretary General's High-level Advisory Group on Climate Change Financing (AGF); the Global Climate Observation System (GCOS) and its sub-regional climate programme; and the Africa-EU Climate Change Partnership. The conference helped to position the ClimDev Africa programme within this evolving knowledge and institutional terrain and how best it can facilitate the interaction between the policy, research and practice. The overall objective of the conference was to establish a forum for dialogue, enhance awareness raising, mobilize effective commitment and actions through bringing together policy makers, academicians and practicing stakeholder with the aim of effectively mainstreaming climate change concerns into development policies, strategies, programmes and practices in Africa. CCDA also aimed to strengthen Africa's position and participation in international climate change negotiations with a view to ensuring adequate reflection of the continent's concerns and priorities in a post-2012 international climate change regime (http://www.uneca.org/acpc/ccda/ccda1/index.htm).

8.2.4 Regional Economic Communities in Africa

The marginalisation of Africa in the global economic and political decision-making systems made it for a long time difficult to make its voices internationally heard (Mutharika, 1998). The dawn of regional economic communities (RECs) in Africa can be traced back to the 1960s, when the United Nations Economic Commission for Africa (UNECA) encouraged African states to incorporate single economies into subregional systems with the ultimate objective of creating a single economic union on the African continent. In order to realise this aim, the Organisation of African Unity (OAU, predecessor of the African Union, AU) identified the need to enhance regional integration within the organisation, recognising that each country on its own would have little chance of, inter alia, attracting adequate financial transfers and the technology needed for increased economic development (Hansohm and Shilimela, 2006).

Africa has, since then, taken various steps towards enhancing the process of economic and political integration on the continent (Kouassi, 2007). The Abuja Treaty, which was adopted in June 1991, came into force in 1994. Since then, 52 out of the 53 AU member states have signed the Treaty, while 49 have ratified it. Meanwhile, several RECs have been established on the continent. At the seventh ordinary session of the AU's Assembly of Heads of State and Government in Banjul, The Gambia, in July 2006, the AU officially recognised eight such communities (Assembly/AU/Dec.112 (VII) Doc. EX.CL/278 (IX)). Alphabetically listed, these are as follows:

- The Arab Maghreb Union (AMU) www.maghrebarabe.org/en/
- The Community of Sahel-Saharan States (CEN-SAD) - www.cen-sad.org/
- The Common Market for Eastern and Southern Africa (COMESA)- www.comesa.int/
- The East African Community (EAC) www.eac.int/
- The Economic Community of Central African States (ECCAS) - *www.africa-union.org/root/au/recs/**eccas**.htm*
- The Economic Community of West African States (ECOWAS) - *www.**ecowas**.int/*
- The Intergovernmental Authority on Development (IGAD), www. ***igad**.int/* and
- The Southern African Development Community (SADC) - *www.**sadc**.int/*.

All AU member states are affiliated to one or more of these RECs, as tabulated below:

Table 8.1: AU Member States and their affiliations to Regional Economic Communities (RECs)

AMU	CEN-SAD	COMESA	EAC	ECCAS	ECOWAS	IGAD	SADC
Algeria	Benin	Burundi	Burundi	Angola	Benin	Djibouti	Angola
Libya	Burkina Faso	Comoros	Kenya	Burundi	Burkina Faso	Ethiopia	Botswana
Mauritania	Central African Republic	DRC	Rwanda	Cameroon	Cape Verde	Kenya	DRC
Morocco	Chad	Djibouti	Tanzania	Central African Republic	Cote d'Ivoire	Somalia	Lesotho
Tunisia	Comoros	Egypt	Uganda	Chad	Gambia	Sudan	Madagascar
	Cote d'Ivoire	Eritrea		Congo	Ghana	Uganda	Malawi
	Djibouti	Ethiopia		DRC	Guinea		Mauritius
	Egypt	Kenya		Gabon	Guinea-Bissau		Mozambique
	Eritrea	Libya		Guinea	Liberia		**Namibia**
	Gambia	Madagascar		São Tomé and Príncipe	Mali		Seychelles
	Ghana	Malawi			Niger		South Africa
	Guinea-Bissau	Mauritius			Nigeria		Swaziland
	Kenya	Rwanda			Senegal		Tanzania
	Liberia	Seychelles			Sierra Leone		Zambia
	Libya	Sudan			Togo		Zimbabwe
	Mali	Swaziland					
	Mauritania	Uganda					
	Morocco	Zambia					
	Niger	Zimbabwe					
	Nigeria						
	São Tomé and Príncipe						
	Senegal						
	Sierra Leone						
	Somalia						
	Sudan						
	Togo						
	Tunisia						

State members of RECs officially recognised by the AU (Ruppel, 2009a).

RECs can enhance regional co-operation to collectively increase bargaining power during international climate change negotiations. It has already mentioned supra, that human rights are most relevant in the context of climate change. In the context of regional integration, Africa can generate greater voting power (Langhammer and Hiemenz, 1990). At first glance it appears that neither climate change nor the promotion and protection of human rights is within the RECs' focal range. However, all RECs have, at least in one way or another incorporated the environment and human rights into their treaties. In most cases, a general tribute can be found in the basic legal concepts underpinning RECs. The interrelationship between climate change, human rights and economic development has become closer over the past few years due to increasing discussions in the world community on the issue. Therefore, the promotion of human rights plays an important role in the process of regional integration, as envisaged by the Abuja Treaty as well as by REC constitutive legal instruments. However, the integration process faces many obstacles and challenges. The fear of losing State autonomy, the fear of losing national identity, socioeconomic disparity among members, historical disagreement, lack of vision, and unwillingness to share resources to name but a few (Ruppel, 2009a).

On the judicial side, the enforcement of rights within RECs works through the activities of regional community courts or similar institutions. Most RECs have judicial bodies that deal with any controversies relating to the interpretation or application of community law. However, the fact that many African states are members to various RECs can be regarded as a hurdle in respect of the integration process (Viljoen, 2007; Ruppel and Bangamwabo, 2008). Despite multiple costs for membership contributions and negotiation rounds, and technical problems such as the application of different external tariffs in respect of each member country and the eventual lack of identification with one specific REC (Andresen et al., 2001), the question of the concurrent jurisdiction of different judicial organs has to be addressed.

Only focusing on eastern and southern Africa, except Mozambique, all countries of the Southern African Development Community (SADC) are at the same time members of at least one other trade agreement in the region. Eight SADC members are also members of the Common Market of Eastern and Southern Africa (COMESA), four countries are members of SADC and the Southern African Customs Union (SACU), Swaziland is a member of SADC, SACU and COMESA, and Tanzania is a member of SADC and the East African Community (EAC). Various bilateral free-trade agreements as well as the membership of all SADC countries in the African Union (AU) may be regarded as obstacles to deeper integration in many respects. Such overlapping memberships are not only problematic in terms of duplication of work and costs, but also because a sub-regional customs union is envisaged by both COMESA and SADC, and it is legally and technically impossible to be a member of more than one such union (Jakobeit et al., 2005).

The question of concurrent jurisdiction of different judicial organs is a contentious issue with regard to multiple memberships, as all of the aforementioned organisations do have judicial organs, at least to some extent. The SACU Agreement provides for a Tribunal (SACU Tribunal), COMESA established the COMESA Court of Justice in 1994, the East African Court of Justice is the judicial arm of the East African Community (EAC) and the list goes on (Ruppel, 2009a, 2010e; Nwauche, 2009).

The African Ministerial Conference on the Environment (AMCEN), which so far played a prominent role in the African response to climate change (2009 Nairobi Declaration on the African Process for Combating Climate Change / UNEP/12/9), has a strong regional and sub-regional focus. AMCEN thus builds on the potential that RECs can enfold in the integration of adaptation measures into regional policies and socioeconomic development (Scholtz, 2010). AMCEN is a permanent forum where African ministers of the environment discuss mainly matters of relevance to the environment of the continent. It was established in 1985 when African ministers met in Egypt and adopted the Cairo Programme for African co-operation. The Conference is convened every second year. In the 2010 Bamako Declaration on the Environment for Sustainable Development, at the thirteenth session of the African Ministerial Conference on the Environment, the Conference's contribution in providing political guidance and leadership on environmental management to Africa since its creation in 1985 in Cairo, was appreciated.

AMCEN was established to provide advocacy for environmental protection in Africa; to ensure that basic human needs are met adequately and in a sustainable manner; to ensure that social and economic development is realised at all levels; and to ensure that agricultural activities and practices meet the food security needs of the region.

In October 2008, the Heads of States of Governments of the member states of SADC, the Eastern African Community (EAC) and the Common Market for Eastern and Southern Africa (COMESA) negotiated a communiqué a the basis of the Tripartite Partnership. Therein the Heads of State and Government representing all three regional economic communities agreed that the communities should merge into a single market in order to promote the rapid social and economic development of the region. With the 2011 Second Tripartite Communiqué the respective Heads of State adopted the following developmental approach to the Tripartite Integration process

> that will be anchored on three pillars [...]: Market integration based on the Tripartite Free Trade Area (FTA); Infrastructure Development to enhance connectivity and reduce costs of doing business as well as Industrial development to address the productive capacity constraints [...].[20]

According to the Communiqué, the Tripartite initiative incorporates 26 Countries which is almost half of the African Union with 600 million people and a Gross Domestic Product (GDP) of approximately US$1.0 trillion. A Tripartite Free Trade Area is envisaged by 2016. Only recently the East African Community (EAC), the Common Market for Eastern and Southern Africa (COMESA) and the Southern African Development Community (SADC) have initiated discussions towards the establishment of the COMESA-EAC-SADC Tripartite Climate change programme to facilitate their long-term vision of working together. This was announced in September 2011 at the 4th Special Africa Ministerial Conference on Environment (AMCEN). The COMESA-EAC-SADC tripartite initiative is strongly in line with the overall AMCEN vision that seeks to have the whole of Africa speak with one voice at Climate change fora.

8.2.5 National Policy and Legal Framework

8.2.5.1 National Constitutions, Policy and Statutory Law

National Constitutions usually set the framework and the opportunity for revising national policies and laws. Also on national level human rights impacts of climate change can become relevant. Such impacts and outcomes of climate change are likely to affect constitutionally protected rights such as rights to life, dignity, food, water, shelter, and health or rights associated with gender, children and indigenous peoples. These must be addressed in the national context. Moreover, an effective climate change policy recognises the need to promote gender equality and equity and hence shall strive to enhance the contribution of women toward sustainable development. Women, especially those in African rural areas, particularly suffer from adverse effects of climate change. Other vulnerable groups include the poor, the elderly and other marginalised groups. In many African countries are currently in the process of formulating (or re-formulating) a climate-change-specific policy which guides the development and implementation of national climate interventions. In terms of national sectoral (statutory) legislation, if successfully implemented, these laws can lead to sustainable development, promote and effect an existing climate change policy. Apart from a climate change law and policy, a broad bundle of other national laws and policies directly or indirectly deal with climate change related effects and regulatory requirements. Such laws and policies deal inter alia with mining, water supply and sanitation, agriculture, regional planning and development, forestry, fishing, tourism, land-use planning, resettlement policy, health and many more.

20 Cf. Second Communiqué of the COMESA-EAC-SADC Tripartite Summit of Heads of State and Government *COMESA EAC SADC TRIPARTITE* (2011) <http://www.comesa-eac-sadc-tripartite.org/sites/default/files/documents/Communique%20of%20the%202nd%20Tripartite%20Summit%20-%20English%20-%2012.06.2011.pdf/> (accessed 19 October 2011).

8.2.5.2 Climate change policy

A national climate change policy should lay out a number of principles that ought to guide the process, while also outlining the roles and responsibilities of the relevant stakeholders to ensure the effective implementation of the policy. While climate change has the potential to side-rail development processes, the key is to prepare sufficiently and effectively and to use the threats and opportunities of climate change to lay the basis for sustainability and prosperity (Nandi-Ndaitwah, 2011).

The purpose of a climate change policy is thus to state national intention to respond to climate change in order to promote and maintain the welfare of the people. Furthermore it documents the intention to provide for a conducive policy environment to facilitate development and implementation of climate change mitigation and adaptation being the main responses to climate change. A climate change policy should envisage diminishing the threat of climate change, to advance solutions for current impacts of climate change and to promote and accelerate efforts to adapt to the impacts of climate change for the benefit of present and future generations. UN members are obliged under Millennium Development Goals (MDGs). The eight MDGs are as follows:

- Eradicating extreme poverty and hunger (MDG1)
- Achieving universal primary education (MDG2)
- Promoting gender equality and empowering women (MDG3)
- Reducing child mortality (MDG4)
- Improving maternal health (MDG5)
- Combating HIV and AIDS and other diseases (MDG6)
- Ensuring environmental sustainability (MDG7), and
- Developing global partnership for development (MDG8).

Apart from the fact, that all of the MDGs are in one way or another relevant in the context of climate change, one specific indicator of progress towards achievement of Target 9 of MDG7 is the reduction in the level of consumption of ozone-depleting CFCs. With regard to the objectives of a climate change policy it should promote development and implementation of strategies and action plans that will lower the vulnerability of citizens and sectors to impacts of climate change through the adoption and successful implementation of appropriate and effective climate change adaptation and mitigation measures. The cross cutting nature of climate change issues have ramifications for diverse activities in basically all different government ministries. A national climate change policy will thus require that many government ministries, directorates and departments work together in a coordinated manner, to ensure that response measures are holistic and properly directed, acceptable to all and carried out with a national focus (Mfune et al., 2009a, b).

In order to adapt to climate change, and to prepare adequately for the likely impacts, capacity has to be built at individual, institutional and systemic level. This will ensure that policies and laws are reviewed and harmonised to adequately address climate change issues in general, and adaptation and mitigation in particular. Further, it is important that the available skills and competencies within government are efficiently harnessed. In the light of this, stakeholder involvement requires consultation of professionals from government, NGOs and the private sector when addressing climate change and related development issues. A climate change policy should *inter alia* relate to the following:

- Mitigating climate change
- Limitation of greenhouse gases
- Pursuing low-emissions development strategies
- Making existing renewable technologies economically viable

- Use cleaner, more energy-efficient technologies
- Meet Kyoto requirement implement mechanisms
- Adaptation to climate change is required in each major sector and encompasses a range of different approaches and strategies (cf. IPCC AR4, WGII findings).
- Cooperation

Namibia, for example, has embarked in 2008 to come up with a draft national climate change strategy and action plan, which was introduced in 2009 (cf. http://www.met.gov.na/Documents/Proposed%20Climate%20Change%20Policy.pdf). In June 2011 Namibia's Prime Minister Nahas Angula indicated that a national policy on climate change for Namibia be placed within the global framework of political, developmental, and technological interests (cf. http://www.namibian.com.na/news-articles/national/full-story/archive/2011/june/article/policy-on-climate-change-needs-review-pm/). Namibia is expected to present its 2011 National Climate Change Policy later this year after its Parliament adopted it. Like Namibia, many African countries have taken similar and laudable steps in preparing themselves for climate change and the related future.

8.2.5.3 Indigenous involvement and Customary Law

Indigenous peoples have been voicing their concerns about the impacts of climate change on their collective rights as distinct peoples, and the importance of giving them a voice in policy-making on climate change at both national and international levels; further, to take into account and to build on their traditional knowledge. Customary law and indigenous knowledge should therefore be incorporated into climate change policies in order to foster the development of cost-effective, participatory and sustainable adaptation strategies (Mfune et al., 2009a, b).

Populations whose rights are poorly protected are likely to be less well-equipped to understand or prepare for climate change; they would be less able to lobby effectively for government or international action; and are more likely to lack the resources needed to adapt to expected change of their environmental and economic situation. Despite the legal influence of the ex-colonial powers, a large number of Africans still live under indigenous customary law. It regulates marriage, divorce, inheritance and land tenure, amongst other things. Thus, customary law is a body of norms, customs and beliefs. However, despite this relevance for the majority of the population, customary law has for a time been marginalised and even ignored owing to colonial rule. Customary law is a complex, dynamic system which has constantly evolved in response to a wide variety of internal needs and external influences (Hinz, 2003; Ruppel, 2010b).

In many African countries it is still the overall responsibility of traditional authorities to supervise and ensure the observance of the customary law of that community by its members. Customary law can also plays an important role in the sustainable development of natural resources and the protection of biological diversity as it incorporates a broad knowledge of ecosystems relationships (Hinz and Ruppel, 2008, 2010). Thus, customary law can provide a basis for indigenous communities to address issues of poverty and food security in an increasingly global society. Moreover, incorporating customary law and indigenous knowledge into climate change policies is likely to contribute to the development of more effective adaptation strategies that are cost-effective, participatory and sustainable. After all, indigenous people have always been tasked to develop flexible mechanisms to cope with climatic conditions and their vulnerability.

8.2.6 Gaps in institutional, policy and legal frameworks for dealing with climate change in Africa

African governments have progressed in addressing climate change and related issues. The African Union (AU) has also succeeded in presenting a cohesive African position on climate change. However, significant gaps remain. At the regional level effectively managing consensus and divergence remains challenging. Divergent priorities among African countries threaten the potentials of the AU to wield influence in international climate politics (e.g. UNFCCC COP15 in Copenhagen, 2009) (Hoste, 2010). The AU thus needs to address divergence factors in lieu of international negotiations. The Africa group will then be better prepared when diverging circumstances threaten to disintegrate its common positions.

Integrating climate change into issues of common concern such as environmentally triggered migration and trans-boundary water management are inexistent. While the regional economic organisations such as the ECOWAS, the COMESA or the EAC provide for the movement of their citizens in their regions, ensuring access to resources for resource users (e.g. pastoralists, fishermen etc.) from neighbouring countries remain largely unaddressed. The AU (2010) has only recently published its policy framework on pastoralism, proposing among others to secure pastoralist mobility and access to sufficient rangelands. Similarly most African rivers are trans-boundary – in a changing climate context, regional agreements should not disadvantage local livelihoods as is the case in some areas, for example, in Macaneta (Mozambique) with the Inkomati River (Bunce et al., 2010).

At the national and sub-regional levels, various policy gaps exist, a major one being the sluggishness in mainstreaming climate change into all development sectors. In many African countries, a climate policy is non-existent or still in the making e.g. Kenya, Nigeria and Namibia (Republic of Namibia, 2009; Koblowsky and Ifejika Speranza, 2010; Madzwamuse, 2011). Development and climate policy run parallel and integrated development-climate policy framework is inexistent (Chuku, 2009), making it also difficult to stop the rebranding of Official Development Assistance (ODA) as climate response. Very few sectoral policies consider climate change, and need reviewing to close this gap.

The lower tiers of government need to be involved and to implement the national policies and strategies in their sub-national contexts. In countries as Nigeria where a certain decentralisation has taken place, state (sub-national) governments are setting the pace in some climate change responses. This progress may be good in the short-term but it would be better to align the sub-national policies and responses to national frameworks.

The lack of strategic visioning in addressing climate change is linked to the inexistent climate change policies. In part, a major reason for the high vulnerability of African populations is the high dependence on agriculture. Yet, no national plan addresses this issue in a strategic manner, for example by aiming to reduce the population dependent on agriculture for their livelihoods through building human capacity and skills that allow population to move to secondary economic sectors. Fewer investments exist in strategic areas such as legislature, coordination, advocacy and financial cooperation (Madzwamuse, 2011).

Many coordinating agencies handling climate change seem to lack the political authority to facilitate government-wide support (Madzwamuse, 2011). Climate change transcends the mandates of a particular ministry and should be assigned to a central organ with the political and executive authority to drive climate change responses across all of government such as a commission, the Ministry of finance and planning, the office of the president or the prime minister. The positioning of climate change in the environment sector tends to limit the public's and decision makers' understanding of its impacts and implications for national economies and undermines political commitment for prioritising and resourcing adaptation (Madzwamuse, 2011). In countries such as Mozambique, the Ministry of Planning and Development, lack clear focal points for the environment (Sietz et al., 2011). Various African governments have recognised this limitation. For example, Nigeria is about to set up a national climate change commission under the

presidency. Namibia also plans to establish a Climate Change Unit in the Office of the Prime Minister to remove the emphasis on climate change as an environmental problem and to raise its profile as one of the biggest development challenges (Republic of Namibia 2009). Such a central organ can effectively address the existing problems (also in the non-governmental sector) of institutional rivalries and clashes, exclusion, duplication of activities, inefficiency and delays in climate policy process, lack of credibility, accountability, policy coherence and coordination and policy fragmentation (Kok and de Coninck, 2008; Koblowsky and Ifejika Speranza,[21] 2010; Madzwamuse,[22] 2011; Levy, 2011).

To accelerate action on climate change presidential directives may be necessary. This recommendation draws analog from the Kenya presidential directive on gender, which within its short life span has become the document of reference for gender mainstreaming in government activities in Kenya. African governments should consider this option as a way of climate-proofing and mainstreaming climate change.

African governments should make provisions for integrating climate change responses into national budgetary allocations. Economic planners often lack guidelines on mainstreaming climate change adaptation at the national level. As with other policy spheres, climate-proofing development through integrating climate change in all policy spheres has its costs and trade-offs. Considering the chronic understaffing and under-funding of certain government activities, climate change will bring more work and governments should improve staff skills and provide more resources to address the add-on challenges of climate change. Many operational limitations hinder implementation. They include, dysfunctional organisational arrangements causing conflicting and overlapping mandates, overburdening reporting requirements of various international agreements and conventions, and inability to retain skilled staff (Sietz et al., 2011; Madzwamuse, 2010, 2011).

As many African countries adopt a development first strategy, it is critical to implement it in a sustainable manner. Concentrating adaptation and mitigation on priority development sectors such as the oil sector in Nigeria, the energy sector in South Africa, the tourism sectors in Kenya and Tanzania, or generally agriculture, needs to be balanced with responses in other sectors. The energy sector is one of the major sectors contributing to greenhouse gas emissions worldwide – this is also the case in certain African countries such as South Africa. Yet the importance of achieving energy security has favoured the South African decision to invest in the coal-fired Medupi power plant at the cost of increasing it emissions (Rafey and Sovacool, 2011). South Africa thus risks a policy trade-off between its energy- and climate policy (Pegels, 2010). Economic development priority and energy security seem also to have been traded for environmental sustainability and led to a public debate on the "climate debt" of South Africa. How to address trade-offs in climate responses between economic sectors and the procedures to follow remain unaddressed in policy (Chuku, 2009; Ifejika Speranza, 2011). In adopting a development first strategy, African countries should follow a low-emission path, and where untenable, devise strategies to address their future climate debt.

Cross-cutting issues such as HIV-AIDS, chronic food insecurity, gender inequality, persisting poverty and energy poverty and their inter-linkages with climate change need to be better explored to harness their synergies and reduce trade-offs.

Sufficient attention on how national climate policies and responses might play out at local levels to increase or erode the adaptive capacities of local populations is needed. Trade-offs exist in monetary terms for example between policies on cleaner energy use and income losses for producers: In Kenya, Tanzania, Mozambique and Zambia, where most households use wood-fuel or charcoal for cooking, charcoal production is a livelihood to a high proportion of their populations. Hence, without accompanying measures, cleaner energy policies will destroy such livelihoods, thereby undermining efforts at poverty eradication (Chuku, 2009). As the rural poor are often excluded from policy-making,

21 In a study of the Nigerian climate change policy process

22 In an evaluation of the state of preparedness for climate change adaptation in seven African countries namely Botswana, Kenya, Nigeria (with references to Ghana), South Africa, Tanzania, Uganda, and Zimbabwe.

the gap between individual adaptation actions and national policy-making processes often results in policies and institutions that rather increase vulnerability by undermining rural livelihoods and local adaptation strategies (Bunce et al., 2010; Chikozho, 2010). Macro-economic investments such as on tourism, commercial forestry and agriculture for export tend to displace local landowners and resource users leaving them more vulnerable to climate change impacts (Murombedzi, 2007; Taylor, 2009; Nelson, 2010; Madzwamuse, 2011). Policies should thus provide guidelines for dealing with cases where climate change responses may reduce greenhouse gas emissions but cause a loss of local livelihoods.

Weak research-policy-linkages means that solutions to various climate change problems remain on the shelves. African countries already support their hydro-meteorological services to improve the quality of collected evidence on climate change. Research can also contribute in various other ways, for example in vulnerability assessments for identifying adaptation priorities. However, the link between research and policy remains poor. Pathways through which researchers can reach policy makers are few to inexistent and the contributions that science makes largely remain unharnessed. There is no umbrella body guiding and prioritising research work, leading to misfit of research priorities with national knowledge gaps and dependence on individual researcher initiatives. The ensuing research results are not adequately disseminated leading to duplication of efforts and the lack of finances and technologies for research further compound the situation. It is thus necessary that specific mechanisms be established to address this shortfall. African governments need to direct substantial funding to research on issues, which they deem to be important or collaborate better with foreign initiatives in order to integrate their research priorities. Climate change is also hardly integrated in the education curriculum, exceptions being in South Africa through its integration in the secondary school curriculum in 2006 (Mokeleche, M., 2009). Education ministries in other African countries like Mozambique lack clear focal points for climate and environment issues (Sietz et al., 2011). Government officers also need to be better able to articulate climate change issues, its impacts on their sectors, the possible responses, and how they can take advantage of the opportunities that climate change offers.

There is still a need to improve the awareness of the African public on climate change in a way that they effectively understand and respond to it. Awareness raising and promoting policy change has been mainly at the national level (Levy, 2011[23]), but sub-national and community levels have received lesser attention. The role of the media and communication in supporting this intervention needs consideration (BBC WST, 2010). Moreover, many climate change terms are in English, a language that local people are not conversant with, hence African governments need to make provisions for translating global climate change terms to local language terminologies as people respond better to issues when they understand it and can talk about it (BBC World Service Trust (BBC WST) on Africa Talks Climate[24]; BBC WST, 2010a, b, c, d, e, f, g, h, I, j, k). Awareness raising needs to be more differentiated and tailored to particular actor categories, especially, the rural population that directly depend on natural resources for their livelihoods and to local government administration that seem to have been neglected by activities at national levels (BBC WST 2010). Creating platforms for inclusive public debates on climate change will also increase public understanding of climate change.

Policies on biofuel production are largely inexistent, although biofuel production is increasingly gaining attention in Africa. There is a dearth of studies on what such a low-carbon strategy entails for African governments and the livelihoods of its peoples (cf. Mshelia et al., 2010). The question of how far African countries have considered the opportunity costs and risks inherent in broadly embracing biofuel production remains unanswered. Prominent among biofuel initiatives is the EU–Africa Energy Partnership. Charles et al., (2009) argue that it is uncertain, whether the Energy Partnership will be truly mutually beneficial for sustainable transport fuel production and use in the long term, especially for sub-Saharan African nations currently investing heavily in the biofuel industry, or those intending to do

23 Studies in Burkina Faso; Cameroon; Congo; Ethiopia; Gabon; Ghana; Kenya; Lesotho; Malawi; Mauritius; Morocco; Mozambique; Namibia; Niger; Nigeria; Rwanda; Sao Tome and Principe; Senegal; Tanzania; Tunisia

24 From surveys in DR Congo, Ethiopia, Ghana, Kenya, Nigeria, Senegal, South Africa, Sudan, Tanzania, Uganda

so. Points of reflection include the dependence on external sources for technology transfer, the danger of shifting vast stretches of arable land from food production to the cultivation of cash-crops (Anderson and Fergusson, 2006), the association with an increase in food prices (Bwibo and Neumann, 2003); and dependence on food imports leading to an increase in national debt (Bourguignon, 2004). Certain project developers and NGOs already exploit the policy vacuum on bioenergy in some countries and have convinced small-scale farmers to shift to growing bioenergy feedstock without actually securing them markets.

Designing policies for dealing with climate change offers the opportunity to address the dichotomy between parallel regulatory systems, i.e. the traditional and the state laws, e.g. in access to land, the management, use of and control over natural resources and benefit sharing. However, issues remain on how to develop a national framework for compensating natural resource users for providing environmental services and how to proceed with a low-carbon development and the role of green transformation in these processes.

Finally, institutional barriers limit mainstreaming. For instance, despite a supportive legislative environment and climate awareness among donors, the limited institutional capacity in Mozambique restricted mainstreaming initiatives (Sietz et al., 2011). Governments need to address factors such as inadequate human resources, limited incentives in the national public sector, insufficient data and information and their management and dissemination, as well as the erosion of institutional memory due to inability to retain skilled staff.

8.2.7 Conclusion

The international climate change regime is growing, however, in order to achieve more climate change justice for Africa it requires that certain gaps are closed and rights and responsibilities are distributed with greater fairness in future. This in turn means to ensure that especially poor and marginalised communities in Africa do not suffer a disproportionate burden associated with climate change. Climate change calls for more intelligent collective action focusing on the human suffering that climate change is expected to cause, especially in Africa.

The former executive Director of the United Nations Environmental Programme (UNEP), Klaus Töpfer once stated, that sustainable development cannot be achieved unless laws governing society, the economy, and our relationship with the Earth connect with our deepest values and are put into practice internationally and domestically. The problem with climate change, however, continues to lie in that such laws must be enforced and complied with by all of society, and all of society must share this obligation. In this context the question that still needs to answered, or perhaps better negotiated is this: How can the law work for everyone equitably (developing and developed countries), combat climate change, reduce poverty, retain wealth and at the same time protect the environment? (Ruppel, 2011c). It is to be seen what the negotiations can achieve in answering the aforementioned question.

At COP 16 in Cancun, a goal of limiting global temperature rise to below 2˚C above pre-industrial levels, with a provision to review the adequacy of this goal at a subsequent date, was agreed upon. However, an emissions gap exists between the current pledges and what is needed to keep average temperature increase to 2˚C or lower. Africa's agreed position – along with over 100 developing countries including Least Developed Countries (LDCs), Small Island States (SIDs) and others – is for the adoption of a global goal of limiting warming to well below 1.5˚C.

Chapter 9:

CONCLUSIONS AND RECOMMENDATIONS

9.1: Links between climate change, green growth and sustainable development

Stabilizing emissions to maintain a global temperature increase to less than two degrees centigrade will require the global community to move fast along a low-carbon growth pathway. In effect what is being called for here is green growth which means fostering economic growth and development, while ensuring that natural ecosystems continue to provide the resources and environmental services on which our well-being rely. To do this, investments must be catalyzed including bringing in of innovation which will underpin sustained growth and give rise to new economic opportunities and an integrated cross-sectoral policy approach is needed. The challenge for the world is therefore to enable all countries to go along this path.

A number of developing countries have drawn up or are in the process of drawing up National Low Carbon Growth Pathways (NLCDP) that are in their national interest, addressing how the challenges required to meet their development needs through low carbon growth pathway can be met. In these country-specific studies, there are assessments of country development goals and priorities, in conjunction with greenhouse gas (GHG) mitigation opportunities, with investigation of the implied additional costs and benefits of lower carbon growth. The plans drawn up can help attract international concessional funding to cofinance programs in energy, industry, transport, and natural resource management, which have carbon reduction implications.

These studies identify some broad messages (i.e., the need for renewable energy (RE) and energy efficiency, including low cost transport options, and untapped cogeneration investments), application of resource use efficiency technologies that enhance sustainable development, and generating a wealth of knowledge that provides a global public good. The goal is to use this knowledge to create low carbon pathways and to identify GHG reduction investments beyond these countries (World Bank, 2009).

African countries are not being left behind. A number have already begun to identify opportunities and challenges in their transition to a green economy. These countries include Rwanda which even though is currently a low carbon economy, is concerned that its continued economic development (currently ~9% pa) could be easily put at risk by mild economic shocks (e.g. heightened oil prices) or climatic extremes (e.g. droughts and floods). The Long Term Mitigation Scenario (LTMS) in South Africa provides an interesting case study on a high emitting developing country facing the challenge of managing a development path and reducing emissions (Winkler, 2010). The LTMS was a multi stakeholder research based scenario process that has produced an assessment of country's mitigation potential (DEA, 2009). It was a rigorous, peer reviewed and inclusive process based on energy, non-energy and economy-wide modeling.

Overall, at the continental level, the African Heads of state and Government meeting at the seventeenth session of the African Union Summit held in July in Malabo, Equatorial Guinea, the fourth session of the African Ministerial Conference on Environment held in September 2011 in Bamako, Mali, and most recently the Seventh Session of the Committee on Food Security and Sustainable Development and the Africa Regional Preparatory Conference on Sustainable Development(Rio+20) held in Addis Ababa, Ethiopia in October 2011, all converged in identifying opportunities and challenges in the transition to a green economy with links to the achievement of the MDGs, climate change and sustainable development. The African Countries recognized that managing a green economic transformation requires enabling

policies and institutional frameworks that imply a critical role for the state, through public investment, fiscal policies, regulations, public procurement, sustainable livelihoods, and market creation at national, regional and global levels, as well as the facilitation of an active participation of non-state actors.

The challenges to development are complicated by the complex economic, social and technological choices, together with uncertainties in understanding future climate changes, notwithstanding the continent's low and negligible GHG emissions, and the climate variability and change impact on key development sectors.

It is to be noted that Africa is at an early stage of economic growth and therefore has enormous opportunities to promote sustainable economic pursuits. Opportunities exist for linking poverty alleviation to winning strategies that include provision of off-grid renewable energy for poor households, expanding reproductive choice including access to reproductive health services, community forest management designed and implemented in a participatory and gender sensitive manner, equitable and adaptive disaster responses including community-based risk mapping, innovative social protection schemes (HDI Report, 2011). Currently, global policies on finance and technology provide opportunities to transform the challenges into development opportunities across Africa; to leap- frog the carbon-intensive phase of development and move directly to cleaner and more advanced transportation modes, energy and land-use solutions. The continent has yet to build its infrastructure and has therefore the opportunity of charting out a new development paradigm on a low carbon pathway with a view to investing in sustainable infrastructure. This is the 'development first' approach that offers the organizing principle to pursue development strategies with ancillary climate benefits and enhance capabilities of African countries to implement climate resilient strategies (ACPC, 2011). Green economy offers opportunities for mobilizing resources towards a low emission, climate–resilient development pathway. Policies and investments to sustain and enhance natural capital assets - the soils, forests and fisheries on which many poor communities depend for their livelihoods will be key.

9.2: Reinforce the most important themes that emerge above.

Climate change and development are inseparably interlinked; consequently, the African continent needs to pursue the opportunities presented under climate change negotiations to achieve its development aspirations. Due to their vulnerability, it is imperative for African countries to move along a development pathway that emphasizes poverty reduction, economic growth and the enhancement of human wellbeing, while increasing resilience to the physical and economic impacts of climate change. The key messages that have come across based on the thematic areas are as follows:-

Capacity building, improving understanding of climate change science

Noting the need for scientifically established facts and knowledge through climate science, having in place sound data, information and service delivery mechanisms for Africa to reach a common understanding of the evidences, the extent of the impact on its economic growth, social development and serve as a basis to adopt action oriented response to addressing climate change in Africa, the first recommendations are in relation to improving the state of Climate Science.

African countries need to build capacity, to collect, analyse, and use climate data and information for decision makers and practitioners at all levels, with Regional centres of excellence scaling-up Africa-focused climate research, that is relevant to local needs, practical and policy-driven, so as to improve the science base and reduce prediction uncertainties in user-relevant climate variables.

There should be a creation of new centers where necessary and improvements in existing networks of centers of excellence for data, climate science and applications in Africa, building on the UNEP work A Preliminary Stock taking: Organizations and Projects focused on Climate Change Adaptation in Africa carried out at the request of AMCEN (UNEP, 2009).

A regional network must be created based on the results of the mapping that would serve as repository of knowledge on climate change issues and help in building capacities of individual countries and NMHSs in Africa;

Adapting by building resilience and facilitating a transition towards low carbon societies

Although climate change is affecting all countries of the world, African countries will be most affected because their environments are closely linked with climate, and the livelihoods of their inhabitants are largely dependent on the utilization of land-based resources as well as on freshwater and riverine systems as sources of potable water, fish and transport. As a result of this dependency on natural ecosystems and widespread poverty, the communities in sub-Saharan Africa are particularly vulnerable to the effects and impacts of climate change

These impacts are already having adverse effects on food security; sustainable water supply and extreme weather event are causing 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.

Not all the climate change effects are negative but the few benefits of global climate change for Africa will be overshadowed by the enormous negative impacts. Africa therefore must immediately try to adapt to the changes and pursue sustainable development on the path of green economy. Establishment of national, regional and continental mechanisms to cope with climate change induced risks such as flood, drought and desertification in Africa.

Climate change adaptation and risk management need to be integrated into development practice across sectors and economic planning and management at both the national and regional levels as well as at local community levels. However,-in many parts of Africa-mainstreaming is not yet established as standard practice in government and administrative processes, procedures and systems.

Applying appropriate risk management principles, tools, and measures can reduce current and future vulnerability to climate variability and change. A number of risk management approaches/frameworks have been developed that can be modified to address national, regional and local assessment needs.

The enhancement and building of capacity for research in climate variability and change adaptation, multi-level and multi-stakeholder adaptive governance, protection of vulnerable people, management of financial schemes to insure against and mitigate natural disasters, improvement of resource use efficiency in agriculture, diversified infrastructure for energy, water, and transportation suitable to the local conditions. Adaptation measures for specific sectors involve the understanding of the impacts of current and projected climatic changes on each sector including extreme climate as well as the identifying and evaluation of adaptation options. This requires multi-stakeholder collaboration, public participation and a pro-poor vulnerable approach (IGES 2011) http//www.iges.or.jp

Mitigation

While mitigation has not historically been the focus for the Africa region, there is recognition that moving to a low carbon development approach could be beneficial for a developing country economy competing in the global context.

Some of the opportunities highlighted include:

- The REDD mechanism that offers an opportunity for rural communities in terms of cash flow as well as new technologies that can contribute to the reduction of deforestation and degradation;
- Through the Technology Mechanism the transfer and deployment of new and existing technologies provides an opportunity to access alternative mitigation technologies, introduce new markets as well as develop technical skills and capacity;

- The CDM mechanism allows for north-south collaboration for knowledge sharing and technical capacity building through mitigation projects;
- NAMA's can be framed in such a way as to increase the sustainable development and co-benefit opportunities from mitigation initiatives
- Different approaches for identifying mitigation needs have been presented – development of GHG inventories, to Low Carbon Development Strategies. The approach appropriate for the national context must be pursued and will also depend on local resources and capacity.

◊ In terms of taking mitigation initiatives closer to implementation, an outline of steps- from identification of the appropriate mitigation action through to outlining an appropriate MRV strategy has been provided in section 5.5. Furthermore it is essential to develop capacity to identify mitigation needs and frame them in such a way that they can attract the necessary and available finance – whether through NAMA's and/ or the carbon market.

◊ Finance and technological support must be made available to African countries for development and implementation of NAMAs

Practitioners need to be aware that some of the issues relevant to mitigation are still being negotiated under the UNFCCC such as the form and function of NAMA's, the NAMA registry and MRV whereas other initiatives such as the TNA's and CDM mechanism have been operational for some time. Therefore the focus for practitioners will vary depending on which aspects of mitigation they are involved in from UNFCCC negotiation through to on-the-ground project implementation.

Investment

Total existing commitments to funds for dealing with climate change is inadequate as compared to the substantial requirements additional public and private investments led by a socioeconomic rational are needed to help mitigate and adapt to climate change. Disbursing adequate financial resources to Africa would assist the continent address adaptation needs, develop institutional capability, acquire and build capacity for applying technologies and promote long term investments.

Africa is positioned to attract climate investments as global climate change financing architecture takes shape and realigns with the general interests of the Least Developed countries. Opportunities may be explicit or implicit in the current global and regional investment financing frameworks.

Various tools and approaches can be utilized to identify climate change investment needs. These tools offer the first level identification of areas and projects, which would attract investments and can assess the feasibility of the investment ideas especially those, which may require involvement of the private sector. Investments that may need private sector involvement and or participation have to be commercially viable to attract investments.

The mapping and identification of needs will be a requirement for participatory consultations on some of the investments especially the downstream investments that may target households and or communities.

Internationally established investment initiatives such as CDM, which is a Global Environmental Investment and Credit Scheme that allow compliance trading of certified credits, Trade-credit offsets, Voluntary trading of carbon credits, Private public partnerships, exist and should be considered when elaborating investment plans in clean energy, water management, scaled up sustainable agriculture, sustainable tourism, health, etc.

Furthermore, the public sector should play an active role in addressing investment risks, offering a conducive economic and social environment for private sector investments. The private sector in return should have a clear understanding of the linkages between public actions and private reactions and work actively on improved public private cooperation to define investment priorities.

Climate investments obey to socioeconomic priorities. Indeed, studies have shown that the effects of climate change on the economy, and more generally environmental risks, will pose new and serious challenges to growth and prosperity. Investments in climate mitigation and initiatives that can co-benefit adaptation can generate massive employment for African countries and help save substantial costs.

Finance

A number of estimates of the costs of the economic impacts of climate change on Africa have been made. These include estimates by the UNFCCC, UNEP, World Bank and others. These estimates include different methodologies, categories of adaptation and time.

While a wide range of funds are available in support of both adaptation and mitigation to climate change, they are not commensurate with the resources required based on the studies on the financial flows required to combat climate change. Moreover each of the different funds available have their own procedures for accessing funding, most requiring co-financing, either through in-kind contributions or as direct co-finance.

Mechanisms to provide adaptation funds for Africa should be simple and accessible. Moreover, enhancing capacity to cope with existing vulnerabilities (adaptation deficit) is a first step for enhancing resilience for the future, though these needs are associated more closely with development than future climate change.

Some capacity-building efforts exist to facilitate access to funding by countries, such as the least developed countries, and to design effective adaptation programmes. There is need to greatly scale up these efforts, especially if projected financing for adaptation is realized in the future. It is clear that current approaches to disburse small amounts of funds after tedious and lengthy proposal steps, will not meet the challenge for the future.

With the increase of funding sources to address climate and development needs, there are increased complexities in accessing these resources. Noting the demand from countries for direct access to resources, institutions such as UNEP and UNDP have put in place programmes to support countries establish national institutions that can serve as national implementing entities, accessing and managing these resources to support country-driven objectives.

There is need for countries to develop climate change strategies, programmes and plans, including national low carbon growth plans that will assist in attracting international concessional funding to co-finance programs in energy, industry, transport, and natural resource management, which have carbon reduction implications.

For some of the more substantial funds, few countries are invited by the funding programme to participate in pilot programmes. This has led to a few countries accessing funds easily, while the majority is still struggling to attract grants and investment in adaptation. Overall, investment in adaptation may be more difficult to disentangle from investment in development more generally, and there is an increased push for adaptation to be fully integrated into development planning.

The information provided in this guidebook is therefore aimed at enhancing awareness and enabling the countries to:

- ◊ Ground long-term programmes and strategies on clear assessment of the scientific and economic basis for action that also limit climate impacts.
- ◊ Develop coherent response s to climate challenges that are strategic, incorporating cost – effective low–carbon growth including the capacity requirements, within a broader sustainable development context.
- ◊ Make contributions in the establishment of well-founded positions for international negotiations

on the future of the climate regime and on funding needs and opportunities

- ◊ Assist countries in their efforts to harness climate finance including opportunities made available for support.
- ◊ Increase national competitiveness in the face of a green revolution.
- ◊ Build dialogue, local capacity, and know how, through the involvement of a wide range of stakeholders needed to understand and negotiate trade-offs and achieve broad support for a locally owned vision and package of policies for sustainable development.
- ◊ Build African capacity in CDM and other climate change-related project development expertise to reduce the transaction costs for Africans and their organizations in accessing climate (including carbon) finance.

Policy makers need to focus on creating signals that climate change actions will be an important and continuing factor in government policies for the foreseeable future in ways that will affect investor expectations of relative risk and reward, this should ensure that financing will follow.

Decision makers can integrate Green Growth concepts to encompass policies that promote resource use efficiency, energy security, improvements in the quality of economic growth, and the mobilization of alternative and renewable energy sources and thereby include climate action in comprehensive low carbon sustainable development strategies.

ANNEXES

Annexe 1: mitigation points:

		Status (July 2011)	Implications for practitioners	Useful References
CDM	Clean Development Mechanism	Operational but current discussions on CDM reform	Capacity to identify a suitable project, complete CDM application, registration, PDD, monitoring plan	Fenhann and Hinostroza, Information and Guidebook, 2011, UNEP RISOE Centre
LCDS	Low carbon development strategies	Encouraged in decision 1/CP16 that developing countries develop LCDS	Knowledge of national emissions profile, technical skills to model sectoral emissions and projections	http://africacarbonforum.com/2011/docs/Presentations/D3/P6/Carnahan.pdf
MRV	Monitoring Reporting and verification	Agreed in Cancun, final format of international MRV undecided	Capacity to identify and manage a domestic MRV system, and frame mitigation actions with this in mind.	Cancun Decision CP16 Ellis and Moarif, S. 2009 NDRC
NAMA	Nationally Appropriate Mitigation Actions	Agreed in BAP, final format and function to be decided	Capacity to identify, implement and operationalise nationally appropriate mitigation actions. Consider sustainable benefits and co-benefits as a key focus.	Ecofys, 2010 Jung and Hoehne CDM/NAMA paper
REDD	Reforestation			
TM	Technology Mechanism	Established in the Cancun decision, to be operationalised after COP17	The two components of the technology mechanism are the Technology Executive Committee (TEC) and the Clean Technology Centre and Networks (CTC and N) The format and function of the TEC and the CTCN are being decided.	UNFCCC Technology Mechanism http://unfccc.int/ttclear/jsp/index.jsp
TNA	Technology Needs Assessment	Decision 4/CP7. Since then nearly 100 TNA's submitted	Capacity required to prepare TNA. Assistance may be provided by UNEP, UNDP and GEF.	UNFCCC Technology Needs Assessment http://unfccc.int/ttclear/jsp/TNAReports.jsp UNDP Guidebook http://unfccc.int/ttclear/jsp/TNAHandbook.jsp

Establishment of a strong institutional structure for implementation. A general model of this structure (lesson 3), which countries are encouraged to adjust to their own contexts, is illustrated in Figure 5.1.

While the particulars of the institutional structure may vary by country, all countries are required to ensure that the roles of National TNA Committee, National Consultants /experts, Workgroups, and TNA coordinator are clearly defined (lessons 2).

- Development of detailed national work plans closely tied to the major steps of the TNA process (lesson 4), entailing the following key steps:
  - ◊ Step 1 - Prioritization of technologies, itself a two-stage process involving: 1.1 sector priorization; and 1.2 prioritization of technologies.
  - ◊ Step 2 – Barrier Analyses and Formulation of an Enabling Framework
  - ◊ Step 3 – Preparation of a Technology Action Plan
- Building capacity of institutional actors (lesson 1) according to their roles at each stage in the TNA process. Table 2 summarizes the close integration of training with the TNA process as currently deployed in the project – targeting each stakeholder participation group with the relevant methodologies and data support services.

TNA Process Step	**Institutional Elements**		**Methodological tools**	**Database support**	**Training Events**
	Decision-making Entity	**Technical Support Entity**			
1. Prioritization of Technologies					
Stage 1. Prioritizing Sectors	-National TNA Committee	-TNA Coordinator	-TNA Handbook		Regional Capacity Building Workshop – 1 on Multi criteria spreadsheets
Stage 2. Prioritizing Technologies	-National TNA Committee -Sectoral work groups	-National consultants	-TNA Handbook -Multi-criteria Tools -FICAM Model	-Guide books -Help Desk -Climate Techwiki	

2. Barrier Analyses and Enabling Framework	*-Sectoral work groups*	*-National Consultants*	*-Barrier Analysis Guidebook* *-Market Assessment Method*	*-Policy Database* *-Technology Transfer Series (Primary theme: Enabling frameworks)*	Regional Capacity Building Workshop – 2 on Market/ Barrier Analysis and Template for TAP
3, Preparation of Technology Action Plans	*-National TNA Committee* *-Project Steering Committee*	*-National Consultants* *-Work groups*	*-TAP Template* *-Financing Guidebooks*		

The training curriculum encompasses topics informed by lessons in the table below.

TNA Project Training Curriculum

TNA Step	Key Training Topic

Prioritization
Sectors
Technologies
	• Stakeholder engagement methods and processes
	• Technology and sector prioritization methodology (TNA Handbook + tools including:
	  • Multi-criteria Analysis
	  • Financial Analysis
	  • Technology Fact Sheets
	• Technology database management
	• Preparation of technology fact sheets
	• Economic assessment of adaptation technologies

Barrier Analyses and Enabling Framework	• Methodologies for:
	  • Barrier analysis including market mapping tools
	  • Analysis of policy and institutional gaps, formulation and implementation of enabling policy measures, case studies.

Preparation of Technology Action Plans	Structure and content of a technology action plan (using a template) • Development of project concepts • Funding options and mechanisms • Intellectual property rights

The expected outcomes of the project include:

- Capacity developed through training workshops and utilization of guidebooks and easy access to technology information.
- National consensus on priority technologies and agreement on a national action plan, and readiness to implement the action.
- Methodologies which complement the revised TNA Handbook and facilitate technology information

available to countries.

- Regional networks ensure that support to the countries available in the region for technology information, methodology, preparation of action plan, and a cooperation mechanism to share TNA experiences.
- Increased national and interregional cooperation on technology transfer as a means to facilitate preparation of TNAs and implementation of TAPs.

To date (September, 2011), preparatory actions, including appointment of national coordinators, establishment of formal institutional structures, have been completed all but one of the first group of 15 countries selected in November 2009 (referred to as "First Round Countries in the project context). Similar actions are underway in the 21 Second Round countries approved by the Project Steering Committee in December 2010 (see Table 3 for the 11 selected African countries benefiting from the project).

Table 3. African Countries Participating in the GEF-funded Global TNA Project

First Round	Second Round
Cote d'Ivoire	Zambia
Mali	Rwanda
Morocco	Ethiopia
Senegal	Mauritius
	Ghana
	Sudan
	Kenya

Annex 2: International Financing mechanisms with an Africa focus

Fund	Thematic Area	Financing mechanism	Total Amount	Eligibility
DEG - Deutsche Investitions- und Entwicklungsgesellschaft mbH	Mitigation, Agriculture, Energy Efficiency, Fisheries, Forestry, Industry, Infrastructures, Renewable Energy Services, Tourism, Transport, Waste Management	Co-financing, Debt , Equity, Loan, ODA, Other, Risk management, ,Structured financing, Technical assistance	EUR 25 million per project, larger volumes through co-financings	Private sector investment in developing and emerging market countries for profitable projects that contributes to sustainable development goals.
GEF Small Grants Programme	Mitigation, Energy Efficiency, Low-Carbon, Renewable Energy, Transport , Urban	Grant	$50,000 per project	Community-based or non-governmental organizations (CBOs or NGOs) in 101 SGP participating countries
World Bank Carbon Funds and Facilities	Adaptation, Mitigation, Agriculture, Climate-Resilient, Energy, Energy Efficiency, Forestry, Fuel Switching, Fugitive Methane, Low-Carbon, Natural Resource Management, Renewable Energy, Sustainable Land Management, Transport, Urban, Waste Management	Carbon Finance	About USD 2.5 billion under management through 10 carbon funds and facilities	IBRD/IDA member countries; CDM or JI-eligible project activities (also voluntary window mainly for forestry and agriculture-based projects) and AAU transactions (through GIS); Project with at least 200,000 Mt CO2e emission reductions by 2012; Host country approval

Fund	Thematic Area	Financing mechanism	Total Amount	Eligibility
MDB Pilot Program for Climate Resilience (PPCR)	Adaptation, Agriculture, Climate-Resilient, Coastal Zone Management, Energy, Forestry, Infrastructures, Low-Carbon, Populations & Human Settlements, Sustainable Land Management, Water	Grant , Loan , ODA , Technical assistance	USD 1 billion	MDB eligibility (Regional Development Banks, International Development Association (IDA)) in the following African countries/regions: Mozambique, Niger, Zambia;
UN-REDD Programme	Capacity Building, Mitigation, Forestry, Natural Resource Management, Sustainable Land Management	Grant , Technical assistance	$97 million	DR Congo, Tanzania, Zambia
MDB Clean Technology Fund (CTF)	Mitigation, Agriculture , Energy, Energy Efficiency, Fuel Switching, Industry, Infrastructures, Transport	Co-financing , Grant , Loan , ODA	USD 4.5 billion pledged by donors (Australia, France, Germany, Japan, Spain, Sweden, United Kingdom, United States)	Countries that have an active MDB country program (World Bank and Regional Development Banks) including Algeria (MENA), Egypt Morocco (Country and MENA), South Africa, Tunisia
The Global Environment Facility (the GEF)	Adaptation, Capacity Building, Mitigation, Agriculture, Climate-Resilient, Energy, Energy Efficiency, Forestry, Low-Carbon, Renewable Energy, Sustainable Land Management, Transport, Water	Co-financing , Grant	To date, USD 3 billion has been allocated for mitigation and enabling activities and USD 400 million for adaptation.	Parties to UNFCCC, non-Annex I Parties or eligible to borrow from the WB (IBRD and/or IDA) or eligible recipient of UNDP technical assistance.

Fund	Thematic Area	Financing mechanism	Total Amount	Eligibility
Seed Capital Assistance Facility (SCAF)	Mitigation, Energy, Energy Efficiency, Renewable Energy	Co-financing , Equity , Grant	$10.47 million	Commercial Private Equity or Venture Capital Funds can receive cost-sharing support for including early stage seed capital windows within their broader commercial investment offering.
UNEP Renewable Energy Enterprise Development (REED)	Mitigation, Energy, Energy Efficiency , Infrastructures , Low-Carbon , Renewable Energy	Equity , Loan	Up to USD 250,000, depending on the project	Each project is assessed individually by UNEP, E+Co and in-country partners for eligibility
EIB Climate Change Technical Assistance Facility	*Mitigation, Carbon Capture & Storage (CCS) , Energy Efficiency, Forestry, Fuel Switching, Fugitive Methane*	*Grant , Loan*	*Total funding of EUR 5 million*	Any carbon mitigation project that will be eligible for CDM or JI crediting
EIB Post-2012 Carbon Credit Fund	Mitigation, Carbon Capture & Storage (CCS), Energy Efficiency, Forestry, Fuel Switching, Fugitive Methane, Low-Carbon, Renewable Energy, Sustainable Land Management	Carbon Finance	Fund assets of EUR 125 million	All CDM and JI host countries; projects generating at least 250,000 tonnes CO2e in EURs or CERs with vintages 2013-2020
MDB Forest Investment Program (FIP)	Mitigation, Climate-Resilient, Forestry, Low-Carbon, Sustainable Land Management	Grant , ODA	USD 578 million (Australia, Denmark, Japan, Norway, Spain, UK, US)	ODA eligible and active MDB country program, including Brazil, Burkina Faso, Democratic Republic of Congo, Ghana, Indonesia, Lao PDR, Mexico, Peru.

Fund	Thematic Area	Financing mechanism	Total Amount	Eligibility
UNDP/MDG Carbon Facility	Mitigation, Agriculture, Energy Efficiency, Fuel Switching, Fugitive Methane, Infrastructures, Renewable Energy, Transport, Waste Management	Carbon Finance	Project-specific	No specific exclusions. Initial eligibility screening early in project cycle.
International Climate Initiative (Germany)	Adaptation, Mitigation, Agriculture, Disaster Risk Reduction, Energy Efficiency, Forestry, Populations & Human Settlements, Renewable Energy, Sustainable Land Management, Transport, Water	Grant , Loan , ODA	€120 million per year [€371 million to date]	Any project proponent must prove at least three years of international project development experience; Total project duration of less than five years;
Forest Carbon Partnership Facility (FCPF)	Mitigation, Forestry	Carbon Finance , Grant	About USD 160 million so far (USD 110 million under the Readiness Mechanism and USD 51 million under the Carbon Finance Mechanism).	Country members of the International Development Association (IDA) or International Bank for Reconstruction and Development (IBRD, the World Bank), located between the 35th parallel of latitude north and 35th parallel of latitude south.

Fund	Thematic Area	Financing mechanism	Total Amount	Eligibility
Special Climate Change Fund (SCCF)	Adaptation , Capacity Building, Agriculture, Climate-Resilient, Coastal Zone Management, Disaster Risk Reduction, Infrastructures, Natural Resource Management, Populations & Human Settlements, Sustainable Land Management, Water	Grant	USD 110 million	Non-Annex I countries with focus on Africa, Asia and small island states
UNDP/Spain MDG Achievement Fund	Adaptation, Capacity Building, Mitigation, Technology, Agriculture, Coastal Zone Management, Forestry, Populations & Human Settlements, Renewable Energy, Sustainable Land Management, Water	Grant , ODA	90 million USD in climate change thematic window	Select countries and members of the UN Development Group

Fund	Thematic Area	Financing mechanism	Total Amount	Eligibility
Least Developed Countries Fund (LDCF)	Adaptation, Capacity Building, Mitigation, Agriculture, Climate-Resilient, Coastal Zone Management, Disaster Risk Reduction, Fisheries, Forestry, Populations & Human Settlements , Sustainable Land Management, Water	Grant , ODA , Technical assistance	USD 169 million	48 LDCs that have completed a NAPA; project must address NAPA priority area
The Hatoyama Initiative (Japan)	Adaptation, Mitigation, Agriculture, Disaster Risk Reduction, Energy Efficiency, Renewable Energy	Grant , Loan , ODA , Technical assistance	There is no minimum or maximum amount of assistance.	Developing countries in consultation with Government of Japan (some private sector actors may also be considered).

Fund	Thematic Area	Financing mechanism	Total Amount	Eligibility
MDB Scaling-Up Renewable Energy Program for Low-Income Countries (SREP)	Mitigation, Energy , Forestry , Natural Resource Management, Renewable Energy , Sustainable Land Management	Co-financing , Equity , Grant , Loan	USD 318 million	SREP supports a host of renewable energy projects implemented to achieve transformation change within developing countries. Sectors eligible include wind and solar projects, small hydro and biomass, and geothermal. The program will also consider cooking and heating projects like sustainable forests, biogas, and other renewable-based fuels. To be eligible, low-income countries must be qualified for MDB concessional financing (IDA or its equivalent). Other factors include institutional capacity to undertake a large scale SREP-funded program and the in-country renewable energy resource potential. SREP pilot countries: : Ethiopia, Kenya, Mali

Fund	Thematic Area	Financing mechanism	Total Amount	Eligibility
UNFCCC Adaptation Fund	Adaptation, Agriculture , Climate-Resilient, Coastal Zone Management, Disaster Risk Reduction, Energy Efficiency, Fisheries , Forestry , Industry , Infrastructures, Low-Carbon , Natural Resource Management, Populations & Human Settlements, Renewable Energy , Services , Sustainable Land Management , Transport , Waste Management, Water, Water efficiency	Grant	USD 300-500 million by end-2012	Developing country Parties to the Kyoto Protocol that are particularly vulnerable to the adverse effects of climate change. A cap in resource allocation per eligible host country, project and programme will be agreed by the Board based on a periodic assessment of the overall status of resources in the Adaptation Fund and with a view to ensuring equitable distribution.
International Development Association (IDA)	Adaptation , Capacity Building, Mitigation, Agriculture, Climate-Resilient, Fisheries, Forestry Industry, Infrastructures, Natural Resource Management, Populations & Human Settlements, Sustainable Land Management, Urban , Water	Grant , Loan , Technical assistance	In replenishment process for FY 2012-FY2014	Eligibility for IDA support depends first and foremost on a country's income level, as measured by GNI per capita (the threshold for FY 2010: US$1,135)

Fund	Thematic Area	Financing mechanism	Total Amount	Eligibility
UNDP Green Commodities Facility	Mitigation, Agriculture, Fisheries, Forestry, Industry, Infrastructures, Natural Resource Management	Technical assistance	Project-specific	The GCF currently focuses on bulk traded goods of cocoa, coffee, cotton, and tuna, but will expand into a wider array of agricultural, forestry and fisheries products including rice, soy, palm oil, lobster, shrimp, beef, and timber.
AfDB Congo Basin Forest Fund	Mitigation, Forestry, Natural Resource Management, Populations & Human Settlements, Sustainable Land Management Eligibility	Grant	GBP 100 million	Innovative projects that address deforestation issues in COMIFAC member countries.
ClimDev-Africa Special Fund (CDSF)	Adaptation, Capacity Building, Mitigation, Agriculture, Climate-Resilient, Energy, Forestry, Low-Carbon, Natural Resource Management, Populations & Human Settlements, Sustainable Land Management, Water	Co-financing , Grant , Other	USD 136 million	See “Project Types” section for more information.

Fund	Thematic Area	Financing mechanism	Total Amount	Eligibility
NEFCO Carbon Finance and Funds	Adaptation , Mitigation, Energy , Energy Efficiency , Fuel Switching, Fugitive Methane, Industry , Renewable Energy , Waste Management	Carbon Finance , Grant , Technical assistance	EUR 135 million	Projects should be in line with the requirements of the Kyoto Protocol, in particular the fulfillment of the requirements of the JI Supervisory Committee and CDM Executive Board of the UNFCCC Secretariat, and the second trading period of the EU ETS (and subsequent periods).

For additional information;http://www.climatefinanceoptions.org/cfo/FundingSourceBySource

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