



Seventh African Development Forum

*Acting on Climate Change for Sustainable
Development in Africa*

Climate Change and Sustainable Development in Africa: An Overview

ADF VII • 10 - 15 October 2010 • United Nations Conference Centre • Addis Ababa, Ethiopia



African Union



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I. Table of Contents

Abbreviations and Acronyms	v
Climate Change and Sustainable Development in Africa: An Overview	1
I. Introduction	1
II. Overview: Why climate change is important for Africa	2
III. Extent of the threat from climate change to Africa	7
IV. Understanding the full significance of climate change	10
V. Responding to climate threats in Africa: Opportunities and challenges - in relation to a green economy	13
VI. Implications for International Engagement	26
VII. Knowledge management: Policy, planning and practice	27
VIII. Conclusions	29
IX. Recommendations for Action	30
Glossary of Terms	32
References and Further Reading	35

Abbreviations and Acronyms

ACMAD	African Centre of Meteorological Application for Development
ACPC	Africa Climate Policy Centre
AfDB	Africa Development Bank
APF	Africa Partnership Forum
APRM	Africa Peer Review Mechanism
ATPC	Africa Trade Policy Centre
AR 4	IPCC Fourth Assessment Report, 2007
AUC	African Union Commission
CAADP	Comprehensive Africa Agriculture Development Programme
CBD	UN Convention for Bio-Diversity Conservation
CDM	Clean Development Mechanism
CER	Certified Emission Reduction
CoP	Conference of the Parties
CO ₂	Carbon Dioxide
CRM	Climate Risk Management
CSO	Civil Society Organization (=NGO)
DRR	Disaster Risk Reduction and Recovery
EU	European Union
FAO	Food and Agriculture Organization
GCOS	Global Climate Observing System
GDP	Gross Domestic Product
GEF	Global Environmental Facility
GFCS	Global Framework for Climate Services (WCC 3)
ICPAC	IGAD Climate Prediction and Applications Centre
ICSU	International Council for Science
IGAD	Inter-Governmental Authority on Development
IPCC	Intergovernmental Panel on Climate Change
IRI	International Research Institute for Climate and Society
ISDR	International Strategy for Disaster Reduction (UN)
LDC	Least Developed Country
MDG	Millennium Development Goal
NAMA	Nationally-Appropriate Mitigation Actions in Developing Countries
NAPA	National Adaptation Programme of Action
NGO/NGDO	Non-Governmental (Development) Organization
NOAA	National Oceanic and Atmospheric Administration
NMHS	National Meteorological and Hydrological Service
PRSP	Poverty Reduction Strategy Paper
REC	Regional Economic Community
REDD	Reducing Emissions from Deforestation and Degradation
SADC	Southern African Development Community
SIDS	Small Island Development States
SLWM	Sustainable Land & Water Management
SLR	Sea Level Rise
UN (GA)	United Nations (General Assembly)
UNCTAD	United Nations Conference on Trade and Development
UNDP	United Nations Development Programme

UNECA	United Nations Economic Commission for Africa
UNFCCC	United Nations Framework Convention on Climate Change
UNHDR	United Nations Human Development Report
UN Energy	UN interagency Mechanism on Energy
UNEP	United Nations Environment Programme
WB	World Bank
WCC	World Climate Conference
WHO	World Health Organization
WMO	World Meteorological Organization
WTO	World Trade Organization

Climate Change and Sustainable Development in Africa: An Overview

The purpose of this document is to provide context for a range of discussions at ADF VII, in order to drive forward response actions to climate change in Africa. It provides a basic overview of issues, opportunities and constraints related to sustaining development in a changing climate. There are also a number of Issue Papers to highlight essential matters for consideration in focus sessions at the Forum. These are elaborated further in the selected references.

This document is not a detailed examination of the diverse aspects of climate change science. There are many such documents. Rather it seeks to provide the reader with the big picture. In order to address the matter of sustainable development in Africa through a changing climate it is important first to appreciate the true scale of the challenge and then respond accordingly. Anything less risks being irrelevant.

I. Introduction

1. **The task:** The fundamental task of the forum is to examine the climate change challenge and determine what actions are required today to ensure that Africa's future development process is *climate resilient*. To achieve this, it is essential to consider the *whole problem in a long-term perspective and inclusive global context*. Only then is it possible to identify the best ways forwards and opportunities for leverage.

2. **Current global development pathways:** Although global warming (the cause of climate change) is only part of a larger set of important environmental degradation problems, it is a very significant indicator. There is compelling evidence that the impacts 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*. Global warming is a clear and stark manifestation of this non-sustainability. Humanity cannot survive climate change without addressing the fundamental causes of environmental degradation, which are integral to current development pathways. Continuing with development-business-as-usual is a dead end: it will become increasingly disastrous for Africa and the world as climates become more and more hostile, ecosystems become unstable, and environmental services break down, one after the other.

3. **All change:** 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. Combating climate change is

a huge challenge, but it could be the catalyst for transformation to a much better world for everyone, given good global governance.

4. The Sections have been explained below in the following manner:

- Section II explains briefly why climate change is important;
- Section III assesses the expected impacts and threats to development in Africa;
- Section IV elaborates more on the full significance of climate change;
- Section V looks at some of the many important responses needed in relation to a green economy;
- Section VI looks at the implications for international engagement;
- Needs for knowledge are outlined in Section VII;
- Conclusions in Section VIII; and
- Recommendations for action in Section IX.

II. Overview: Why climate change is important for Africa

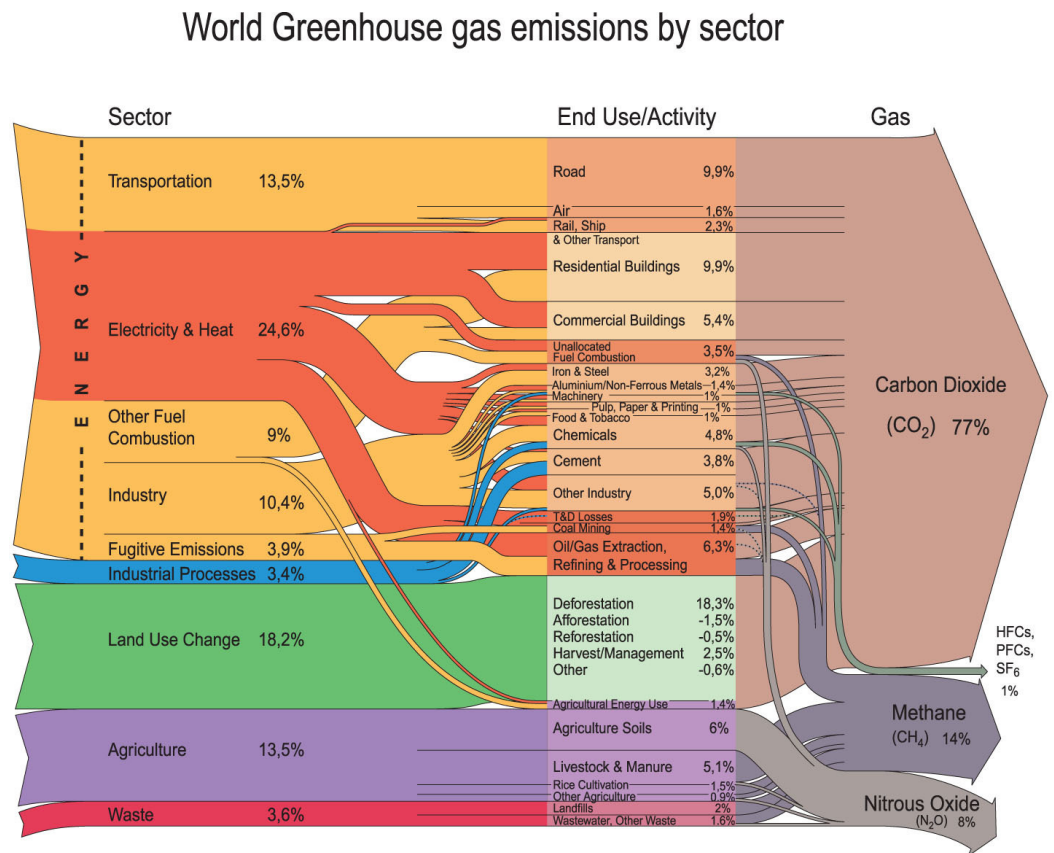
5. **Global warming:** There is unequivocal evidence that the world is getting warmer¹. Much of this “global warming” is caused by human activities that release “greenhouse gases” into the atmosphere. The two main sources of these emissions are burning fossil fuels (oil, coal and natural gas) and agricultural and other land use changes especially deforestation, as elaborated in table 1 below.

Sector*	All GHG Emissions	CO ₂ only
Electricity and heat	25	32
Agriculture, Land Use Change and Forestry	34	24
Transport	13	17
Manufacturing and Construction	10	13
Other fuel combustion	9	10
Industrial processes	3	3
Waste	3	-
Lost emissions	3	1
Total	100%	100%

* Note these percentages are indicative, depending critically on the precise definition of sectors

1 UNFCCC, NOAA, Hadley Centre,

Figure 1: Greenhouse gas emissions from different sectors (*Global percentages*).



All data is for 2000. All calculations are based on CO₂ equivalents, using 100-year global warming potentials from the IPCC (1996), based on a total global estimate of 41 755 MtCO₂ equivalent. Land use change includes both emissions and absorptions. Dotted lines represent flows of less than 0.1% percent of total GHG emissions.

Source: World Resources Institute, Climate Analysis Indicator Tool (CAIT), Navigating the Numbers: Greenhouse Gas Data and International Climate Policy, December 2005; Intergovernmental Panel on Climate Change, 1996 (data for 2000).

6. Over the last 60 years, the rate of emissions has accelerated enormously, driven by rapid global economic development, with little regard for the environment. As a result, global warming to date is 0.8° Celsius. While an overall rise of 2° Celsius is considered “probably manageable”, a rise of 4° Celsius is considered highly risky for the future of the planet as natural processes² will amplify man-made warming and any “control” could be lost. On present trends, we will pass the 2° Celsius emission threshold around 2025³ so the window of opportunity for meeting the Copenhagen accord is already closing.

7. **Mitigation:** To keep average temperature rise within the “manageable” limit, we must reduce global emissions rapidly and make serious progress during this decade. This requires phasing out the use of fossil fuels and changing many of our current land use, agricultural, waste, consumption and construction practices. Globally, this is a huge challenge because global GDP is currently on course to triple (\$45 trillion to about \$130

² For example, as currently frozen tundra melts in a warmer world, it releases much methane.

³ It takes 25 years or more for emissions to express themselves fully in warming: we are already committed to about a 1.5 °C rise although only 0.8 °C is already observed.

trillion) by 2050. Emissions are likely to follow suit (i.e. triple, as developing economies including Africa, grow) unless a major technological breakthrough appears or incentives are changed that result in radically less energy and/or carbon-intensive growth patterns. For Africa, this is not such a big problem because per capita energy consumption is still very low, and so there is considerable potential to leap-frog towards a clean energy pathway through existing and emerging financing mechanisms. Payments by developed countries to mitigate and temporarily “offset” their emissions could be a substantial opportunity for financing clean development in Africa.

8. **Climate change:** Global warming is causing local and regional climates to change in many ways, thereby modifying climate risks. These changes will have many different impacts on human habitat and livelihood conditions, and increasingly so as the climate gets hotter and becomes more unstable. The larger and faster the changes, the more likely it is that adverse effects will dominate. The main changes include:

- a) Increase in local mean temperature and extremes – both land and water;
- b) Change in rainfall - its onset, seasonal distribution and extremes;
- c) Increase in frequency and intensity of large storms and tropical cyclones;
- d) Increase in evaporation losses from plants and water surfaces; and
- e) Increased melting of glaciers and other ice bodies.

Associated effects include:

- i) Sea level rise and ocean acidification;
- ii) More severe droughts and floods;
- iii) More damage from high wind in storms;
- iv) Disrupted crop calendars, with different pests, diseases and water requirements;
- v) Heat waves and spread of disease to new areas (e.g. malaria); and
- vi) Increased water demand and reduced water availability.

9. **The main impacts** 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. These include⁴:

- a) **Increases in drought, flood, windstorms** and other extreme climate phenomena, which will increase the number and intensity of disasters, reduce freshwater availability, threaten food security and human health, diminish industrial production and weaken the physical infrastructure base for socio-economic activity, resulting in reduced development;
- b) **Changes in rainfall with decrease in river basin run-off** and less water available for agriculture and hydropower generation due to changes in rainfall and river sensitivity to climate variation. Models suggest a likely increase in rainfall in eastern Africa, with reductions in northern and southeastern Africa. Agro-climatic zones will shift, and farmers will have to address increased variability in many factors critical to crop production; and
- c) **Sea level rise** leading to coastal erosion and flooding, particularly in western, eastern and northern Africa, and bleaching of coral reefs along the Red Sea and Indian Ocean coastal zone. With more than one-quarter of the popula-

4 After the Africa Partnership Forum (APF) 2008, IPCC 2007, GEO5 2010, MDG Summit 2010 and many other similar documents

tion living within 100 kilometres of the coast and most cities concentrated there, the vulnerability to marine-induced disaster from tidal waves and storm surges will increase.

10. The net effect will be to exacerbate socio-economic vulnerabilities, undermining people's abilities to cope with life in a more hostile climate

Known and uncertain aspects of global warming to consider

1. **Permanent change:** Simply put, changes will be permanent. We will have to live forever with raised temperatures (2°C, 4°C...), raised sea levels (1m, 10m...) and changed rainfall patterns. Even with low-carbon development, the planet will take a long time to re-adjust back to previous norms - if ever.
2. **Controlled warming:** Today, we probably still have some potential control over amounts of future warming. But we must reduce global emissions immediately and radically. Then the level of permanent temperature rise *may* be manageable.
3. **Uncontrolled warming:** There are several potential amplifiers of planetary warming. If critical points are reached, we will lose the little influence we currently have. Environmental mechanisms will speed up the warming, possibly making planet Earth too hot to support life.
4. **Lack of knowledge:** We do not fully understand planetary processes. We just do not know how much warming is manageable; how quickly climates will change; how much this will impact our lives. But if we do not respond fast enough, we risk finding out the hard way.
5. **Quantifying risk:** The risk of hitting critical points rises very rapidly with global temperature change. While an overall rise of 2° Celsius *may* be safe, a rise of 4° Celsius is probably unsafe. But what is an "acceptable" level of risk when the future of mankind is at stake?
6. **Trends in current emissions:** Globally, greenhouse gas emissions are rising faster today than the worst case scenario described by the Intergovernmental Panel on Climate Change (IPCC) in their 4th Assessment Report. Emissions from fossil fuel grew around 1 per cent a year in the 1990s, to more than 3 per cent in 2007.
7. **Present trajectory:** We have already experienced a 0.8° Celsius rise. With current emissions, we are heading for a commitment of at least 3° Celsius and possibly 4° Celsius temperature rise, this century. A ceiling of 2° Celsius cannot be achieved with a global economy based on fossil fuels.
8. **Time-lag:** At present rates of increasing emissions, we will be committed to over 2°C warming around 2025, though this may not be evident in temperature records until nearer 2050. With immediate and drastic emission reductions, we can postpone these dates; but inaction over the last 10 years has severely reduced the window of opportunity.
9. **Adaptation:** The planet takes decades before emissions fully express themselves in changed climates. This inertia risks giving the false impression that actions to accommodate a changing climate can wait, until it is too late.
10. **Precautionary principles:** We need to embark on a global "damage limitation" process using the best available knowledge to manage the risks. We must remain within limits deemed manageable. Are the alternatives even worth considering: life on a dying planet?

11. **Adaptation:** While Africa has contributed relatively little to the causes of human-induced climate change, it is among the first and worst to be impacted. For example, it is believed that in Africa many already dry areas will get drier and high rainfall areas will become even wetter. So for Africa, adaptation is a much more important and immediate concern than mitigation. Almost everyone in Africa will be affected by climate change, one way or another. As such, there is widespread need to adapt current practices to "life

in an increasingly hostile climate". For Africa's development process to be sustainable, it must be made more resilient to climate change. Further, Africa must be proactive in preparing for change. This will cost. But it will cost even more if we delay and only react to changes when forced to do so - like the flood situation in Pakistan earlier this year.

12. **Living with Uncertainty:** What we know about climate change is alarming. What we don't know is even more worrying. However, an essential feature of managing climate effects is the need to deal with uncertainty. Standard techniques exist for managing risks. Effective risk management requires understanding and utilizing research outcomes and policy variables, which may be expressed in probability terms. Climate risk management (CRM) is a recently developed approach for managing existing climate variability, and offers an entry point for also addressing a changing climate. CRM is already practiced a little in Africa (see Issues Paper No. 4) but needs extending to all sectors, scaling up for all countries, and adapting for other aspects of development in a changing climate.

Uncertain sea level rise in a warming world

The prospect of sea level rise demands careful consideration. Fluctuations of the sea level are normal in the history of the planet. Since the last ice age 20,000 years ago, sea levels have risen by more than 100 metres; but have been stable for the last 7,000 years up until about the year 1900. Now they are rising again, and unless current rates of global warming are mitigated, many major cities of the world will drown during the years ahead*. This, by any definition, is unsustainable global development.

How much? How soon?

Based on current understanding, sea level rise will be less than a metre during this century. Some analysis suggests much larger rises are possible - maybe one to three metres if emissions are not controlled and temperature rises are extreme. If the "less than 2°C target" is actually achieved, then final sea level might be constrained at about 3 metres. However, nobody is sure because mankind has never heated the planet this way before.

Impact in Africa

An assessment of the consequences of sea level rise concluded that many millions of people are likely to be displaced in this century. While most countries will be affected to some extent, outcomes will be extremely unfair. Severe impacts will be limited to a relatively small number of countries like Egypt and low lying islands. In other countries, like the Gambia, life will become increasingly difficult.

Potential rise in sea level

During recent years (1993–2003), average sea level rise has been about 3 mm a year. This has been caused partly by expansion of water as oceans get warmer and partly by melting of land ice, in roughly equal measures. Potentially, melting of all glaciers has a sea-level rise equivalent of about half a metre. The complete Greenland ice shelf is equivalent to over six metres and the whole Antarctic ice shelf another 70 metres rise. Any significant meltdown however, would probably take several centuries.

* See *START Cities at risk* <http://start.org/programs/cities-at-risk> for example

13. **Climate scepticism:** For climate and earth-system scientists, the evidence is overwhelming that: (a) the world is warming; (b) the cause is excess emissions from the many activities of mankind; and (c) local climates are already changing as a consequence. Some people, however, strongly deny this interpretation of the facts, seeing it all as “natural” climate variability. The arguments of these “climate sceptics” have been disproven⁵ many times - their interests are not scientific but economic. They seek to delay global response to the problem, working on behalf of organizations that stand to lose the most in the short term. Climate sceptics serve a useful purpose however, by ensuring that scientific communication of the problem is made more effective, and that governments thereby improve collective remedial strategies. This is essential for engaging people and communities everywhere in the process of addressing the problem.

14. **Geo-engineering:** Of more concern perhaps, are suggestions to “fix” the global warming problem through technological means⁶. Methods either propose removal of greenhouse gases from the atmosphere to reduce the warming effect, or reflection of part of the incoming sunlight back into outer space to cool the planet slightly. Africa should be extremely wary of such proposals, and seek agreement through the United Nations Framework Convention on Climate Change (UNFCCC) to ensure that no deliberate large-scale manipulation of the planetary environment to counteract anthropogenic climate change will be attempted without exceedingly careful prior consideration and global agreement.

15. It is the cumulative series of relatively “benign” technological solutions that have taken place since the industrial revolution that has caused the global warming problem today. These include very many activities such as coal mining for power and electricity generation, oil drilling to power motor vehicles, chainsaws used to deforest the planet, intensive meat and dairy industry, construction with cement, and so on. One would have to have unlimited faith in technology to assume that there would be no adverse side-effects from a technique for “fixing” the planetary heat cycle.

16. The temptation of geo-engineering is that it appears much less expensive (initially) than retooling the world for a low-carbon economy. It is also intended as a way to maintain current lifestyles with unsustainable consumption patterns in the developed world, and gets in the way of a genuinely radical shift to low-carbon living in line with ecological limits.

III. Extent of the threat from climate change to Africa

17. *Climate change on top of existing climate variability is a big killer in Africa*⁷.

18. 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

5 See <http://www.skepticalscience.com/argument.php>

6 See <http://royalsociety.org/geoengineering-the-climate/> for discussion and an assessment

7 AU-NEPAD 2003 Environmental Action Plan, ch. 5 climate change paragraph 104.

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.

Climate Change in Africa

Climate records show warming of approximately 0.7°C over most of the continent during the 20th Century, a decrease in rainfall over large portions of the Sahel, and an increase in rainfall in East and Central Africa. Climate change scenarios for Africa, based on results from several general circulation models using data collated by the Inter-governmental Panel On Climate Change (IPCC), indicate future warming across Africa ranging from 0.2°C per decade (low scenario) to more than 0.5°C per decade (high scenario). With a more rapid warming scenario, large areas of Africa would experience rainfall that significantly exceeds natural variability in the December to February and June to August periods, with resultant adverse impacts on many sectors of the economy including agriculture, infrastructure, and health, with consequent effects on economic growth and poverty reduction.

19. **Vulnerability:** The concept of vulnerability is important for understanding climate change in the context of social and human development. First, global warming and climate change are expected to increase human vulnerability as a result of both extreme weather events and long-term environmental degradation. Secondly, vulnerability draws on the multiple dimensions of social and human deprivation such as social exclusion, gender, migration, employment, health and education, as well as the coping strategies and resilience of those affected. Thus, the climatic, social and human dimensions of vulnerability bring together adaptation, mitigation, coping mechanisms, with social cohesion and integration, for synergizing policies and actions on climate with social and human development.

20. **Expected impacts:** The kinds of climate changes happening and expected are likely to have a wide range of economic, environmental, social and human developmental impacts right across the continent. They include:

- a) **Reduced agricultural production:** Increased temperatures and evaporation, coupled with decreased water availability will reduce agricultural production. More than 60 per cent of people in Africa depend on farming for their livelihood, and 50 per cent of all exports are agricultural products. Furthermore, one-third of income in Africa is generated by agriculture, with crop production and livestock husbandry accounting for half or more of household income. The poorest members of society are those most dependent on agriculture for their livelihoods. As most agricultural production on the continent is rain-fed, it is highly vulnerable to changes in climate variability, seasonal shifts, and precipitation patterns;
- b) **Reduced fresh water availability⁸:** The drier the climate, the more sensitive is the local hydrology to change. Relatively small changes in temperature and precipitation are already causing major changes in runoff in West Africa.

Arid and semi-arid regions are particularly sensitive to reduced rainfall and increased evaporation and plant transpiration.

Extreme events like downpours are expected to become more intense. This will increase floods and runoff while reducing the ability of water to infiltrate the soil.

Changes in seasonal rainfall patterns will affect the regional distribution of both ground and surface water supplies. Reservoirs and wells will be affected. Changes at the surface will alter groundwater recharge and aquifers. Water quality may also respond to changes in the amount and timing of precipitation.

New patterns of runoff and evaporation will also affect natural ecosystems. Freshwater ecosystems will respond to altered flood regimes and water levels. Changes in water temperatures could affect the growth of disease organisms, and the diversity and productivity of ecosystems. Changes in runoff, groundwater flows, and precipitation will affect water qualities.

Rising sea levels could invade coastal freshwater supplies. Coastal aquifers may be damaged by saline intrusion as salty groundwater rises. The movement of the salt-front up estuaries would affect freshwater pumping plants upriver.

Reduced water supplies will place additional stress on people, agriculture and the environment. The most vulnerable regions are arid and semi-arid areas, some low-lying coasts, deltas, and small islands;

- c) **Loss of biodiversity.** Biodiversity is the basis of Africa's wealth. It provides consumptive resources as food, fibre, fuel, shelter, medicine, and wildlife trade; and non-consumptive functions such as stabilizing the environment and other ecosystem services. Losses in biodiversity are associated with erosion, floods, sea level rise, and the spread of invasive alien species. For example, the coral reefs in the Indian Ocean experienced massive bleaching in 1998, with over 50 per cent mortality in some regions;
- d) **Increased food insecurity:** Climate change affects food security in several ways: not only will it affect agricultural production and supply, it will also impact the demand side by exacerbating socio-economic risks and vulnerabilities: With local production declining, income opportunities and purchasing power will decrease. At the same time, decrease in production and increased global demand will lead to price increases for the most important crops, including rice, wheat, and maize— of 25 to 150 per cent by 2060 (WFP et al., 2009). Climate change will significantly increase the risk of hunger and malnutrition: Calorie availability in 2050 is likely to have declined relative to 2000 levels throughout the developing world;
- e) **Increased health problems:** Heat waves that will have serious health consequences for people who work outdoors. Changes in rainfall will also influence disease vectors for malaria and increase susceptibility to water-borne diseases such as cholera. Small changes in temperature and precipitation can boost the population of malaria-carrying mosquito. Increased flooding will also enhance breeding grounds for the malaria carriers in formerly arid areas. These problems will be exacerbated by the inability of many communities to

cope with increased prevalence of the disease, thus increasing health care costs; and

- f) **Increased migration:** Climate change impacts such as flooding, drought and desertification are displacing large populations and forcing people to leave their homes and lands in search of better livelihoods or to evade disasters. Pastoral communities have used mobility to take advantage of annual and seasonal rainfall variations. But the prolonged drying trend in the Sahel since the 1970s has demonstrated the vulnerability of such groups to Climate Change. They cannot simply move their axis of migration when wetter zones are already densely occupied and permanent water points fail at the drier end. The problem of droughts appears to be most severe in sub-Saharan Africa, particularly in the Sahel, the Horn of Africa and the Southern Africa Development Community (SADC) area. The result has been widespread loss of human life and livestock, and substantial changes to social systems. It is estimated that about 60 million people will eventually move from the desertified areas of sub-Saharan Africa towards northern Africa and Europe by the year 2020⁹.

21. **All together now:** 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. The nature and extent of some of these impacts are explored further in the Issues Papers.

IV. Understanding the full significance of climate change

22. **Need for transformation:** *Climate change is the defining human development challenge of the 21st Century*¹⁰. If global development continues with business-as-usual, the planet will probably become uninhabitable within the next few generations. If we continue to pollute our atmosphere as we are doing today, the future of the planet will be a hot one, with dramatic local climate changes, increasingly violent weather and sea level rise measured in tens of metres. The planet is heating up already, and to stop it going much further the world must radically change its ways – and soon: hence UNFCCC.

23. **As the African Union and the New Partnership for Africa's Development (AU-NEPAD)**¹¹ put it: *"Climate change now provides a unique opportunity for the international community to question the modes of development currently in practice and to choose a new mode of development for the future. The key development sectors of the economy are at risk, with grave consequences for life on earth if climate change is not addressed. Hence, action must start now and involve all actors"*.

9 UNCCD, 2006

10 UNHDR 2007/8

11 NEPAD 2008, APF.

24. **The United Nations World Economic and Social Survey**¹²: *“The food, energy, financial and climate crises that unfolded simultaneously at the end of the first decade of the twenty-first century have exposed major weaknesses in existing mechanisms designed to manage the process of global development.... Sustained and widespread future prosperity will require major reforms in global economic governance and new thinking about global economic development”.*

25. *“A central concern of the new thinking will be the need for a focus concentrated on sustainable development — entailing an approach that would balance material wealth improvements with protection of the natural environment and ensure social equity and justice — rather than one narrowly centred on economic growth and private wealth generation based on market incentives. Global solutions will be required for global problems and, given the interdependence of these problems, policy responses will need to be highly coherent at various levels if the international community is to achieve the multiple objectives associated with fair and sustainable global development”.*

26. **What is holding back response to the problem?** According to the United Nations Human Development Report (UNHDR): *“The world lacks neither the financial resources nor the technological capabilities to act. What is missing is a sense of urgency, human solidarity and collective interest within a Global Governance. Climate change poses challenges at many levels. In a divided but ecologically interdependent world, it challenges all people to reflect upon how we manage the environment of the one thing that we share in common: planet Earth. It challenges us to reflect on social justice and human rights across countries and generations. It challenges political leaders and people in rich nations to acknowledge their historic responsibility for the problem, and to initiate deep and early cuts in greenhouse gas emissions. Above all, it challenges the entire human community to undertake prompt and strong collective action based on shared values and a shared vision, and the Green Economy Agenda could be the one”.*

27. **What is meant by a green economy**¹³ → *A Green economy is typically understood as an economic system that is compatible with the natural environment, is environmentally friendly, ecological, and for many groups is also socially just. These attributes are the conditions that must be ‘imposed’ on an economy from the perspective of many green economy advocates. This conventional concept of a green economy may be alternatively described as “the greening of an economy”. Some fundamental criteria for meeting these conditions have been established since the Rio Summit in 1992. These include using renewable resources within their regenerative capacity, making up for the loss of non-renewable resources by creating renewable substitutes, limiting pollution within the sink functions of nature, and maintaining ecosystem stability and resilience. Conditions for social justice may include: (a) not compromising future generations’ capability to meet their needs; (b) the rights of poor countries and poor people to development and the obligations of rich countries and rich people to changing their excessive consumption levels; (c) equal treatment of women in access to resources and opportunities; and (d) ensuring decent labour conditions. Additionally, issues of good governance and democracy are seen as critical for ensuring social justice and equity. Less understood but perhaps of much greater interest is a green economy as an “economic system that is dominated by investing in, producing, trading, distributing, and consuming not only*

12 UNWESS 2010

13 Text on this page derived from UNEP 2009 Global Green New Deal and Preview 2010

environmentally-friendly but also environmentally-enhancing products and services". In this sense, many green conditions such as those listed above should no longer be seen as constraints on an economy, but rather, as forces that generate new economic opportunities. This is about expanding and reshaping, not reducing, the space for economic development and poverty reduction.

28. **Green Economy Initiative:** This is a global initiative launched by the United Nations Environment Programme in 2008 to seize the opportunities that the concept of a green economy has to offer. It seeks to accomplish two tasks. First, it tries to make a "beyond-anecdotal" macroeconomic case for investing in sectors that produce environmentally-friendly or environmentally-enhancing products and services ("green investment"). Second, the initiative tries to provide guidance on how to boost pro-poor green investment. The goal is to encourage and enable policymakers to support increased green investment from both the public and private sectors.

29. **A low-carbon economy:** This is a concept acquiring increased attention amidst rising public awareness of climate change and the urgent need for transformational change of the economy. A low-carbon economy is one that emits a minimal amount of carbon dioxide and other greenhouse gases, although what constitutes the minimum has yet to be agreed upon. What is important, however, is that economies are reducing their carbon intensity over time, in both unitary (CO₂ per unit of GDP) and absolute terms. A low-carbon economy can be seen as one of the outcomes from implementing a green economy. Investing in renewable energy and energy efficiency is expected to produce gains such as generate new sources of income and jobs and reduce carbon emissions. A **low-carbon development pathway** is development with minimized emission of greenhouse gases, such as using renewable energy rather than coal, oil and gas.

Carbon footprint from different sources of electric power

Estimates* of CO₂ emissions produced by different kinds of electric power plants.

Power Source	Nuclear	Wind	Hydro	Biofuel	Geo-thermal	Solar Voltaic	Gas	Oil	Coal
CO ₂	5	5	5	15	100	100	500	900	1000

Units are grams of CO₂ for each kilowatt hour of electricity produced throughout the entire lifecycle of the power plant, including manufacture and construction.

** Indicative values compiled from several sources including UK DTI and US Department of Energy*

30. **The green economy strengthens sustainable development:** The green economy with low-carbon development pathway is firmly founded on the Rio concept of sustainable development but takes it further to deal with the problem of global warming and challenges of climate change. That the whole planet is now warming as a result of the activities of mankind is clear evidence that current global development is fundamentally-unsustainable. Fine-tuning of current practices is totally inadequate. There is need to transform the global economy in fundamental ways, ensuring that all actions must be genuinely sustainable at local to planetary levels. Transformational change to a global green economy with a low-carbon development pathway is essential to avoid compromising future generations, human civilization and even life on earth.

31. **And Africa?** Africa is on the verge of an economic and developmental take-off. However, pursuing the classic free market model of fully-exploiting resources *“as if there is no tomorrow”* has environmental consequences. Is Africa going to contribute its own pollution load to a planet already under severe ecological stress or does it have an alternative pathway for economic growth? Can Africa develop a green economy and follow a low-carbon development pathway which values ecosystems and the services that they provide? Is it possible to meet both the needs of a rapidly-growing population and people’s aspirations for higher living standards through developing a green economy? Does such a pathway exist within the current world order? The United Nations¹⁴ believes so: *“the shift to climate-friendly living and production is potentially-achievable without sacrificing growth in the developing world if tackled from a holistic viewpoint that links climate change to a new development paradigm”*.

32. **Green future.** On the assumption that the ever-increasing demands of climate change will force a global transformation (economic, social and environmental) within the very near future, and the enormous current value of goods and services provided by the natural world will be factored into national economies, then a green economy with low-carbon development pathway would appear to offer great potential for genuinely sustainable development in Africa.

33. Developing such a green economy will be challenging. Many practices will need to be changed with immediate effect. Where green values overturn existing practices, the transition will be particularly difficult. The demands of a changing climate and transformation of global systems will force the pace. However, Africa, with its small investment in fossil energy and abundant land resources suitable for locking up carbon, is in a unique position to benefit fully from the many opportunities available.

V. Responding to climate threats in Africa: Opportunities and challenges - in relation to a green economy

34. *The magnitude, variety and nature of threats to Africa from a more hostile climate are profound and extend right across the economy and into all walks of life. As a consequence, measures and actions required for transition to a climate-resilient green economy will be many, diverse, often costly and difficult to deliver equitably. However, such transformation in Africa could be hugely beneficial for the majority of people today, as well as for future generations.*

35. **Mitigation is an opportunity:** Significant opportunities for the future of Africa appear to reside in arrangements for global mitigation processes, the Clean Development Mechanism (CDM)¹⁵ in particular. This is designed to help reduce overall emissions through developing countries being paid by industrialized polluters to lock carbon away (for example, in reforestation) thus “offsetting” new emissions of greenhouse gases in the industrialized world. *The CDM allows emission-reduction (or emission-removal) projects in developing countries to earn certified emission reduction (CER) credits, each*

14 **Acting on Climate Change: the UN System Delivering as One, UN-GA 2009, MDG Summit 2010.**

15 See <http://cdm.unfccc.int/index.html>

equivalent to one tonne of carbon dioxide. These CERs can be traded and sold, and used by industrialized countries to meet a part of their emission reduction targets under the Kyoto Protocol. The value of these credits is expected to rise as pressure grows on industrialized countries to reduce emissions.

36. Africa has not had its full share of CDM projects to date. New arrangements are required to make the CDM more appropriate to Africa's circumstances. Africa's negotiating team on the United Nations Framework Convention on Climate Change (UNFCCC) must secure these changes and encourage innovative participation. The value of these "credits" should increase dramatically as the industrialized world struggles to honour its commitment made at Copenhagen to limit temperature rise to 2°C

37. **Adaptation is the challenge - and an opportunity to make development sustainable:** The main challenges involve enabling a large and vulnerable population to adapt to the many changes and develop a better life for themselves that is resilient to a more hostile climate. Wherever possible, adaptation to climate change should be planned and resourced. If planning is inadequate, adaptation will be reactive and less predictable, development will be set back, people will get hurt and assets lost.

38. Planning adaptation involves better management of climate risks in all sectors, by all stakeholders, with all available means. A new risk management culture is needed, which incorporates climate concerns within a long-term planning perspective, to increase personal and national resilience. National and local development policy and budget processes must be supported to anticipate the effects of climate change, and address risks as best as they can. At the local level, organizations should be supported in planning their own adaptation processes – for example with community-based natural resource management plans for improved environmental security in a changing climate.

39. **Green economy as integrator:** The green economy provides a rational way of integrating adaptation and mitigation processes into overall development policies and programmes. This would sustain long-term wealth creation and quality of life in Africa and support existing development frameworks (MDGs, PRSPs, NAPAs, NAMAs, Strategies for disaster reduction etc.) that constitute useful sub-mechanisms since they represent important multi-stakeholder and cross-sectoral interests. The transition from today's situation to a coherent green economy however, will not be straightforward and many different measures are necessary for taking the whole process forward successfully.

40. **The top 10 essential measures** for addressing climate change by greening the economy in Africa comprise:

- a) Visionary **leadership** within a **global partnership**;
- b) Effective **governance**, guiding the many complex processes affecting the lives of more than a billion people, and maintaining **peace and security** through radical change;
- c) Well informed policies for a **green economy** with low-carbon development pathway, in order to deliver sustainable growth and poverty reduction;
- d) Coherent strategy on **adaptation to climate change** that builds resilience through improved management of climate risks in lives and livelihoods, including **food security, disaster risk reduction and social protection**;
- e) Major **financial resources** well invested;

- f) Major renewal of **infrastructure**, in harmony with a changing environment;
- g) Incentives for green **trade and industry** with fully-engaged private sector and good access to low-carbon **technology**;
- h) Transformed use of land and water** - agriculture, forestry, ecosystems, biodiversity - with improved environmental and food security for poor communities;
- i) Change in **human values**, aspirations and development frameworks with all citizens informed and engaged – especially women and youth; and
- j) Strengthened **capacities** and a culture of **innovation** with quality **science** focused on sustainable development.

41. The purpose of ADF VII is to consider the above measures holistically, in the context of the whole problem, and for the benefit of the whole continent. The Forum needs to identify and recommend priorities and timescales for follow-up actions.

42. Some of the many issues that must be examined in each of the 10 essential measures are touched on below. These are examined in more detail in individual *Issues Papers* linked to sessions of the Forum (see table 2 below).

43. With all the inherent uncertainties of climate change, there are many more questions than answers, for, mankind has limited previous experience with good planetary management on which to build¹⁶. However, asking questions is an essential part of the process of coming to grips with the problem and identifying potential opportunities. In many cases, there are “soft” and “no-regret” actions, which pay off irrespective of the future holds. For example, Africa with a green economy and associated improved food and environmental security, better governance, improved land and water management, functional ecosystem services, better disaster preparedness, etc., will be a much better place to live in, with or without climate change.

¹⁶ Addressing the ozone hole by means of the Montreal Protocol is probably the best and only example.

Table 2: Summary of opportunities and challenges from climate change, as amplified in the associated Issue Papers

Issue Paper	Subject	Main Issues	Challenges	Opportunities	Green Economy
IP 1	Governance and Leadership response to Climate Change	Leadership and Governance will be tested to extremes by all the changes required for adaptation in a Green Economy	Maintaining peace, security and human rights through rapid change; delivering the MDGs in a more hostile climate; good economic & financial governance	Opportunity for genuine sustainable development with greater regional coherence and solidarity from working together for a better future	Sine qua non
IP 2	Climate Change, Agriculture and Food Security	a) increased climate variability b) Declining productivity in a warmer world	Maintaining production, minimizing emissions, feeding 2 billion people; Lack of water. Rural safety nets	CAADP, Sustainable land and water use, Carbon trading, Rural biofuel, Aquaculture, Livestock export; Index insurance	Transformation most beneficial if not essential
IP 3	Climate Change and Human Development	Increased vulnerability of poor and marginalized groups	Inclusion of all in CC debate and adaptation processes. Rural services and safety nets	Investment in rural livelihoods from carbon trading and adaptation funds. Employment for youth in infrastructural renewal	Transformation most beneficial
IP 4	Climate Risk Management: Monitoring, Assessment, Early warning and response	Managing uncertainty; CRM little practiced in Africa due to weak climate services	Developing capacity for managing climate risk and integration in policy planning and practice.	CRM can provide positive benefits in terms of stabilising markets (e.g. with index insurance), as well as disaster risk reduction	Vital tools
IP 5	Climate Change, Trade and Industrial Development	Mitigation of emissions from fuel, energy and processes Role and function of Industry in a Green Economy	Agricultural trade and post-harvest processing more variable Fuel price rises and vulnerable trade routes	Carbon trading emission reductions, Index insurance to stabilize agricultural processing industry	Opportunities in transformation: trade essential
IP 6	Governance for Peace and Security in a Changing Climate	Climate Change will stress existing pressure points Increased disaster risk; Competition for resources	Sustaining rural livelihoods to minimize migration Organising adaptation processes in fragile states and insecure areas	Enhanced solidarity with collective response to assist countries worst affected. Improved environmental security.	Transformation most beneficial
IP 7	Financing Climate Change Adaptation and Mitigation actions	Little finance committed so far. CDM not fair for Africa. New financing framework required.	A strong and fair UNFCCC agreement with sufficient adaptation funding. Investment priorities and governance	Adapt the CDM for sectoral mitigation; Foreign Direct Investment in mitigation and carbon credits; new funding mechanisms	Sine qua non

Issue Paper	Subject	Main Issues	Challenges	Opportunities	Green Economy
IP 8	Climate change and Infrastructure Development	Infrastructure deficit due to past underinvestment Much present infrastructure vulnerable to extreme weather	Adaptation for extreme events; sea level rise and coastal infrastructure; increasing power to meet demand; Concrete causes much emission:	Carbon trading funds to renew energy, transport, agricultural and forestry infrastructure; Information and Communication Technologies	Opportunities in transformation: Energy a key issue
IP 9	Climate Change and Ecosystem Sustainability	Current development practices totally -unsustainable: loss of ecosystem services: water and carbon the key linkages	Many interlinked problems that need to be addressed coherently: competition for water resources: changing behaviour of TNCs et al.	REDD and other carbon trading funds for ecosystem renewal with agriculture, environment, water and rural energy working synergistically.	Transformation essential
IP 10	Science, Technology Innovation and Capacity-Building for addressing Climate Change	Trained capacity lost, lack of investment, science remote from development practice, poor access to technology	Increase capacity to inform global negotiations, mitigation and adaptation policies; assist low-carbon pathway and improve environmental monitoring	Green technology transfer, science partnerships for development, innovation centres for adaptation and mitigation, reversing the brain drain	Fundamental elements
IP 11	Private Sector response to Climate Change	National action and international cooperation can support climate compatible development by creating an enabling environment for investment and using innovative financing instruments to leverage private sector financing.	Designing policies that effectively leverage private capital and know-how to deliver effective modalities and instruments to address climate change at the scale and pace needed. In this context, the role of Public Finance Mechanisms (PFMs) cannot be overemphasized.	Innovative financing instruments including direct project lending and lines of credit to local finance institutions as well as microfinance and other innovative products.	Fundamental elements

Issue Paper	Subject	Main Issues	Challenges	Opportunities	Green Economy
IP 12	Climate Change, Economic Growth, and Poverty Reduction in Africa	The threat to economic growth, which is central to development and poverty reduction, is among the most significant consequences of climate change. The effects of climate change are more severe for vulnerable and disempowered groups in the community, including women and children who have the potential of being strong actors in current and future development. Also, a hostile climate will make achieving development goals much more costly for African countries.	Cost of adaptation is projected at many billions of dollars a year, increasing pressure on African countries development budgets. Besides financing, institutional innovations will be essential if adaptation measures are to be effective.	Integrating climate risk management into development practice Adaptation must be approached as a cross-sectoral issue and should no longer be perceived as the sole responsibility of the ministry of environment.	Integrating element

Essential Measure (1): Visionary leadership within a global partnership.

44. The future of Africa will be very strongly influenced by the outcome of current global climate negotiations through UNFCCC.

- a) Does Africa need additional skills and support to obtain a strong and just global agreement in the UNFCCC negotiation process? The Africa Partnership Forum has been greatly beneficial but does it go far enough? Should the Joint Secretariat be strengthened to contribute a more coherent support role?
- b) Green Economy: Can future demands of a Green Economy be integrated into such an agreement to provide adequate opportunity for Africa's human, social and economic development?
- c) Global Partnership: Does Africa's transition to a Green Economy depend on simultaneous global transformation, or can Africa go it alone?

Essential Measure (2): Effective governance, to guide the many inter-related processes of profound change that will affect more than a billion people – while maintaining peace and security.

45. The many aspects of good governance are central to African economic development, realizing the MDGs, and coping successfully with climate change. Successful delivery of the fundamental changes will require visionary leadership with good and inclusive governance, and thriving public, private and civil institutions all working towards similar goals. It is crucial that all efforts geared towards management of climate change entrench processes that are inclusive and participatory of all stakeholders so that decisions reached are respected by all.

- a) Political Governance. How many governments have the foresight, ability and political will to transform existing development programmes into low-carbon development pathways within a Green Economy - so integrating adaptation, mitigation and development? How much new legislation will be needed together with more effective implementation of existing laws, in harmony with neighbouring states?
- b) Stability: More pressure on existing stress points will threaten security and stability. Does Africa need to strengthen the rule of law and enhance peace-keeping capacity? What special measures might be needed to facilitate adaptation in fragile states? Mass migration risks destabilizing cities and neighbouring states. Do regional support measures need strengthening for controlled migration?
- c) Accountability: Is the African Peer Review Mechanism sufficient to lever reluctant governments into the line for responding to Climate Change or does it need further strengthening?
- d) Rights: How best to ensure that the basic rights of vulnerable communities are not compromised further in the scramble to develop while adapting to a changing climate?

Essential measure (3): Well-informed policies for a ‘Green Economy’ with low-carbon development pathway for sustainable growth & poverty reduction while reducing emissions

46. Macroeconomic policies in Africa, particularly the fiscal policies related to taxes, should encourage cleaner economic activity. Tax policies should reward users of clean methods of production while penalizing those who use old, environmentally-degrading methods. This is acute in the mineral, manufacturing and energy sectors.

- a) Do African economists and planners have sufficient understanding of the main implications of redirecting Africa’s economy along a green, low-carbon path? Is the United Nations Environmental Programme (UNEP) route map sufficient to inform Africa’s UNFCCC negotiations?
- b) Can all countries in Africa be brought on board? How equitable would a green economy be for different countries? What about countries deeply engaged in the current high-carbon economy? Are the Regional Economic Communities (RECs) experienced enough in climate change issues to ensure the necessary regional harmonization?
- c) Are policymaking and planning processes robust enough at all levels? Does a dominant public sector have the flexibility and innovative skills to recognize and develop new green opportunities?
- d) And how can the entrepreneurial and risk management skills of the private sector be engaged to the best effect? ICTs are powerful tools vital to a green economy: can governments be persuaded to be more supportive?
- e) Green values often relate to traditional values: can traditional leaders be enlisted to assist local processes?

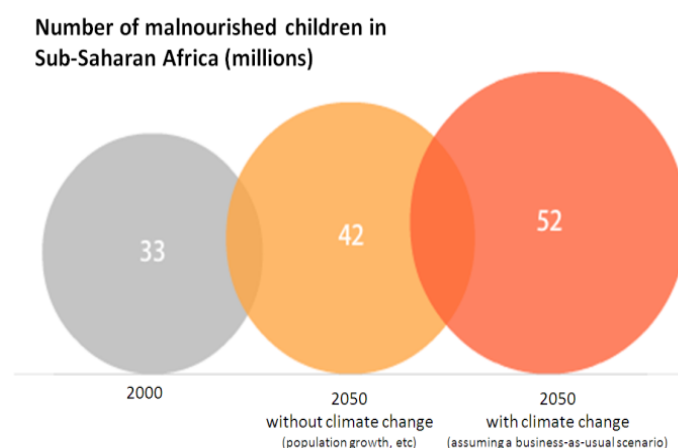
Essential measure (4): Coherent strategy on adaptation to climate change that builds resilience through improved management of climate risks in lives and livelihoods, including food security, disaster risk reduction and social protection.

47. Increase in climate variability, an early indicator of Climate Change, has already led to a greater number of weather related disasters, affecting many vulnerable communities in Africa, especially the poor. Such disasters can lock people into endless poverty and become a powerful force for migration. The impact of such occurrences must be reduced through improved preparedness and resilience-building.

- a) Disaster risk reduction: Are countries in Africa prepared for a significant increase in weather related disasters as a consequence of larger and more frequent extreme events? How can we ensure that all stakeholders receive early warning information on extreme events?
- b) Climate risk management offers many advantages for people, communities, business and governments, - but is little practiced in Africa with its highly variable climate. Why are climate services currently so weak and so little engaged in the African development agenda? How can they be improved? How can we increase community participation in making and using weather observations to improve agricultural practices for instance?
- c) Food security: The food security situation in Africa is set to worsen in a more hostile climate and further exacerbate poverty. Can a green economy reverse

the trend and feed a doubled population by 2050? How do we make sure that such a change translates into better access to food, poverty reduction and inclusive development? What are pro-poor adaptation technologies and practices, and how do we promote their adoption?

- d) Social protection: What are existing instruments to address the socio-economic dimensions of vulnerability? What public risk transfer and social protection schemes can be strengthened to serve as a platform for pro-poor adaptation? How can “productive safety nets” be made “adaptive safety nets”?



Source: Nelson *et al.*, 2009

Essential measure (5): Major financial resources well invested

48. Financing adaptation to climate change in Africa demands really major resources, increasing through the next several decades, at least. Opportunities within the CDM do not suit Africa’s potential for mitigation since investment opportunities in cleaning up high greenhouse gas emissions industries are not available in Africa. Clearly, for CDM to have an impact in economic and social development in Africa, some of the accounting rules and investment criteria need to be changed. Foreign Direct Investment in mitigation and transformation to a low-carbon economy could be of interest to transnational corporations¹⁷. Currently there are many climate funds but little commitment, see <http://www.climatefund.info/>.

- a) Are **UNFCCC negotiations** likely to provide sufficient resources for Africa to adapt to climate change and transform to a green Economy? Are tabled commitments of about \$40 billion per year by 2020 likely to be sufficient? Can such sums be invested by States in ways that attract further private sector investments of the kind required?
- b) What changes in existing mitigation financing mechanisms are required to help provide resources for Africa to develop in a sustainable low-carbon way? How should the CDM be adapted to be more appropriate to Africa’s interests?

¹⁷ UNCTAD World Investment Report 2010

- c) How can Africa obtain more control over new climate finance for addressing its own climate change and development agenda? Can finance flows be made more predictable so that investments can be scheduled effectively? Is “Integration” of financial mechanisms both desirable and feasible?¹⁸

Essential measure (6): Major renewal of infrastructure in harmony with a changing environment

49. African infrastructure is run-down and weak as a consequence of underinvestment over the past few decades. Much will need modifying to become low-carbon; and much will need replacing or adapting to greater extremes in weather and sea level rise. Sectors needing major infrastructural renewal include energy, transport, water and Sanitation, ICT, urban, industrial and coastal protection, agriculture, forestry and rural health and educational facilities.

- a) **Programming infrastructural development.** How can existing plans for infrastructural development be integrated into the “low-carbon requirement”? Can existing planning and construction regulations be reformed accordingly, and enforced effectively without paralysing the whole process? Is suitable technology available? How can enhanced infrastructural investment be programmed to sustain growth and maintain employment?
- b) Is there sufficient information on expected changes in climate for adapting infrastructure design? What long-term rise in sea level should be accommodated in new coastal infrastructure - one, three, or seven metres? Which areas should be abandoned and which protected? Are best design and construction practices easily shared in Africa?
- c) A forward-looking low-carbon energy strategy: **National and regional power plans** may need adapting to accommodate both rising demand from growing industries and the need for sustainable sources. Solar energy could meet many rural needs, given suitable investment.

Essential measure (7): Incentives for green trade and industry with a fully-engaged private sector and good access to low-carbon technology

50. Africa currently appears poised for economic take-off. Prospects for the African internal market are promising. One critical challenge that Africa and the rest of the world face is how to make trade and climate change policies compatible with each other. Given the reality of climate change, it is important to identify and take advantage of new green opportunities arising, to minimize potential negative impacts on trade and industry from climate change and strike the appropriate balance between new rules being developed to combat climate change under UNFCCC and the existing WTO multilateral trade rules .

- a) While there are many new trade and industrial opportunities in the green economy, will they be sufficiently large and clear cut to justify a change in economic direction for Africa? Is there any viable alternative for Africa? Is sufficient information available to help guide future investment strategies by the private sector, for example?

18 For example, as outlined in UNDP Discussion paper on Human Development in a Changing Climate: A Framework for Climate Finance

- b) Should the African Union (AU) programme for the Acceleration of Africa's Industrialization be revised for a green economy, to incorporate climate change considerations? Do regional and national governments have sufficient information to be able to incorporate climate change considerations within their industrial development frameworks and support for trade?
- c) Africa needs much better access to many low-carbon technologies for activities such as rural electrification. How might trade policy be mobilized in support of low-carbon and environmental technology diffusion? Are African negotiators in the UNFCCC process pursuing technology transfer issues vigorously enough?
- d) Could national biofuel programmes assist development of the rural economy? With appropriate incentives, village biofuel production could drive improvements in local road and market infrastructure, leading to greater trade in surplus food production and other products, benefitting rural producers and local industries, traders and consumers.

Essential measure (8): Transformed use of land and water - agriculture, forestry, ecosystems, biodiversity, with improved environmental and food security for poor communities

51. CAADP is assisting participating countries towards fundamental reform of their entire agricultural sector while adhering to the "green" principles of sustainable land and water management. It seeks greater economic growth through agriculture-led development, with a view to eliminating hunger, reducing poverty and enhancing food and nutrition security and export growth. AU-NEPAD has been charged to build on CAADP and develop an African agricultural-based mitigation and adaptation framework that integrates carbon sequestration into agriculture and carbon financing and brings together ministries of agriculture, environment, and water, using an inter-sectoral approach - a good basis for developing a green economy.

- a) **Ecosystem services:** In the present economy, ecosystem services are grossly undervalued 10 to 100 fold. Practical policies must be formulated. Financing mechanisms must create the right incentives for rehabilitation of the degraded environment. Can a new culture that values and optimizes sustainability in production and resource utilization be created in planning and decision making?
- b) **Land use and REDD:** Given the impacts of population growth, urbanization, globalization of markets, international investment flows, land purchases, carbon trading, the need for vast carbon lock-up in reforestation (REDD) and anti-desertification programmes, is pressure on land in Africa likely to increase markedly over future decades? What will that mean in terms of multiple stakeholder interests, and how will that be managed equitably? Is Africa up for sale?
- c) **Agriculture:** A green economy could be of huge benefit to parts of African agriculture but can existing support services cope with the demands for widespread changes in practices? Can Africa feed a rapidly growing population with expected long-term decline in agricultural productivity in a warmer world? Can farmers be empowered to cope with increased climate variability through risk management practices like index insurance? Will the major

opportunities for locking carbon away and mitigating emissions through improved agricultural practices raise rural incomes, but reduce productivity further, and so exacerbate overall food insecurity?

- d) **Water** is a scarce and valuable resource but is often managed as if it were still in abundance. Climate change will highly aggravate water stress in arid and semi-arid areas. By 2025, nearly 50 per cent of Africa's predicted population of 1.45 billion will be faced with water stress or scarcity. Water policies must address this growing scarcity through pricing or other means to ensure that (a) water is used efficiently; (b) watersheds are conserved; and (c) finance is available for further investment. Competition for water is a primary contributor to environmental insecurity, and climate change will make it worse.
- e) **Environmental security:** Is there sufficient understanding of climate change impact on the resilience of Africa's ecosystems, habitats, biodiversity, natural resources and hence people? Are environmental monitoring and management mechanisms sufficiently robust and fit for purpose in a green economy?

Essential measure (9): Change in human values, aspirations and development frameworks with all citizens, informed and engaged, especially women and youth

52. While development of Africa through a green economy should have significant benefits for many currently disadvantaged groups – like the rural poor – there is concern that it will not be adequate to offset the increased risks of life in a more hostile climate. Adaptation programmes must engage all actors and reach all communities, with meaningful participation of communities in the design of programmes to help meet their health, education and employment needs, and those of disadvantaged groups.

- a) **Youthful hope:** How can we engage the innovative energies of the youth in the process of adaptation, constructively combating the impacts of climate change? How best to culture the next generation with values appropriate for a sustainable world?
- b) **Women:** Impacts of climate change are not gender neutral. Women will be disproportionately affected due to their responsibility for household water supply, energy and food security and their unequal access to resources. At the same time, they have proved effective in mobilizing communities to respond to and prepare for climate change and natural disasters. Climate change initiatives must build on women's experiences, knowledge and coping capacity.
- c) **Inclusion:** How can we ensure that all society – including women, young persons and socially vulnerable groups - is properly consulted in elaborating priorities and participates in creating sustainable societies? Many civil society organizations (CSOs) will relish the prospect of a green Africa in a more equitable world, but how can their many efforts be harmonized to the greatest developmental benefit?

Essential measure (10): Strengthened capacities and a culture of innovation with quality science focused on sustainable development

53. Major investment in climate and environmental sciences is required if Africa is to sufficiently be competent in: (a) extended global negotiations; (b) transformation to a Green Economy; and (c) Climate Change adaptation and mitigation processes.

- a) **Capacities:** While human capacities need strengthening throughout Africa, what are the top priorities for investment vis-à-vis climate change? What should be done to reverse the brain drain and ensure that such capacities are available in Africa for the long term?
- b) **Innovation:** How can Africa promote innovation? Consensus is more valued in African society than individual brilliance. Does this stifle innovation or are mechanisms for rewarding innovation lacking?
- c) **Environmental monitoring:** Does Africa need to initiate a coordinated continent-wide programme for monitoring a number of aspects of environmental change? Can the continent manage the whole adaptive process without a clear overview of changes and trends? Might experience from India in large-scale transformation of agriculture assisted by independent monitoring of environmental changes be useful for managing and verifying major REDD programmes in Africa?
- d) **Science for development:** How can science best support local CSOs working to increase resilience of poor rural communities? How should the science and practice of Climate Risk Management be advanced throughout Africa? How can communications be improved to ensure that decision makers (at continental, regional, national and local levels) are all supported with adequate scientific advice?

54. Finally, an integrated example to show how policy, bio-sciences, technologies and business could help develop a soft and no-regret programme for action should be initiated.

**Waste to bio-fuel: Urban waste disposal problem reduced by 80 per cent.
Example of new green technology, innovation, employment,
good governance, mitigation of emissions and pollution**

TMO Renewables Ltd has genetically modified a “compost-heap” bacteria into a biofuel engine. They have now signed a contract worth \$25 million a year for 20 years to turn 102 million tonnes of non-recyclable municipal waste into biofuel each year. The process should convert over 80 per cent of residential waste into ethanol and recyclables with no external energy or water inputs and a minimum of air and water emissions. In addition to the revenue from 5 million gallons of ethanol produced from the first plant, there are significant “tipping fees” for all the municipal and commercial waste that is treated.

This is second-generation biofuel technology which uses cellulose rather than grain. Replication of similar waste to ethanol bio-refineries could drive significant green job creation and community economic development.

<http://www.tmo-group.com/news/news-20-09-10.aspx>

VI. Implications for International Engagement

55. Climate change is the definitive global problem, affecting people and their affairs at all scales from global atmosphere to home and garden. Global climate governance therefore is a *'collective action problem'* that requires full stakeholder participation in coherent responses. Hence, international engagement and partnerships at all scales are essential, not least, to assist in addressing the numerous "boundary" issues.

56. **Global voice:** Africa needs a **clear voice** in global negotiations in order to obtain a strong and fair global agreement on limiting global warming, repairing damage done and developing a green economy. In such negotiations, Africa has an important role as third party broker. The AU Committee of African Heads of State and Government on Climate Change (CAHOSCC) would benefit from additional support to develop its voice in global governance on climate change and related agreements.

57. **Global partnerships:** The African Partnership Forum¹⁹ is a good example of a global partnership that benefits Africa in terms of access to distilled knowledge and strategic thinking. It would be useful to examine other global and regional partnerships to see where they might be strengthened to take on new roles, and identify new needs for other similar initiatives. There may be need for a network of international research and innovation centres to focus on developmental problems facing the least developed countries (LDCs).

58. **Africa regional:** The need to address the climate change challenge has strengthened the role of the United Nations and other regional bodies like the European Union. Similarly, the AU embodies the ambitions of African States to form a much needed integrated active actor on the world stage. But AU capabilities, especially financial ones, are lacking. A stronger core for the African Union is essential to support the many global and regional negotiation processes concomitant on climate change. The Joint Secretariat needs to be able to provide greater guidance, with a strengthened AUC engaging in a greater number of continental-scale activities such as (a) leadership and good governance; (b) maintaining peace and security with support to fragile states; (c) development of strategies and common policies; (d) guidance for a green economy; and (e) continental climate and environmental monitoring and knowledge sharing.

59. **Africa subregional:** The RECS are the building blocks for the future, guiding and supporting common policies, programmes and actions and strengthening governance. They must be prepared to take on greater responsibilities and promote harmonized regional responses to climate change, encourage the African Peer Review Mechanism (APRM), and monitor and evaluate effectiveness of investments, policies and practices.

60. **Africa transboundary:** Improved transboundary passage, trade, transport and communications will be important for assisting adaptation and development. If surface waters in transboundary watersheds are reduced as a consequence of climate change, then modalities for their equitable management need to be agreed before conflict arises. This may also apply to management of other common property resources like protected areas and coastal and maritime resources.

¹⁹ <http://www.africapartnershipforum.org/>

VII. Knowledge management: Policy, planning and practice

61. Responding effectively to climate change has many implications for managing knowledge, information and data in Africa. The vast majority of development policies, planning processes and programmes will have to be adapted for life in a changing climate and green economy. They must be based on understanding of the problems and opportunities, consistent with mitigation and adaptation requirements, coherent between sectors, and delivered in coordination with many partners and stakeholders. Delivering complex change amid much uncertainty and in a more hostile climate puts a premium on quality knowledge for integrated and timely decision-making.

62. While the development community may reflect on mainstreaming climate change into development, those who appreciate the scale of the problem see it more as maintaining development through climate change, and entitle it the green economy with low-carbon development pathway.

63. ***Developing the capacity to manage climate uncertainty today and in the future is paramount.*** While one clear way to reduce climate uncertainty is to obtain better information, this may not always be possible, *and there will always be a significant degree of irreducible uncertainty about our future climate.* A particular challenge in Africa is the scarcity of quality climate information, which can hamper efforts to better characterize the current climate and climate change. Despite scientific advances in understanding and modelling our climate, the largest element of uncertainty is our future development (emission) path, hence the need for continuous climate and environmental monitoring, regular vulnerability assessment and reliable early warning systems.

64. ***Climate Risk Management*** is the use of climate information to cope with impacts of climate on development and resource management. It covers a broad range of potential actions *both to minimize adverse outcomes and maximize opportunities* in climate-sensitive economic sectors through improved resource management. It addresses adaptation to Climate Change and disaster risk reduction in any climate sensitive development sector by focusing on actions that can be taken today, to improve outcomes and preparedness, and by understanding, then anticipating interactions of economic, environmental and social systems with future climates.

CRM is a new science for development and as such, much is needed to implement it effectively in Africa. Capacity-building and substantial improvements in data supply, climate services and sectoral management practices are all essential.

65. ***Improved policy*** requires evidence and understanding of the impact of climate variability and change on development related outcomes, and the utility of climate information to reduce climate impacts. Evidence on impacts of climate variability and change will help make the case for accelerated mitigation and adaptation measures. CRM is an essential tool in support of policymaking processes.

66. ***Improved planning:*** *Over the longer term, ignoring climate change in planning will result in inefficient and suboptimal investments and decisions.* Planners have historically managed climate risks with differing degrees of success, depending, in part, upon the quality and scope of the climate information available to them. In places with good cli-

mate records, expectations about how climate is likely to change have been developed by creating simulations of future climate that are consistent with past variations. This information can be helpful to managers and policymakers looking at longer term investments and strategies.

67. **Improved practice** on a large scale requires investment in capacity-building, training programmes and policy dialogues, knowledge management and generation, as well as dissemination of best practices, tools and transfer of appropriate technologies. Development of CRM methods and tools is essential, including their integration into relevant economic and financial analyses which assess vulnerabilities and weigh risks. Such tools could help improve the economic rationale of decision-making under climatic uncertainty. Integrated advisory services and networks of early warning systems would also be of benefit.

Creating resilience strategies for water supply

Achieving water security and economic development effectively means using scarce water resources more efficiently and managing the risk of impacts from climate variability and change. Innovative solutions use latest technology such as remote sensing, global datasets and climate modelling and forecasting. Solutions may be water policy interventions that include option contracts and insurance for water supply in times of scarcity and early warning systems for floods and droughts. In some cases, additional investment in infrastructure, such as reservoirs and water treatment and reuse plants, may be necessary.

In Metro Manila, Philippines, the IRI works with the urban water supply service, irrigators and national level agencies to create anticipatory strategies for managing water crises. Economic mechanisms such as option contracts and index insurance are used with climate information and forecasts. The reservoir that supplies water to Metro Manila is increasingly vulnerable to hydrologic variability, both drought and flood. A large irrigation area also relies on water from the reservoir in this shared water system. In times of water scarcity, questions of where the water should be allocated become critical and often contentious. Research indicates that incorporating seasonal forecasts into decision support system can increase hydroelectricity and irrigation water in wetter years, where water would usually be spilled over the top.

Despite the potential, integration of seasonal rainfall forecasts into water resource reservoir operations is practically non-existent, even in regions of water scarcity. This is often attributable to the tendency of water managers to act in a risk averse manner, preferring to avoid consequences of poor forecasts, at the expense of unrealized benefits. Work by the International Research Institute for Climate and Society (IRI) on hydropower benefits in Ethiopia's upper Blue Nile basin explored the effects of conservative reservoir decision-making, relying on critical dry forecasts only. Even with this limited forecast use, greater hydropower benefits were observed 97 per cent of the time, in comparison to operational decision-making based solely on average historical conditions. This demonstrates that water managers can remain risk averse and still realize benefits from climate forecasts.

68. **Improved climate services:** Pro-poor services must be able to tailor and communicate information to user needs. Improved communication between climate providers and key climate-sensitive sectors is also essential. Technical advisory services on climate risk management that are supported by experts to enable translation of climate information products are the missing link. While ClimDevAfrica has started investing in upgrading

regional climate services by strengthening regional and subregional climate for development institutions, more effort should be made at the national level in the context of the evolving Global Framework for Climate Services.

69. **Improved climate data** is indispensable, as are observations for local use, national and regional planning and global change, in coordination with the user communities. While climate science has made substantial advances in recent years, and reliable information is increasingly available, it is essential that this information is well used locally with full ownership by the relevant communities. Data policies in some countries still restrict access to data which makes CRM very difficult.

70. The climate community are trying to put their house in order but, much remains to be done. ClimDevAfrica is working on many fronts: with the Global Climate Observing System (GCOS) to improve climate monitoring; with the African Centre for Meteorological Applications for Development (ACMAD) and regional centres to strengthen practices; with the Africa Climate Policy Centre (ACPC) to advance climate policies and CRM. The Global Framework on Climate Services is preparing a comprehensive approach to improving matters, but links between climate services and rural communities in Africa are extremely weak. Climate services should work closely with many different communities, using feedback to develop specialist services to meet their needs and encourage them to make observations and use the information in their own agricultural practices.

VIII. Conclusions

71. **Climate change is the biggest challenge for the future of Africa**, and the world. It must be addressed through a global partnership. In the absence of strong global response to the challenge, there is relatively little that Africa can do on its own to adapt to all the expected impacts of a changing climate.

72. **Business as usual holds a highly problematic future** for Africa as a whole. Current development pathways are simply not sustainable: the damage to people, their livelihoods, the environment and society in general, is just too great. The green economy offers a way forward through climate change, with opportunity for everyone, but is critically dependent on a strong global agreement for transforming the way we treat the planet.

73. **Current negotiations under UNFCCC** are absolutely vital for the future of the continent, and a better world. Africa must continue every effort to obtain a strong and fair global agreement. Other global agreements must be harmonized with UNFCCC purposes, and existing financing mechanisms for mitigation and adaptation need reform to maximize opportunity for Africa's development through a green economy.

74. **Moral high ground:** Because Africa (a) has contributed the least to global warming; (b) will suffer the most from the impacts of climate change; and (c) has the potential to lock up significant quantities of atmospheric carbon relatively cheaply and quickly through re-vegetation, it has a unique and important catalytic role to play in climate

change negotiations, encouraging developed and emerging economies towards an agreement which is in everyone's best interest.

75. **Climate resilience:** In rural Africa there is much concern about the impact of already changing local climates and the extreme vulnerability of so many communities faced with a more hostile climate. It is imperative that Africa's leadership take up the challenge of improving climate resilience now. Countries in the arid regions of Africa are being forced into "reactive adaptation", which is both more expensive and less effective than planned adaptation.

76. **Reluctance:** At present, Africa is not prepared for adapting to climate change. Leaders do not have access to the resources and technology needed to address yet another complex, macro-constraint to development that requires difficult and costly changes. Too many people are yet to take ownership of climate change and make it also their problem. Visionary leadership and political ownership are absolutely essential for successful adaptation to climate change within a green economy.

77. **In the meantime:** There is much preparatory work and many preliminary actions to be undertaken while global agreements with adequate finance are negotiated. Climate Change adaptation considerations will have to be integrated into policy processes and decision-making across a range of sectors, from continental to local. Climate risk management offers multiple different ways to work more effectively within a variable and uncertain climate.

IX. Recommendations for Action

Africa should accelerate preparations and response actions to the many threats from climate change and start working on opportunities for sustainable development in a green economy.

In particular, there is need for Africa to:

78. **Strengthen information and skills available to the African negotiating team at UNFCCC** to ensure the best possible future for the continent in a more equitable world. Green economy considerations must be brought to the fore. *This might be achieved by empowering negotiators with solid scientific, social and economic arguments produced by a dedicated team such as the African Climate Policy Centre.*

79. **Develop a continental strategy and master plan** to map out the many inter-related issues and guide coherent policies and programmes in all pertinent domains, for combined mitigation, adaptation and development within a green economy. *This might be achieved by establishing a climate change and green economy taskforce for Africa as part of the Africa Partnership Forum (APF) and nourish new partnerships throughout Africa and the world to meet the many needs of the combined process.*

80. **Reinforce leadership and governance through the Joint Secretariat** (including RECs) and prepare for scaled-up response actions in proportion to the monumental task,

once adaptation financing becomes available. *At the regional level, it will be important to improve policies and institutions to integrate climate risks, and identify transboundary issues and economies of scale for natural resources and energy management.* New partnerships should be built through solidarity around the central concerns of various regions and countries, which vary greatly.

81. **Promote adaptation actions** with immediate effect by using the significant resources already available to focus on those most vulnerable. Adaptation strategies must, at least, aim to address the consequences of a changing climate and strengthen the resilience of vulnerable communities to short-term climate variability and new climate risks while promoting integrated and balanced long-term development. There are many proposals for adaptation programmes already developed by different stakeholders, with multiple “no-regrets” adaptation actions crying out to be addressed: MDG and Disaster Risk Reduction and Recovery (DRR) strategies and the National Adaptation Programmes of Action (NAPAs) may also provide a basis for early action.

82. **Reverse the brain drain** by establishing key institutions to advance green development in a more hostile climate, with organizational arrangements that are likely to interest African specialists currently working overseas.

Glossary of Terms

Today climate is everybody's business. Stakeholders from various sectors and backgrounds have different conceptions and use the same terms in varying senses. It is therefore, important to start by clearly stating how some of the most important terms used in this document are meant to be interpreted.

Adaptation → refers to adaptation to the present climate variability and to anticipated climate change.

Carbon sequestration or carbon lock-up or carbon sink: Carbon sequestration is “the process of removing carbon from the atmosphere and depositing it in a reservoir”. Carbon sequestration is mainly a natural process whereby carbon dioxide is stored in plants through the process of photosynthesis. Carbon dioxide can also be stored as plant “organic matter” in soils. It is also a geoengineering term for long-term storage of carbon dioxide or other forms of carbon to mitigate/defer global warming. It has been proposed as a way to slow the atmospheric and marine accumulation of greenhouse gases, which are released by burning fossil fuels. Carbon dioxide is naturally captured from the atmosphere through biological, chemical or physical processes. Some anthropogenic sequestration techniques exploit these natural processes.

Climate change as defined by IPCC refers to the change of the state of the climate that can be identified (for example by using statistical tests) by changes in the mean (average value) and/or the variability of its properties, and that persists for an extended period, typically decades or longer. Climate change may be due to natural internal processes or external forcings, or to persistent anthropogenic changes in the composition of the atmosphere or in land use.

Climate Information → includes, historical data, analyses and assessments based on these data, forecasts, predictions, outlooks, advisories, warnings, model outputs, model data, climate projections and scenarios, climate monitoring products, etc., and can be in the form of text, maps, charts, trend analyses, graphs, tables, Geographic Information System(GIS) overlays, photographs, and satellite imagery.

Climate Prediction → includes forecasts and outlooks; and predictions at monthly, seasonal, inter-annual, decadal, and multi-decadal scales.

Climate Risk Management (CRM) → is an approach to decision making in climate-sensitive activities (for example, agriculture and food security, health, tourism, management of water and energy resources, urban planning and design, transportation, etc.), that seeks to reduce the vulnerability associated with climate risk (both variability and change), and aims to maximize the positive and minimize the negative outcomes for these sectors.

Global Framework for Climate Services (GFCS): While the IPCC, through its assessment of climate, has raised political awareness, there is a need to take the next step, and make available regional and location-specific user-friendly climate information across a range of time and space resolutions for adaptation and climate risk management. On the model of the weather services network, a mechanism must be put in place to ensure delivery

of climate information to users and to enable feedback to the service providers from the user communities on their information needs.

The GFCS, by enhancing climate services, will empower communities to manage and plan for emerging climate risks and opportunities. The Global Framework for Climate Services will help to bridge the gap. It forms a substantive outcome of World Climate Conference (WCC), whose goal is: *“the development and provision of relevant science-based climate information and prediction for climate risk management and adaptation to climate variability and change, throughout the world.”*

The Global Framework for Climate Services has four major components: a user interaction mechanism; world climate services system; climate research; and observation and monitoring. The latter two components are already well established, while the first two components are new efforts. The components recognize and build on the successes of past and ongoing research, assessment and observational programmes.

Green Economy → *A Green economy is typically understood as an economic system that is compatible with the natural environment, is environmentally friendly, ecological, and for many groups, also socially just.* These attributes are the conditions that must be imposed on an economy from the perspective of many green economy advocates. This conventional concept of a green economy may be alternatively described as “the greening of an economy”. Some fundamental criteria for meeting these conditions have been established since Rio. These include, using renewable resources within their regenerative capacity, making up for the loss of non-renewable resources by creating renewable substitutes, limiting pollution within the sink functions of nature, and maintaining ecosystem stability and resilience. Conditions for social justice may include: (i) not compromising future generations’ capability to meet their needs; (ii) the rights of poor countries and poor people to development and the obligations of rich countries and rich people to changing their excessive consumption levels; (iii) equal treatment of women in access to resources and opportunities; and (iv) ensuring decent labour conditions. Additionally, issues of good governance and democracy are seen as critical for ensuring social justice and equity. *Less understood but of much greater interest is green economy as an economic system that is dominated by investing in, producing, trading, distributing, and consuming not only environmentally-friendly, but also environmentally-enhancing products and services.* In this sense, many green conditions such as those listed above should no longer be seen as constraints on an economy; instead, they should be regarded as forces that generate new economic opportunities. This is about expanding and reshaping, not reducing the space for economic development and poverty reduction.

Green Economy Initiative → is a global initiative launched by the United Nations Environment Programme in October 2008 aimed at seizing the opportunities that the modern concept of a green economy has to offer. It seeks to accomplish two tasks. First, it tries to make a “beyond-anecdotal” macroeconomic case for investing in sectors that produce environmentally-friendly or environmentally-enhancing products and services (“green investment”). By a “macroeconomic case”, it mainly refers to the contribution of green investment to output and job growth. Second, the initiative tries to provide guidance on how to boost pro-poor green investment. The goal is to encourage and enable policymakers to support increased green investment from both the public and private sectors. The initiative consists of a range of research and advisory products and services

to be delivered in partnership with organizations within and beyond the United Nations System.

Low-carbon development pathway → Development with minimized emission of greenhouse gases; for example, using renewable energy rather than coal, oil and gas.

“A low-carbon economy” → This is a concept getting increased attention amidst the rising public awareness of climate change and the urgent need for transformational change of the economy. A low carbon economy is one that emits a minimal amount of carbon dioxide and other greenhouse gases, although what constitutes the minimum has yet to be agreed upon. What is important, however, is that economies are reducing the carbon intensity of their economies overtime, in both unitary (CO₂ per unit of GDP) and absolute terms. A low-carbon economy can be seen as one of the outcomes from operationalizing a particular dimension of a green economy.

Mitigation → Actions to reduce greenhouse gas emissions and limit overall Global warming.

‘National Climate Service or National Climate Centre’ can be and often is an entity within a National Meteorological Service to, inter alia, carry out climate studies, conduct climate prediction and projection and to develop and provide climate services. In some countries, climate functions can be mandated to other national entities, including other government agencies, universities or research institutions, in addition to NMHSs. Where needed in this document for discussion on climate service development and delivery, the term ‘NMHS and other mandated institutions’ is used.

National Meteorological Service (NMS): For the purposes of this paper, an NMS is “an organization established and operated primarily at public expense to carry out those meteorological and related functions which governments accept as a responsibility of the State in support of the safety, security and general welfare of their citizens and in fulfillment of their international obligations under the Convention of the World Meteorological Organization”.

In many countries, the NMSs and a Hydrological Service are collocated, and are referred to as the National Meteorological and Hydrological Service (NMHS).

Resilience → is defined as “the capacity of a system to absorb disturbance and still retain its basic function and structure.”

Service → is used to describe an action, such as delivery of climate information (see above), guidance, or a product to a client or user, and does not normally imply a physical entity such as an organization or institute unless this is specifically described (as in NMHS above).

User or decision maker (these terms are frequently used interchangeably) refers to a client (perhaps an individual or organization) with responsibilities for decisions and policies in climate-sensitive settings, for whom a service is provided or to whom some form of climate information is delivered.

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