
CLIMATE CHANGE: IMPACTS AND RESPONSES FOR CARBON NEUTRAL AND CLIMATE RESILIENT DEVELOPMENT IN ETHIOPIA

BELAY SIMANE

Center for Environment and Development, College of Development Studies,
Addis Ababa University. Email: simaneb@yahoo.com

ABSTRACT

The global climate is changing due to the carbon-intensive path of development that has been pursued by rich countries since the beginning of industrial revolution. The concentration of CO₂ in the atmosphere has increased from a pre-industrial value of about 280 ppm to 379 ppm in 2005. Developing countries, especially the least developed countries like Ethiopia, are disproportionately affected by the harmful effects of the global warming on agricultural production and food security, water resources, health, physical infrastructure and ecosystems due to the combination of already fragile environments, dominance of climate-sensitive sectors in economic activity, and low adaptive capacity. Recurrent droughts and floods have resulted in loss of life and property as well as the migration of people. Drought frequency is predicted to increase, placing stress on already vulnerable production systems. The number of people affected due to drought has increased from 1.5 million in 1974 to 12.6 million in 2005. The international community has responded to the problem of climate change by adopting the United Nations Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol (KP) to stabilize the concentration of greenhouse gases in the atmosphere. International climate change negotiation is underway following a “two-track” approach even after the Copenhagen Accord, which is accepted as a political declaration. It is hoped to have a legally binding agreement at the 16th COP meeting in Cancun, Mexico in 2010. While some progress was made on some areas, negotiations on finance and mitigation did not move much forward as expected. The COP 17 climate talks in Durban (December 1- 12, 2012) ended by approving a deal that renewed the Kyoto Protocol and set into motion a Durban Roadmap. The Durban Roadmap for the first time in the history of the UNFCCC sets up a process to negotiate a comprehensive and balanced legal instrument to avert climate change; the legal instrument which would come into force by 2020. The “agreed outcome with legal force under the convention applicable to all parties” will require more decisive action in emission reduction from all countries, including emerging economies. The Ethiopian Government has acknowledged the challenge climate change poses and has taken policy and institutional measures. The Environmental Protection Authority (EPA) is established and has a mandate to ensure the implementation of the UNFCCC and its Kyoto Protocol in a coordinated and yet decentralized manner. Recognizing the urgency and inter-sectoral nature of environment, it has also established the Environment Council (EC) to provide overall leadership in environmental policy and regulatory systems. Following the Bali Road Map and the Copenhagen Accord, Ethiopia is preparing itself to tackle climate change involving two concurrent approaches: adaptation (adaptation strategy) and mitigation (NAMA) or avoided emission of greenhouse gases. The Government of the Federal Democratic Republic of Ethiopia has also initiated the

Climate-Resilient Green Economy (CRGE) initiative to protect the country from the adverse effects of climate change and to build a green economy that will help realize its ambition of reaching middle income status before 2025. International support to manage climate change risks and opportunities is growing. A major obstacle to integrating climate and development at local level stems from lack of capacity and strong institutions that can coordinate and lead the local efforts. The country should build its local capacity to clearly analyze climate change impacts, identify level of vulnerabilities and develop proactive and reactive response measures. Access to climate friendly technologies and financial resources are also needed in order to achieve the ultimate goals of building a carbon neutral and climate resilient economy by 2025 in Ethiopia. There is a need also for a greater awareness creation of climate change and its response measures through a carefully articulated communications process that draws on evidence and experience from the field with key stakeholders.

Key Words: adaptation, climate change, climate resilient economy, global warming, mitigation, vulnerability

INTRODUCTION

The world's climate is continuing to change at rates that are projected to be unprecedented in recent human history. The Third Assessment Report of the Intergovernmental Panel on Climate Change (IPCC, 2001) indicated that the global average surface temperature increased by about 0.6°C during the 20th century. The recent Fourth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC, 2007a) states that 'most of the observed increase in the globally averaged temperature since the mid- 20th century is very likely due to the observed increase in anthropogenic greenhouse gas concentrations'. The IPCC climate model projections from 2001 suggest an increase in global average surface temperature of between 1.4 and 5.8°C from the present to 2100. The range depends largely on the scale of fossil-fuel burning between now and then and on the different models used (IPCC, 2007a).

The impacts of climate change are likely to be highly spatially variable (IPCC, 2007b). Africa will be struck severely by the impacts of climate change (Box 1). Given its geographical position, the continent will be particularly vulnerable due to the considerably limited adaptive capacity, exacerbated by widespread poverty and the existing low levels of development.¹ Climate change, variability and associated increased disaster risks are an additional burden to sustainable development in Africa. It is also a threat and impediment to achieving the Millennium Development Goals. Constraints in technological options, limited infrastructure, skills, information and links to markets further heighten vulnerability to climate stresses.

Box 1. Summary of the Projected impacts of climate change in Africa

- By 2020, between 75 and 250 million people in Africa are projected to be exposed to increased water stress due to climate change.
- By 2020, in some countries, yields from rain-fed agriculture could be reduced by up to 50%. Agricultural production, including access to food, in many African countries is projected to be severely compromised. This would further adversely affect food security and exacerbate malnutrition.
- Towards the end of the 21st century, projected sea level rise will affect low-lying coastal areas with large populations.
- By 2080, an increase of 5 to 8% of arid and semi-arid land in Africa is projected under a range of climate scenarios (TS). The cost of adaptation could amount to at least 5 to 10% of Gross Domestic Product (GDP).

Source: Report. Summary for Policy Makers, IPCC, 2007b.

Ethiopia is also highly vulnerable to climate change and weather variability. It is heavily dependent on rain-fed agriculture, and its geographical location and topography in combination with low adaptive capacity entail a high vulnerability to adverse impacts of climate change. The country's natural resources base, its land, water, biodiversity that are the foundation of its economic development and food security are highly vulnerable to both anthropogenic and natural induced climate changes. The intense pressure on the natural resources base from population growth and inappropriate traditional farming and management practices (extensive cultivation, overgrazing and deforestation and soil erosion) are additional stresses of climate change in the country (Alemneh

¹ Warming generally increases the spatial variability of precipitation, contributing to a reduction of rainfall in the subtropics and an increase at higher latitudes and in parts of the tropics (...) While warming is expected everywhere on Earth, the amount of projected warming generally increases from the tropics to the poles in the Northern Hemisphere. Climate models suggest a global warming of about 3° C and a sea level rise of about 68 cm by the year 2100 due to the CO₂ emission projected under the Business-As-Usual (BAU) scenario. *IPCC report, 2007, Chapter 11 – Regional Climate Projections.*

Dejene, 2003). These factors often interact with one another resulting in a reinforcing cycle of "poverty, food insecurity and natural resources degradation trap".

The science is now "unequivocal" that human activity is contributing to climate change and the impacts are already being observed in all sectors: food, health, water, agriculture, energy and infrastructure (Fig. 1) (IPCC, 2007c). The impacts are expected to bring economic, social and environmental problems, all of which will cause even more poverty and less development affecting all countries, especially the least developed countries like Ethiopia. There are convincing facts that countries like Ethiopia, will be disproportionately affected by the adverse impacts of climate change, and brought about by the carbon-intensive development paths of rich countries over the past century (EPA, 2008; NCCF, 2009).

Understanding the causes and consequences of climate change and the opportunities of climate change adaptation and mitigation options are assumed to support and reinforce the existing efforts of Ethiopia in the development of carbon neutral and climate resilient economy by 2025. The causes and impacts of climate change should be understood, even in simple terms and descriptions by the majority of the population since it affects their livelihoods. For this reason, public awareness through environmental literacy has been among the actions being taken by governments, civil societies, and educational institutions, particularly in the developed countries, to alert the society about the links between environmental safety and sustainable development.

Knowledge of environmental issues includes an understanding of environmental problems/issues caused as a result of human interaction with the environment. Many governments have therefore taken steps to ensure the sustainability of the environment by taking the necessary precautions and raising public awareness. Efforts to overcome continuous environmental degradation and establish sustainable development can be advanced by providing citizens of all ages with opportunities to become more environmentally informed, committed and active, and thus more environmentally literate. For this reason, in many countries, environmental education is being given to students even at elementary education level, and the foundations of consistent environmental literacy are emphasized in elementary schools mainly through science education (Erdoğan and Marcinkowski, 2009).

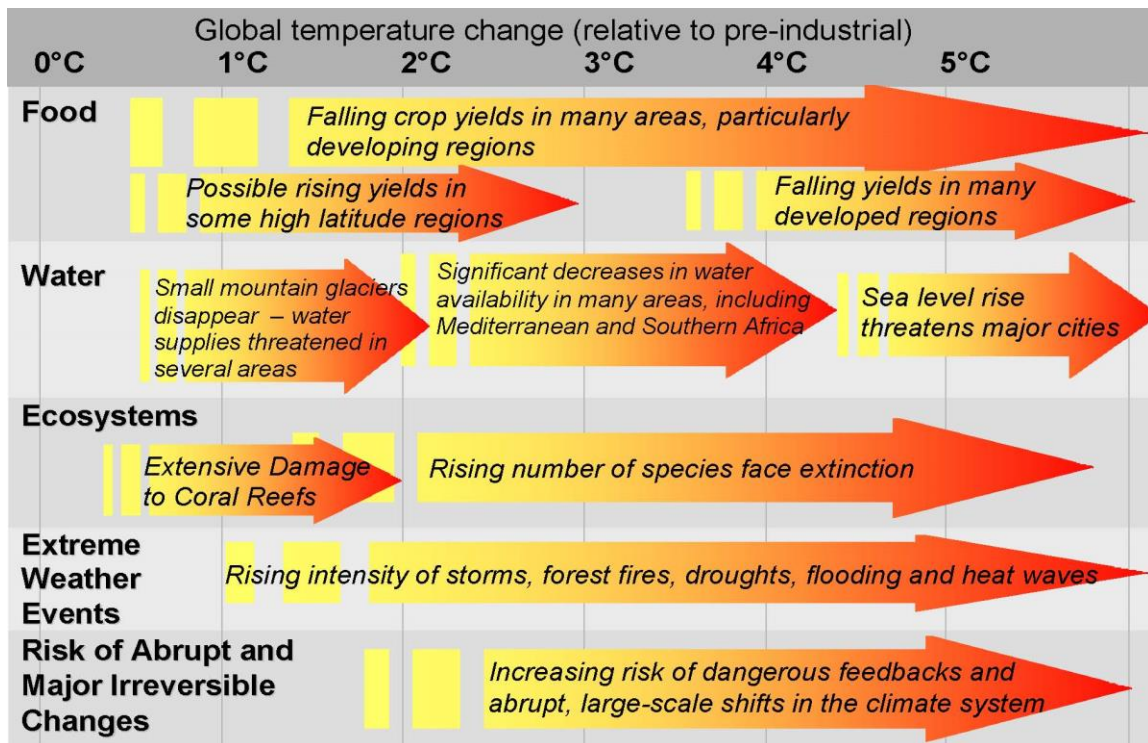


Figure 1. Projected impacts of climate change by Sectors (Source; IPCC, 2007d)

In this paper, attempts will be made to discuss key global climate change issues and their impacts on development, with emphasis on Ethiopia. In particular, the following questions about climate change and global warming (that have been debated strongly among various scientists and policy makers from GOs, NGOs and CBOs) will be discussed:

- What causes climate change, and what is the current status?
- Who should take responsibility to global warming?
- Who will be most affected by climate change?
- Which countries should do more to reduce their green-house gas emissions?
- Do such countries have an obligation to help poor countries deal with the effects of climate change?
- What are the current strides to control climate change?
- What kind of response measures Ethiopia should take to cope with the inevitable climate change situation?

GLOBAL CLIMATE CHANGE STATUS

The IPCC predicts that global temperatures will rise between 1.8 °C and 4.0 °C by the last decade of the 21st century (IPCC, 2007a.). This is due to the accumulation of Green House Gases (GHG) in the atmosphere. The principal, human-generated greenhouse gases are: Carbon Dioxide (CO₂), Methane (CH₄), Nitrous Oxide (N₂O) and Fluorinated Gases (HFCs, PFCs and SF₆) (IPCC, 2007d; NASA, 2009).

Greenhouse gases make up only about 1 per cent of the atmosphere. They act like a blanket around the earth, or like the glass roof of a greenhouse. They trap heat and keep the planet some 33°C warmer than it would be otherwise (EPA, 2009). However human activities are making the blanket “thicker” and as a result trap more infrared radiation and raise temperatures. The natural levels of GHG are being supplemented by emissions of carbon dioxide from the burning of coal, oil, and natural gas; by additional methane and nitrous oxide produced by farming activities and changes in land use; and by several long-lived industrial gases that do not occur naturally.

The concentration of CO₂ in the atmosphere has increased from a pre-industrial value of about 280 parts per million (ppm) to 379 ppm in 2005 (IPCC, 2007d). Most scenarios of future emissions of CO₂ involve increases of CO₂. In 2004, 26.9 billion metric tons of CO₂ were emitted, and 33.9 billion metric tons are projected to be emitted in 2015. By 2030, 42.9 metric tons of CO₂ are projected to be emitted (Fig. 2) (EPA, 2009).

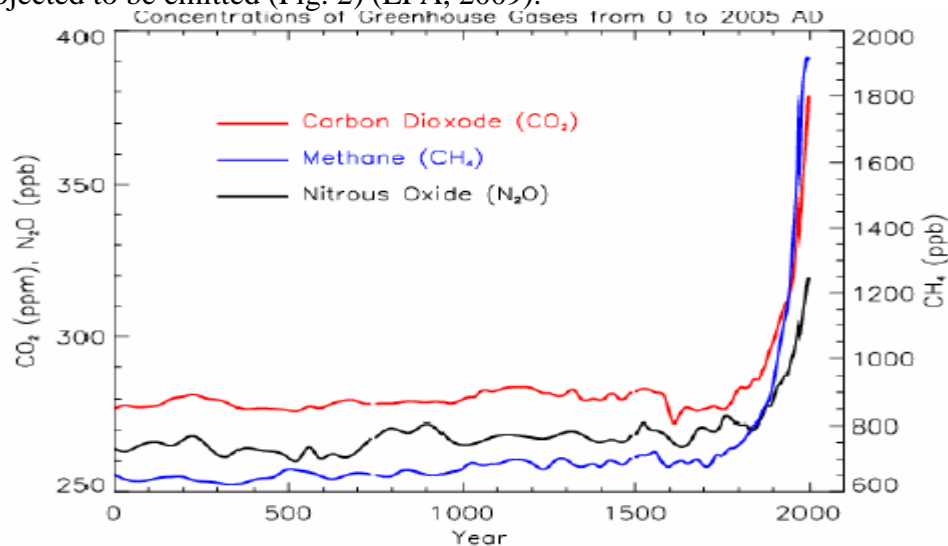


Figure 2. The historical concentration of GHGs

Source: EPA. 2009. [High Global Warming Potential \(GWP\) Gases Web site](#). High Global Warming Potential (GWP) Gases – Science. accessed August 31, 2009. Global Temperature Change Scenarios and its Consequences

Global mean temperatures over land and ocean have increased over the past decades. The Intergovernmental Panel on Climate Change projects that the average surface temperature of the Earth is likely to increase by 3.2 °F to 7.2 °F (1.8 °C to 4.0 °C) by the end of the 21st century, relative to 1980-1990 (IPCC, 2007c; NCDC, 2008). But where in this range temperatures actually occur will depend on the actual changes in CO₂ concentrations in the atmosphere, and these concentrations will depend on human activities and the success in efforts to control releases of CO₂ and other greenhouse gases (Fig. 3). Warming is not also predicted to be evenly distributed around the globe (Box 2).

Fig. 3 provides temperature projections to the year 2100, based on a range of emission scenarios and global climate models. Several factors, such as population growth and the implementation of new, cleaner technology will influence whether temperature increases follow the blue, green or red lines in the graph. Scenarios that assume the highest emission rates of greenhouse gases provide the estimates in the top end of the temperature range. The orange line (constant CO₂) projects global temperatures with greenhouse gas concentrations stabilized at year 2000 levels (IPCC, 2007c).

According to the IPCC, an increase in the average global temperature is very likely to lead to changes in precipitation and atmospheric moisture. Increased temperatures cause changes in atmospheric circulation and increase evaporation and water vapor, resulting in precipitation increases, more intense precipitation, more storms and sea level rise.

Box 2. Predicted warming distribution

- Land areas will warm more than oceans in part because of the ocean's greater ability to store heat.
- High latitudes will warm more than low latitudes in part because of positive feedback effects from melting ice.
- Most of North America, all of Africa, Europe, northern and central Asia, and most of Central and South America are likely to warm more than the global average.
- Projections suggest that the warming will be close to the global average in south Asia, Australia and New Zealand, and southern South America.
- Warming will differ by season, with winters warming more than summers in most areas.

Source: IPCC, 2007c

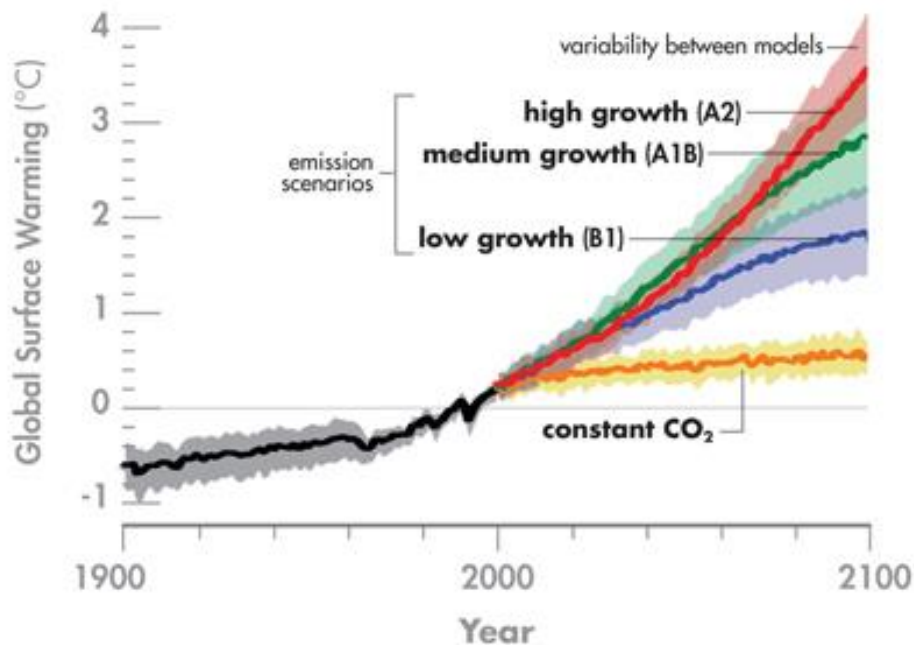


Figure 3. Global Temperature Change Scenarios. Source: IPCC Fourth Assessment Report (2007c)

Climate models suggest an increase in global average annual precipitation during the 21st century (IPCC, 2001 and 2007c), although changes in precipitation will vary from region to region. An increase in the intensity of precipitation events, particularly in tropical and high-latitude regions, including Ethiopia, that experience overall increases in precipitation is also predicted. The frequency of heavy precipitation events has increased over most land areas, consistent with warming and observed increases of atmospheric water vapor (IPCC, 2007c). Mid-latitude storm tracks are projected also to shift toward the poles, with increased intensity in some areas but at reduced frequency.

Tropical storms and hurricanes are likely to become more intense, produce stronger peak winds, and produce increased rainfall over some areas due to warming sea surface temperatures (which can energize these storms) (IPCC, 2007c; NOAA, 2006).

The IPCC estimates that the global average sea level will rise by 7.2 to 23.6 inches (18-59 cm or 0.18-0.59m) by 2100 relative to 1980 to 1999 under a range of scenarios (IPCC, 2007c). These estimates assume that ice flow from Greenland and Antarctica will continue at the same rates as observed from 1993 to 2003, but these rates could increase or decrease in the future. Current model projections indicate substantial variability in future sea level rise between different locations.

The IPCC, which provides policy-makers with the current state of climate science, including the impact of climate change and what can be done to tackle it, is due to publish the first part of its next assessment report, the fifth, in 2013. But already in its fourth assessment report published in 2007, the IPCC showed that a temperature increase of 2 degrees Celsius could have a damaging effect on water supplies, biodiversity, food supplies, coastal flooding and storms and health. The fourth assessment report shows that emissions of the greenhouse gases that contribute to global warming must fall by 2050 by 50-85% globally compared to the emissions of the year 2000, and that global emissions must peak well before the year 2020, with a substantial decline after that, in order to limit the growth in global average temperatures to 2 degrees Celsius above pre-industrial levels. In the near term, by 2020, emissions from industrialized countries (listed in Annex I of the Kyoto Protocol) need to be reduced by 25-40% below 1990 levels, while substantial deviations from the current trend in developing countries and emerging economies will also be required.

IMPACTS OF CLIMATE CHANGE IN ETHIOPIA

Ethiopia's contribution to global greenhouse gas emissions is negligible, but it is affected by the adverse impacts of climate change brought by the carbon-intensive development paths of rich countries over the past centuries. According to the country's First National Communications to the UNFCCC, climate change evidence is most clearly visible in temperature in Ethiopia with increasing trend in time (0.37°C /decade). There is no clear increasing/decreasing trend of annual rainfall observed at national level. Temperature across the country could rise by between 0.5 and 3.6°C by 2070 (NCCF, 2009). The annual average temperature during 2070-2090 is projected to be 26.92 °C, up by 3.84 °C from the 1960-90 average, whilst average daily rainfall will reduce by 3.5% by the end of the century (CRGE, 2011).

While climate change will affect everyone, it is expected to have a disproportionate effect on those living in poverty in developing countries including Ethiopia. The impacts of climate change are already being experienced in Ethiopia. Ethiopia is highly vulnerable to the harmful effects of global warming on agricultural production and food security, water resources, health, physical infrastructure and ecosystems due to the combination of already fragile environments, dominance of climate-sensitive sectors in economic activity, and low autonomous adaptive capacity (Alemneh Dejene, 2003; Calzadill et.al., 2009).

With a current population growth rate of about 2.8 percent per year, Ethiopia's population is expected to reach 129 million by 2030 (CSA, 2007). Ethiopia's low level of economic development combined with its heavy dependence on agriculture, which is sensitive to climate change and its high population growth rate make the country particularly susceptible to the adverse effects of climate change (CRGE, 2011). This is compounded by the fact that Ethiopia is not able to cope with adverse climate impacts with its own resources and technologies. In spite of tremendous efforts and impressive achievements in the social sectors, around 26 million people out of a total of over 75 million lived below the poverty line by the end of 2006-2007. According to the most recent Human Development Report 2007-2008, the country ranks 169 out of 177 (UNDP, 2008b).

Ethiopia's GDP rises or falls about a year behind changes in average rainfall. With agriculture accounting for 45% of GDP and 80% of jobs, the Ethiopian economy is sensitive to climate variability, particularly variations in rainfall (World Bank, 2005) (Fig. 3). Deforestation and land degradation due to population pressure have aggravated the vulnerability of the ecosystem and have led to reduced agricultural productivity, increased sediment loads and accelerated stream flows (higher floods and reduced base flows). Higher temperature eventually reduces yields of desirable crops, while encouraging weed and pest proliferation. Changes in precipitation patterns increase the likelihood of crop failure and production declines. Although there will be gains in some crops, in some regions of the country, the overall impact of climate change on agriculture are expected to be negative, threatening local and national food security.

The IPCC Fourth Assessment Report (4AR) and national documents such as National Action Plans of Adaptation (NAPA) and Plan for Accelerated and Sustainable Development to End Poverty (PASDEP) have put the sectoral impacts of climate change on the national development agenda. The priority sectors affected by climate change include agriculture and food security, water, health and energy. Ethiopia is heavily dependent on rain-fed agriculture, and its geographical location and topography in combination with low adaptive capacity entail a high vulnerability to adverse impacts of climate change. While regional models predict increases in rainfall, higher resolution analyses of Ethiopia suggest a range that spans both increases and decreases in overall rainfall averages. This also suggests an increase in rainfall variability with the potential for a rising frequency of both extreme flooding and droughts that seriously affects the production and food security of the nation (Box 3).

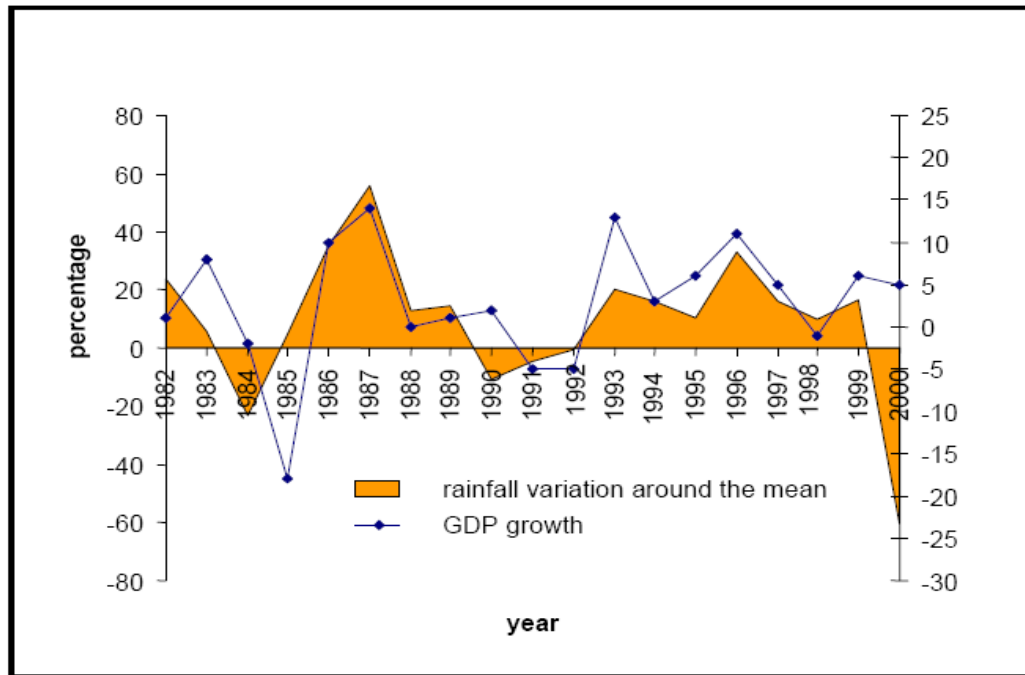


Figure 3. Links between Rainfall and GDP Growth in Ethiopia

Source: The World Bank, 2005)

Climate change will challenge the implementation of current and future development plans. Adjustments and changes will be required at every level: community, national and international. A better understanding of the impacts, costs, changes and communities perceptions of climate change, ongoing adaptation measures, and the decision-making process is important to inform policy makers and sector institutions aimed at promoting successful adaptation strategies for the country.

Ethiopia will need to both mitigate the impacts of climate change, where possible, and adapt to the situation where it cannot be supported with scientific evidence. As impact and response measures will differ regionally, based on the bio-physical and socioeconomic situations within Ethiopia, the management of impacts will need to be defined for each agroclimatic zone based on the analysis of current pieces of information and practices, the scope for variability within these systems and the possibility of alternative farming and livelihoods. Given the challenges outlined above, delivering an integrated response will require an in-depth research on climate change impacts, vulnerabilities and adaptation options of the agriculture sector across different agro-ecologies of the country and enhanced capacity building for the sustainable development of the Country.

The occurrences of droughts are becoming endemic to Ethiopia (Table 1). It is severely affecting the livelihoods of millions of people. The frequency and intensity of its occurrence is increasing in recent years. Flooding is the second most important natural disaster increasing in its occurrence adding more stress on social institutions, and increased the vulnerability of the households (Table 2).

Table 1. The top 10 most important drought occurrences in Ethiopia for the period 1965 to 2008

Year	Number of affected people
1965	1,500,000
1969	1,700,000
1973	3,000,000
1983	7,750,000
1987	7,000,000
1989	6,500,000
1999	4,900,000
2003	12,600,000
2005	2,600,000
2008	6,400,000
Total	53,950,000

Source: "EM-DAT: The OFDA/CRED International Disaster Database, www.emdat.be –Université Catholique de Louvain - Brussels - Belgium". Accessed May 19, 2010.

Table 2. The top 5 most important flood occurrences in Ethiopia for the period 1995 to 2007

Year	Number of affected people
1995	93,875
2003	110,000
2005	235,418
2006	361,600
2007	239,586
Total	1,040,479

Source: "EM-DAT: The OFDA/CRED International Disaster Database, www.emdat.be –Université Catholique de Louvain - Brussels - Belgium". Accessed May 19, 2010.

Box 3. Why Ethiopia is at risk from the Impacts of Climate change

- **Natural resources:** Ethiopia's natural resources base (land, water and biodiversity), its land, water, forests and trees are the foundation of its economic development, food security and other basic necessities of the people. These natural resources are under intense pressure from population growth and inappropriate traditional farming and management practices. There is also a widespread problem related to extensive cultivation, overgrazing and deforestation and consequential soil erosion and soil fertility decline, water scarcity, livestock feed and fuel wood crisis. The quality and management of land management has become an increasing matter of concern due to the additional stress of climate change. Land degradation problems are likely to be exacerbated by a rise in the frequency of extreme weather events (Hurni, 1988).
- **Agriculture:** Growing periods in most localities of Ethiopia will be shortened. Yields from rain-fed agriculture could be reduced by up to 50% (EPA, 2008). Agricultural production, including access to food, in many African countries is projected to be severely compromised (IPCC, 2007b). Projected reductions in yield in some countries could be as much as 50% by 2020, and crop net revenues could fall by as much as 90% by 2100, with small-scale farmers being the most affected. This would adversely affect food security in Ethiopia and exacerbate malnutrition.
- **Biodiversity:** Ethiopia is one of the richest countries in biodiversity owing to the land, soils, and climatic configuration. This richness is the source of economic and social well being through direct provision of food, fiber, and fuel, as well as environmental services including regulation of climate, water, and health services. Species with limited climatic ranges and/or with limited geographical opportunities (e.g. species restricted to Afro alpine ecosystem like Ethiopian Wolf, Walia Ibex and Giant Lobelia), species with restricted habitat requirements and/or small populations are typically the most vulnerable.
- **Extreme Weather events:** Both droughts and floods are already endemic in the country (NCCF, 2009). Droughts destroy farmlands, and pastures, contribute to land degradation, cause crops to fail and livestock to perish. During the 1984–5 drought, GDP declined by around 10 percent and during the recent 2002–3 drought by over 3% (Shibru Tedla, 2004). Drought is also severely affecting hydropower generation. Flooding, in turn, causes significant damage to settlements and infrastructure, livestock and animal health, and the water-logging of productive land undermines agriculture by delaying planting, reducing yields. In addition both droughts and flooding increase the stress on social institutions, and increase the vulnerability of households, particularly those living close to the poverty line, through loss of assets, impaired health, potential conflicts and animal disease with potential risk for humans.
- **Health:** Climate change affects human and livestock health directly through morbidity and mortality impacts of temperature extremes, vectors of infectious diseases, proliferation of non-vector-borne infectious diseases, air quality, floods and storms, and indirectly through impacts on food supply and water resources. Malaria and animal trypanosomiasis will expand their altitudinal range and it is anticipated that other new human, animal and plant diseases will also emerge and increase (IPCC, 2007a).
- **Water:** By 2020, a population of between 75 and 250 million and 350–600 million by 2050, are projected to be exposed to increased water stress due to climate change in Africa. Climate change and variability are likely to impose additional pressures on water availability, water accessibility and water demand in Ethiopia.
- **Energy:** Climate change has impacted on the energy sector by causing a decrease in water resources which, in turn, brings electric energy shortage from hydropower. Global climate change affects developing countries like Ethiopia which are heavily dependent on biomass by reducing the growth and productivity of the biomass energy resources. Power interruptions are becoming common in years of severe drought when water shortages disrupt hydroelectric power generation. The 2002–3 droughts, for example, caused power interruptions that lasted for about four months with a one-day-per-week complete interruption throughout the country and every other day this year (EPA, 2008).

INTERNATIONAL RESPONSE TO CLIMATE CHANGE

At its core, climate change is a cross-cutting issue. Actions to reduce climate change impacts and promote lower-emission economies must reach across a variety of sectors, including energy, agriculture, health, water resources, and forestry. The increasing concentration of the so called Greenhouse Gases (i.e. CO₂, CH₄, N₂O) in the atmosphere as a result of human activities and its possible consequence of global warming/climate change has been an international issue since the 1980's. Governments responded to the problem of climate change by adopting the United Nations Framework Convention on Climate Change (UNFCCC) at UNCED in 1992 which was held in Rio de Janeiro. The ultimate objective of the UNFCCC has been to stabilize the concentration of greenhouse gases in the atmosphere at a safe level (i.e. to avoid dangerous interference with the climate system). The Kyoto Protocol which commits developed country parties to reduce on average 5.2% of their 1990 greenhouse gas emission level by 2010 was also adopted in 1997. The Kyoto protocol is to date the only international agreement that calls for action to reduce emissions of CO₂. However, the protocol fails to include USA, the world's largest CO₂ emitter. The protocol's target completion dates also effectively precluded the participation of developing countries that had experienced great economic growth, such as China, India, Brazil and South Africa. Projection suggests that, by 2050, China's cumulative contributions of CO₂ to the atmosphere will exceed those of the United States (UNDP, 2008b).

The next major international-level efforts were made in 2005 and 2007. The latter was conducted in Bali in December 2007, where governments agreed under the United Nations Framework Convention on Climate Change (UNFCCC) that they would seek to reach agreement on a number of these cross-cutting issues by the 15th Conference of the Parties in Copenhagen in December 2009 (Copenhagen Accord, 2009).

The international negotiations on future action on climate change so far have proceeded along a "two-track" approach (UNDP, 2008b):

- The first track was launched in 2005 and the second in 2007. The first track deals with the commitments for the industrialized countries (Annex I Parties) under the Kyoto Protocol for the period beyond 2012 when the first period of emission reduction commitments (2008-2012) expires. It deals in particular with emission reduction targets and means of implementation. These negotiations were launched in December 2005 at the first session of the Conference of the Parties serving as the Meeting of the Parties to the Kyoto Protocol (CMP 1) in Montreal. The work is being carried out under a specially established subsidiary body – the Ad Hoc

Working Group on Further Commitments for Annex I Parties under the Kyoto Protocol (AWG-KP).

- The second negotiating track was launched under the Convention two years later in December 2007. The Conference of the Parties at its thirteenth session (COP 13) held in Bali adopted the Bali Action Plan. It launched “*a comprehensive process to enable the full, effective and sustained implementation of the Convention through long-term cooperative action, now, up to and beyond 2012*, in order to reach an agreed outcome and adopt a decision at its fifteenth session in Copenhagen in December 2009”.

The Bali Action Plan identified four main building blocks for enhancing action on climate change: mitigation, adaptation, technology and financing, and requested the negotiations to articulate a shared vision for long-term cooperative action, including a long-term global goal for emission reductions. To carry out the work, a new subsidiary body was established under the Convention – the Ad Hoc Working Group on Long-term Cooperative Action under the Convention (AWG-LCA), which was requested to complete its work by Copenhagen (UNDP, 2008b).

The two AWGs in their first year of work (2008) had a rather slow start focusing on planning, and clarifying ideas and procedures. In 2009, the AWG-LCA and the AWG-KP held five negotiating sessions prior to the Copenhagen conference. Negotiations under the AWG-KP made little progress in 2009. Developing countries urged Annex I Parties to commit to ambitious emission reduction targets, while developed countries argued that making progress on aggregate and individual emission reduction targets and in general effectively responding to climate change required the involvement of the United States and major developing countries. Moreover, there was no agreement over the legal structure of the future framework and on the continuation of the Kyoto Protocol beyond 2012. Developed countries saw a single new agreement coming out of both negotiating tracks (AWG-KP and AWG-LCA) as an outcome, while developing countries wanted to see the Kyoto Protocol amended and continued post-2012.

The AWG-LCA in 2009 developed various negotiating texts containing numerous areas of disagreement. While some progress was made on adaptation, reducing deforestation and forest degradation in developing countries plus conservation (REDD-plus) and technology, negotiations on finance and mitigation did not move much forward. Overall, by the time of the Copenhagen conference, the negotiations in the two AWGs had achieved less than what was needed for an ambitious outcome.

The Outcome from the Copenhagen Conference

The Copenhagen conference was attended by over 45,000 participants, including observers and negotiators, and 119 Heads of State. According to the reports by the media, this conference was the largest one in the history of the United Nations, and certainly the largest political event ever focused on climate change. However, despite this high level of political attention to the issue, it was becoming already clear before the conference that reaching a comprehensive post-2012 agreement in Copenhagen would not be possible. While some progress had been made at the technical level in the various negotiating tracks under the Bali Road Map during 2008-9, high-level political guidance was required to resolve the main crunch issues – in particular, commitments by industrialized countries; mitigation actions by developing countries; financing and technology transfer; and measurement, reporting and verification (MRV) of actions and of support (Copenhagen Accord, 2009).

In Copenhagen both the AWG-KP and AWG-LCA presented the outcomes of their work as was requested by their mandates. However, no substantive decisions were finalized for adoption on the work done by the AWG-LCA and AWG-KP in the contact groups under the COP and CMP respectively.

During the last two days in Copenhagen, a group of Heads of State representing the major GHG emitters and the main negotiating groups under the UNFCCC negotiated a Copenhagen Accord in a parallel informal setting – a document outlining a political compromise on the main elements of enhanced action on climate change by those countries. The Copenhagen Accord was presented to all Parties to the Convention with an intention to further consult and gain support for its adoption through decisions by the COP and CMP (Box 4). This effort failed due to opposition from several countries. As a result, the following decisions were made:

- It was decided that both COP 15 and CMP 5 “took note” of the Copenhagen Accord in their final decisions.
- Parties were asked to formally communicate their association with the document to the UNFCCC Secretariat by 31 January 2010.
- It was also decided to extend the mandates of the AWG-LCA and AWG-KP by one more year and the bodies were asked to complete their work for adoption of the outcomes at the next climate change talks in Mexico in December 2010.

- The AWG-LCA was asked in its future work to take into account the results of the work carried out by the COP in Copenhagen on the basis of the texts forwarded by the AWG-LCA in its report.

The Copenhagen Accord was not formally adopted as a decision under the UNFCCC but rather noted by the Conference of the Parties (both COP and CMP) as a political declaration. Parties were asked to communicate to the UNFCCC Secretariat by 31 January 2010 their support of the agreement through written

Box 4. Major issues of the Copenhagen Accord

- Countries commit to keeping global temperature rise below 2°C through deep cuts in GHG emissions, achieving peaking of global emissions as soon as possible, while noting that emissions in developing countries will take longer to reach their peak.
- Annex I Parties commit to implement individually or jointly quantified economy-wide emissions targets for 2020.
- Non-Annex I Parties will implement nationally appropriate mitigation actions (NAMAs). Least Developed Countries (LDCs) and Small Island Developing States (SIDS) may undertake these actions voluntarily and on the basis of external financial support. Mitigation actions taken by non-Annex I Parties will be subject to domestic MRV procedures and reported on every two years through National Communications. However, internationally supported NAMAs will be subject to international MRV procedures.
- Parties to the Kyoto Protocol are requested to “further strengthen the emission reductions initiated by the Kyoto Protocol” and notes the important role of markets in future climate change policy.
- The Accord further notes that social and economic development and poverty eradication are the first and overriding priorities of developing countries and that a low-emission development strategy is indispensable to sustainable development.
- The Accord also calls for the immediate establishment of a mechanism including so called REDD-plus, aimed at reducing deforestation, forest degradation and promoting forest conservation, to enable the mobilization of financial resources from developed countries.
- New and additional resources from developed countries in the amount of “approaching USD 30 billion” for the period 2010-12, with balanced allocation between adaptation and mitigation, is pledged, with USD 100 billion per annum envisaged from 2020 onward.
- Funding for adaptation will be prioritized for the most vulnerable developing countries, such as LDCs, SIDS, and Africa.

Source: Copenhagen Accord, 2009.

submissions. Countries were further asked to submit by the same date their pledges for emission reduction targets (for industrialized countries) and for

mitigation actions (for developing countries) for the period up to 2020, which would then be reflected in the Appendices to the Accord.

Despite the fact that the Copenhagen Accord is a political declaration and not accepted as a COP outcome, it is being considered and supported by many Parties. As of the 27th of May 2010, of the 193 Parties to the Convention more than 126 countries had officially communicated their support to, or association with, the Copenhagen Accord through written submissions. All developed countries and 36 developing countries had further provided information on the mitigation commitments or actions that they would undertake. Ethiopia is one of the first countries that accepted the Accord and is contributing towards its implementation very actively. African Union has also accepted the Accord. However, there are many parties including Civil Societies and countries who are strongly opposing the accord due to various reasons. They argue that the Accord undermines the UN process, the agreed principles of the UNFCCC and Kyoto Protocol, especially equity and common but differentiated responsibility, and threatens a deal under the UN that will truly safeguard developing countries' future. They call on all countries to return to the multilateral UN process, and to build on the progress made before and during the Copenhagen meeting on the two tracks of the negotiations to implement the UNFCCC and its Kyoto Protocol.

The Outcome from the Cancun Conference

The 17th Conference of Parties (COP) of the United Nations Framework Climate Change Conference (UNFCCC) was held in Cancun, Mexico from 23 Nov. - 10 December 2010. Even though, reaching into a conclusive legally binding agreement at Cancun was impossible, the Conference ended with the adoption of a balanced package of decisions that set all governments more firmly on the path towards a low-emissions future and support enhanced action on climate change in the developing world in a transparent and inclusive process can create opportunity for all. The package, called the "Cancún Agreements" was welcomed to repeated loud and prolonged applause and acclaim by Parties in the final plenary.

Elements of the "Cancún Agreements" that need attention include:

- Industrialized country targets are officially recognized under the multilateral process and these countries are to develop low-carbon development plans and strategies and assess how best to meet them, including through market mechanisms, and to report their inventories annually.

- Developing country actions to reduce emissions are officially recognized under the multilateral process. A registry is to be set up to record and match developing country mitigation actions to finance and technology support from by industrialized countries. Developing countries are to publish progress reports every two years.
- Parties meeting under the Kyoto Protocol agree to continue negotiations with the aim of completing their work and ensuring there is no gap between the first and second commitment periods of the treaty.
- The Kyoto Protocol's Clean Development Mechanisms has been strengthened to drive more major investments and technology into environmentally sound and sustainable emission reduction projects in the developing world.
- Parties launched a set of initiatives and institutions to protect the vulnerable from climate change and to deploy the money and technology that developing countries need to plan and build their own sustainable futures.
- A total of \$30 billion in fast start finance from industrialized countries to support climate action in the developing world up to 2012 and the intention to raise \$100 billion in long-term funds by 2020 is included in the decisions.
- In the field of climate finance, a process to design a Green Climate Fund under the Conference of the Parties, with a board with equal representation from developed and developing countries, is established.
- A new "Cancún Adaptation Framework" is established to allow better planning and implementation of adaptation projects in developing countries through increased financial and technical support, including a clear process for continuing work on loss and damage.
- Governments agree to boost action to curb emissions from deforestation and forest degradation in developing countries with technological and financial support.
- Parties have established a technology mechanism with a Technology Executive Committee and Climate Technology Centre and Network to increase technology cooperation to support action on adaptation and mitigation.

The Outcome from the Durban Conference

The United Nations Climate Change Conference, Durban 2011 (COP 17) ended by delivering a road map for a universal legal agreement on climate change to be finalized as soon as possible, but not later than 2015, to be adopted and come into

force from 2020 in a balanced fashion (the implementation of the Convention and the Kyoto Protocol, the Bali Action Plan and the Cancun Agreement). All Governments meeting at the COP 17 recognized the need to raise their collective level of ambition to reduce greenhouse gas emissions to keep the average global temperature rise below 2 degrees Celsius. The Durban Roadmap for the first time in the history of the UNFCCC sets up a process to negotiate a comprehensive and balanced legal instrument to avert climate change; the legal instrument which would come into force by 2020. The “agreed outcome with legal force under the convention applicable to all parties” will require more decisive action in emission reduction from all countries, including emerging economies like the BASIC nations.

The outcomes of Durban Conference included a decision by Parties to adopt a universal legal agreement on climate change as soon as possible, and no later than 2015. The major elements of the Durban Conference outcomes are the following:

- The Durban conference agrees to launch "a process to develop a protocol, another legal instrument or an agreed outcome with legal force". It agrees that this work should be completed by 2015, so that this new agreement or outcome can be implemented from 2020.
- The conference agrees that the process should raise the 'level of ambition' so that the world can close the emission gap and keep below the 2°C or 1.5°C average temperature increase. This would keep the world on track from avoiding catastrophic impacts. The key issue is to ensure that equity will be the basis of deciding the emission reduction targets of the future.
- The conference agreed on the next phase of the Kyoto Protocol -- the only legal instrument in force to combat climate change. It also set a clear target of reductions of 25-40 per cent below 1990 levels by 2020 for the group of countries that are collectively known as Annex 1 parties -- listed for their contribution to the stock of greenhouse gases in the atmosphere. This second commitment period under the Kyoto Protocol would begin on January 1, 2013 till December 2017-2020.
- The Green Climate Fund has also been agreed upon. The most contentious issue in the setting up on the fund was its governance and to whom the fund would be accountable to? It has been agreed that the fund will function under the conference of parties to the climate convention; it will have 24 members, equally from developed and developing with representatives from small island nations and least developed countries; co-chairs will also be similarly divided. Because of opposition from key developing countries. But as the fund has no real or promised money, it will be an empty shell and a shallow victory. The industrialized countries

want the private sector to contribute, but nothing is clear, where the much-needed funds for mitigation and adaptation will come from.

However, reaction to the deal has been mixed. Some emerging economies were arguing for space for basic development for their people and poverty eradication. Others have indicated that the deal struck in Durban still falls short of the ambitious cuts needed to avert global warming. The sources of the long-term finance to fill the Green Climate Fund (GCF) were also contentious issue. It is clear from this conference that the fight to reduce emissions effectively in an unequal world will be more difficult in the years to come. But it is a conference, which has put the issue of equity into the negotiations. Answers to these and many other concerns will be discussed during the next few years including the months in the run –up to COP 18, which will be held in Qatar in 2012.

ETHIOPIA'S RESPONSE TO CLIMATE CHANGE

Even though its contribution to global greenhouse gas emissions is negligible, Ethiopia is being affected by the adverse impacts of climate change brought by the carbon-intensive development paths of rich countries over the past centuries. As a consequence, Ethiopia, has been taking measures to mitigate and adapt to climate change since the 1970s. GOs, NGOs and CBOs have been planting billions of trees. Thousands of hectares of land have been terraced to protect land degradation and improve land productivity. Water harvesting has been practiced extensively throughout the country following the incidence of drought during 2003/4. All these activities are to reduce soil erosion, minimize gully formation, increase ground water, abound springs and streams and eventually minimize the incidence of extreme events like drought and flood (Shibru Tedla, 2004; Alemneh Dejene, 2003).

As a strategy for rehabilitating degraded lands (and those being affected), the Ministry of Agriculture and Rural Development (MoARD), produced the community based participatory watershed guideline (Lakew Desta et al., 2005) as the country wide tool to tackle land degradation and rehabilitate degraded lands. This strategy has now been adopted by all the regions, particularly the four regions (Amhara, Oromia, Southern and Tigray regions), and through the process millions of hectares of land is being rehabilitated. The strategy is also a major tool in the community asset building component of the Productive Safety net Program (PSNP) which is funded by the government and international donors and is being implemented in about 300 food insecure weredas of the country. The government has also, for the first time, gazetted the Rural Land Administration and Use Proclamation in 2005 that guarantees rural land ownership rights through issuance of title certificates and also emphasizes the need to conserve rural land and protect

it from degradation (by following watershed principles) by rural land owners. In general, the rehabilitated community watersheds now support many farmers' households and unemployed and landless youth for their livelihoods; the experience has now become a model for many developing African countries.

The Ethiopian Government has established the Environmental Protection Authority (EPA) as responsible institution to ensure the implementation of the UNFCCC² and its Kyoto Protocol in a coordinated and yet decentralized manner. Recognizing the urgency and inter-sectoral nature of environment, it has also established the Environment Council (EC) by proclamation to provide overall leadership in environmental policy and regulatory systems and to provide high-level oversight of Environmental standards and directives. It is chaired by the Deputy Prime Minister of the country and its members are Federal Ministries, all Regional State presidents, representative of Trade Unions, Environmental NGOs, and the Ethiopian Chamber of Commerce. It is the highest-level decision-making body in government for the environment. The Environmental Protection Authority is the secretariat of the EC.

To address its poverty and food insecurity challenges, Ethiopia has instituted a series of development strategies in line with the principles of the Millennium Development Goals (MDGs). The goals and targets have been reflected in the country's Poverty Reduction Strategy Plans. However, overcoming rural poverty and improving food security, within the context of the ongoing climate change, natural resource degradation and subsistence farming systems, are key development challenges facing the country.

The Ethiopian Government has already put in place a number of policies, strategies and programmes aimed at enhancing the adaptive capacity and reducing the vulnerability of the country to climate variability and change. Such programmes include the Plan for Accelerated and Sustainable Development to End Poverty (PASDEP), the Environmental Policy, and the Agriculture and Rural Development Policies and Strategies. The Environment Policies of Ethiopia (EPE) and Conservation Strategy of Ethiopia (CSE) are the two umbrella instruments regarding the environmental management in Ethiopia. These instruments were approved in 1997 and responded to the then apparent environment and development challenges of the country. Most policy recommendation contained in the EPE and CSE are very much relevant to the CC mitigation and adaptation (EPA, 2008).

In 2005, Ethiopia formulated its five-year MDG-based Medium-Term Development Plan entitled "A Plan for Accelerated and Sustained Development

² The focal institution for coordinating UNFCCC until Copenhagen Conference used to be the National Meteorology Agency.

to End Poverty (PASDEP 2005-2010)”. PASDEP I has clearly identified that atmospheric pollution and climate change are the cause of considerable environmental and socio-economic problems (PASDEP, 2005). The impacts of climate change and atmospheric pollution include weather variability, loss of pastureland, droughts, flood and thus food insecurity and other environmental related health problems. Proposed intervention measures include: developing a federal strategy, standards and law to improve urban air quality; developing a national strategy to enhance coping mechanisms regarding the adverse impacts of climate change; and launching environmentally sound investment and other programmes that foster cleaner development mechanisms, including emissions trading. Ethiopia’s Growth and Transformation Plan (GTP) has recently prepared (2010/11-2014/15) with the objective of building a carbon neutral and climate resilient economy (MoFED 2010). Enforcement of the existing environmental laws is priority actions in connection with environmental conservation and climate change. The formulation and implementation of climate change adaptation and mitigation programmes are highlighted as priority activities.

In response to the UNFCCC calls for the specific needs and special situations of less developed countries (LDC) to be addressed in the form of Climate Change National Adaptation Programmes of Action (NAPA), Ethiopia has prepared “Climate Change National Adaptation Programme of Action (NAPA) of Ethiopia in 2007 (NAPA, 2007). Central to the NAPA process is the integration of climate change adaptation activities with national development policies to ensure effective implementation of adaptation activities. The NAPA process in Ethiopia identified arid, semi-arid and dry sub-humid areas of the country as being most vulnerable to drought; agriculture was identified as the most vulnerable sector; and in terms of livelihoods, small-scale rain-fed subsistence farmers and pastoralists are identified as the most at risk. The NAPA process has identified and prioritized eleven project areas that address the immediate climate change adaptation needs in the country, focusing on human and institutional capacity building, improving natural resource management, enhancing irrigation agriculture and water harvesting, strengthening early warning systems and awareness raising. However, implementation of NAPA activities is not progressing as expected due to financial capacities.

A project entitled “Supporting integrated and comprehensive approaches to climate change adaptation in Africa - Supporting climate resilient sustainable development in Ethiopia” has been signed by EPA and UNDP to support the Ethiopian Leadership in the establishment of an integrated approach to Ethiopia’s management of climate change opportunities and risks. It will support the integration of climate change into the planning and implementation of PASDEPII by ensuring the Agriculture, Energy, Environment, Health and Water sectors

(UNDP, 2010). The programme will pilot approaches to managing climate change risk at the community level in 50 Woredas that integrate traditional or innovative approaches with adaptive practices that are informed by climate risk forecasting. Lessons emerging from these pilot interventions will feed into improving coordinated approaches for climate change adaptation actions. Using the evidence and experience generated, in collaboration with federal and regional public agencies, the private sector, community organizations and other actors and partners, EPA will prepare a strategy to mainstream climate change at all levels and in all sectors as well establish a mechanism that enables the transfer of technology and finance for the construction of a carbon neutral and climate resilient economy in Ethiopia.

Following the Bali Road Map and the Copenhagen Accord, Ethiopia is preparing itself to tackle climate change involving two concurrent approaches: **Mitigation** (actions that **tackle the causes** of climate change, such as reducing greenhouse gas emissions) and **Adaptation**: actions that minimize the consequences of actual and expected changes in the climate. These processes are inherently linked. However, Ethiopia's priority is more on the adaptation of climate change. Adaptation is a way of reducing vulnerability, increasing resilience, moderating the risk of climate impacts on lives and livelihoods, and taking advantage of opportunities posed by actual or expected climate change. Although climate change is a global issue, the impacts of climate change are felt locally. Managing the impacts, including adaptation, is a national issue, taking place at national (for example energy and water management), community and individual levels. Adaptation requires a very different project development and implementation framework than climate change mitigation efforts (Box 6).

In response to the Copenhagen Accord call for the Non-Annex I Parties to prepare and implement Nationally Appropriate Mitigation Actions (NAMAs), Ethiopia has prepared its NAMA and submitted to the UNFCCC secretariat (EPA, 2010a). Key mitigation technologies and practices included in the Ethiopia's NAMA are presented in Box 7.

Box 6. Key principles to be followed for planning Adaptation measures to climate change

- Follow a country-driven approach to adaptation;
- Be based on, and guided and informed by the best available science and traditional knowledge, as appropriate;
- Involve all relevant stakeholders through a participatory approach to ensure ownership and inclusiveness.
- Integrate adaptation actions into sectoral and national planning of sustainable development;
- Adequate institutional arrangements;
- Strong coordination of ongoing activities by GOs, NGOs and CBOs

Source: various negotiation texts of AWG-LCA

Adaptation is fundamentally about sound, resilient development, and therefore is already reflected in many ways in Ethiopia's ongoing development programs. It encompasses action to reduce the vulnerability and build the resilience of ecological and social systems and economic sectors to present and future adverse effects of climate change in order to minimize the threats to life, human health, livelihoods, food security, assets, amenities, ecosystems and sustainable development. Adaptation actions in the Ethiopian context should be planned and implemented at local, woreda, regional, national and global levels through finance, technology and capacity-building. Enhanced cooperation among communities, governmental, non-governmental and international organizations that are implementing adaptation and related activities, in order to encourage synergy and ensure coherence across adaptation actions.

Box 7. Key mitigation Technologies and Practices in the Ethiopia's NAMA by sectors

- **Renewable energy: including** 10 hydro powers with a total of 5632 MW that will be completed from 2010 to 2015), 11 under study with a total capacity of 8915 MW; 7 wind power projects with a total of 764 MW to be completed until 2013; and 6 geothermal projects with a total of 450 MW to be completed until 2018.
- **Bio-fuel Development** to produce 63.36 million liters of ethanol and 621.6 million liters of biodiesel for the market starting from 2010 up to 2015.
- **Electricity Generation from Renewable Energy for Off-grid use and direct use of renewable Energy** including 150 000 solar home systems, 65 000 Small Hydro Projects, 600 wind or solar pumps, 3 000 institutional PV, 3 000, 000 solar Lantern, 3500 Solar water heating, 10 000 solar cookers, 9,110, 000 improved stoves, 125 000 household biogas digesters and 1000 institutional biogas digesters starting from 2010 up to 2015.
- **Transport:** Construction of 9 National Railway routes covering 4885 KMs to be completed up to 2020.
- **Forestry:** reforestation of 21 440 km² degraded lands, lands affected by gullies and slopes, managing 28736.7 km² natural forests, 4390.96 km² deciduous forest, 60360 km² of national parks, 19817 km² non-timber forests, establish 52695 km² production forests, and managing 51496 km² wetlands.
- **Agriculture: Composting** 80000 km² of agricultural land and 261840 km² of practicing agro-forestry.
- **Waste management:** Landfill methane recovery from 9 landfills from a total of 43 million m³ of deposited waste.

Source: EPA, 2010a. Nationally Appropriate Mitigation Actions (NAMAs) report, Ethiopia.

EPA has also formulated a programme of Adaptation to Climate Change for the country to respond to the increasing impacts of climate change (EPA, 2010b). The draft was reviewed in a national workshop on 3-4 March 2010 in

Addis Ababa. The participants came from various federal government agencies, regional governments, research organizations, institutions of higher education, religious institutions, national non-governmental organizations and the private sector. The sectoral ministries and all the Regional Governments are expected to

Box 8. Priority actions to be taken for implementing adaptation measures to climate change

- Identifying the risks posed by climate change and mapping the areas likely to suffer;
- Establishing simple and practical information network;
- Creating/strengthening a vibrant early warning system;
- Mainstreaming into development and service activities;
- Integrating adaptation to climate change into educational curricula at all levels;
- Enhancing an integrated research and development activities on climate change; and
- Accessing financial resources and technologies for the implementation of climate change adaptation.

Source: EPA, 2010b. Ethiopia's Draft Programme of Adaptation to Climate Change

jointly mobilize all the stakeholders down to the local community at the village level in formulating and implementing their responsibilities. About 20 problems and the actors responsible for their solutions have been identified in the areas of health, agriculture, forestry, land management, water, energy, waste, transport, industry, infrastructure, municipalities and disaster management at different levels (EPA, 2010b).

Actions to be taken and the respective actors and lead institutions to obtain the intended solutions to the problems are spelt out (Box 8). About 26 technologies have also been identified and prioritized by EPA for further enrichment and customizations by the different institutions and localities.

The Government of the Federal Democratic Republic of Ethiopia has also initiated the Climate-Resilient Green Economy (CRGE) initiative to protect the country from the adverse effects of climate change and to build a green economy that will help realize its ambition of reaching middle income status before 2025 (CRGE, 2011). The objective is to identify green economy opportunities that could help Ethiopia reach its ambitious growth targets while keeping greenhouse gas emissions low. The government intends to attract development partners to help implement this new and sustainable growth model and to become a "green economy front-runner".

The Climate-Resilient Green Economy (CRGE) initiative follows a sectoral approach and has so far identified and prioritized more than 60 initiatives,

which could help the country achieve its development goals while limiting 2030 GHG emissions to around today's 150 Mt CO₂e – around 250 Mt CO₂e less than estimated under a conventional development path. The green economy plan is based on four pillars (Box 9). Implementing the initiatives would also offer important co-benefits such as improved public health, through better air and water quality, and would promote rural economic development by increasing soil fertility and food security.

Box 10. The Ethical issues in the Climate Change Negotiation

- Burning of fossil fuel has powered the economic growth of the developed nations over the last 200 years. So in this sense GH pollution has been inseparable from growing rich. Therefore, the “**polluter pays principle**” is widely accepted as a guide to who should take responsibility for environmental damage. Industrialized countries should take the responsibility to global warming. However, in recent years, some large developing countries – especially China, India, Brazil and South Africa – have been growing rapidly in recent years and their GHG emission has been growing too.
- In addition to the polluter pay principle, another widely accepted fairness principles is that of “**ability to pay**”. Nations or organizations that are well developed following carbon intensive development approach should be required to do more than those that are poorer. The parties of developed countries should take the lead in combating climate change and the adverse effects thereof. The contribution of countries to climate change and their capacity to prevent and cope with its consequences vary significantly. The UNFCCC therefore calls for financial assistance from countries with more resources to those less endowed and more vulnerable.
- The principles of “**common but differentiated responsibilities**” as key guiding principles for climate change policies have been reiterated by developing countries in Bali and the recent climate talks held in Copenhagen and beyond. It recognizes historical differences in the contributions of developed and developing States to global environmental problems, and differences in their respective economic and technical capacity to tackle these problems (UNFCCC).

Source: UNDP, 2010. The outcomes of Copenhagen: The Negotiations and the Accord. UNDP Environment and Energy Group, Climate Policy Series.

OPPORTUNITIES FOR FUNDING SOURCES

Climate change is as much an ethical issue as a science and economic one (Box 10). Since climate change takes place mainly due to the cumulative emissions over time leading to increased concentration of GHGs in the Earth's Atmosphere, and GH pollution has been inseparable from industrial growth, industrialized

Box 9. The four pillars of the green economy plan:

1. Improving crop and livestock production practices for higher food security and farmer income while reducing emissions;
2. Protecting and re-establishing forests for their economic and ecosystem services, including as carbon stocks;
3. Expanding electricity generation from renewable sources of energy for domestic and regional markets;
4. Leapfrogging to modern and energy-efficient technologies in transport, industrial sectors, and buildings.

Source: Federal Democratic Republic of Ethiopia (2011). Ethiopia's Climate-Resilient Green Economy. Green economy strategy.

countries should take the responsibility to global warming. So, the developed countries should take the lead in combating climate change and the adverse effects thereof. The contribution of countries to climate change and their capacity to prevent and cope with its consequences vary significantly.

The UNFCCC therefore calls for financial assistance from countries with more resources to those less endowed and more vulnerable. In addition to the polluter pay principle, another widely accepted fairness principle is that of "ability to pay". It says nations or organizations that are well developed following carbon intensive development approach should be required to do more than those that are poorer.

The provisions of the Convention and the Kyoto Protocol foresee financial assistance from developed to developing country Parties through the financial mechanism of the Convention, as well as through bilateral, multilateral or regional channels. The Global Environment Facility (GEF) has been acting as the entity entrusted with the operation of the financial mechanism of the UNFCCC, subject to review every four years. In addition, several special funds have been created under the Convention and the Kyoto Protocol, including: the Special Climate Change Fund, the Least Developed Countries Fund, and the Adaptation Fund (UNDP, 2010).

The CDM (Clean Development Mechanism) under the Kyoto Protocol is also contributing to financing lower-carbon development in developing countries while assisting developed countries in meeting their emissions targets. The CDM also generates resources for the Adaptation Fund through a share of proceeds. Out of the globally registered CDM projects as at 28 April 2009 (which were 1596), Africa has only 30 projects (<http://cdm.unfccc.int>©27.04.2009 14:53). Asia and the Pacific have registered 1141 projects. China and India are the major recipient

countries. In Africa, only few countries like South Africa and Kenya are in a better position. However, Ethiopia did not use as effectively as it was anticipated due to capacity problems. Although the country has considerable CDM potentials, Humbo Ethiopia Assisted Natural Regeneration Project (June 19, 2009) is the only registered CDM project. It involves the restoration of indigenous tree species in a mountainous region of South Western Ethiopia. The project contributes to climate change mitigation objectives by contributing to the GHG removals through assisted natural regeneration project.

The Government of Ethiopia has reaffirmed its commitment on the climate agenda and is determined to change the inevitable multiple and serious challenges related to climate change challenges into opportunities when it is possible. To this end, it has opted for a coordinated and synergistic approach starting from the lowest effective administrative unit. The first step taken in this regard is the designation of EPA to lead the process of implementing and ensuring effectiveness of the climate agenda in a coordinated and yet decentralized manner. EPA is in the process of reorganizing itself to efficiently deliver its leadership role in connection to “environment for development” issues. The capacity of EPA also needs to be enhanced in order for it to coordinate and monitor matters related to the management of risks associated with climate change. The private sector, , CBOs and civil societies need support in order to enable them to contribute in the national effort to develop a Carbon neutral and Climate Resilient economy. The country has taken the necessary measures in response to the outcomes of the international agenda and the national needs on adaptation to climate change and mitigation of greenhouse gases. Currently a National Adaptation Framework Programme comprising of 20 vulnerable sectors and groups has been developed, negotiated and accepted by the different stakeholders including GOs, NGOs and CBOs. Furthermore, the Nationally Appropriate Mitigation Actions of Ethiopia which comprises of various sectors and 83 concrete projects are registered by the Secretariat of the UNFCCC in line with the Copenhagen Accord requirement.

However Ethiopia needs to do more than this. The country should build its local capacity to clearly analyze climate change impacts and develop agricultural technologies that can be used to adapt to the changes. Since the country does not have much spare land to plant forests, the approach should be a combined approach through community watershed development where soil erosion is arrested through the construction of various physical structures, and water harvesting is done to support agro-forestry development on degraded sloppy lands. In general, proper land use planning should be performed to designate lands for agriculture, bio-diesel and other purposes.

Agreement on the provision of significant financial support by developed countries was among the most significant outcomes of the Copenhagen conference. In the Copenhagen Accord, developed countries collectively

committed to provide new and additional resources, including through international institutions, approaching USD 30 billion for the period 2010 to 2012, with balanced allocation between adaptation and mitigation. Funding for adaptation will be prioritized for the most vulnerable developing countries, such as the LDCs, SIDS, and Africa. This requires a considerable capacity and coordination of efforts by GOs, NGOs CBOs and local communities. In this regard, EPA needs to take a leadership role to exploit the opportunities.

In addition, in the context of meaningful mitigation actions and transparency on implementation, developed countries committed to a goal of jointly mobilizing USD 100 billion dollars a year by 2020 to address the needs of developing countries. This funding would come from a wide variety of sources: public and private, bilateral and multilateral, including alternative sources of finance. While this was a very positive development, it is not entirely clear from the text whether the USD100 billion annually would only be provided for mitigation, or whether it also included resources for adaptation. According to the Copenhagen Accord, new multilateral funding for adaptation will be delivered through effective and efficient fund arrangements, with a governance structure providing for equal representation of developed and developing countries. However it doesn't explain how it would relate to the existing financial mechanisms.

THE WAY FORWARD AND POLICY IMPLICATIONS

Ethiopia, with a land area of 1.13 million km², is characterized by considerable diversity in terms of its bio-physical environment and its cultural and ethnic composition. This has resulted in a variety of different ecosystems based on local differences in the micro-climate, soil properties, vegetation types and water resources. As a result, the impacts of climate change are likely to be highly spatially variable and so are the response measures.

Ethiopia's contribution to global greenhouse gas emissions is negligible, but it is affected by the adverse impacts of climate change brought by the carbon-intensive development paths of rich countries over the past century. Ethiopia is hit harder than most countries by drought and its devastating consequences. Recurrent droughts have resulted in loss of life and property as well as the migration of people. Drought frequency is predicted to increase placing stress on already vulnerable production systems.

Considering that the adverse effects of climate change pose an additional burden to development goals, integrating adaptation into sustainable development is necessary, and is already being considered and implemented by many GOs, NGOs and CBOs, although it is still in its early stages. Sustainable development in the context of climate change is a particular challenge for Ethiopia, particularly

as it has diverse and fragile ecosystems and has been among the first to experience the direct effects of climate change.

There is lack of communication among different agencies, civil society organizations and the private sector regarding the responses to climate change. This has resulted in redundancy and inefficiency. Organizations do not tend to work together in an integrated manner to deliver adaptation-relevant solutions. EPA and the recently established Environment Council, which draws its membership from federal Ministries Presidents of National Regional States, trade unions, civil society organizations and the private sector should work to improve this current lack of coordination and provide central leadership for climate change. The recent high level decision which gives the EPA to coordinate the climate change agenda in the country will hopefully bring better coordination, but the organization should also strengthen itself to backstop others and prioritize fundable projects by donors. However, the individual and institutional capacity of EPA at all levels to coordinate is limited and need to be substantially improved.

A major obstacle to integrating climate and development at local level stems from lack of capacity and strong institutions that can coordinate and lead the local efforts. This is matched by a lack of technically skilled manpower at regional and national levels. Therefore, capacity building should be considered as a central tenet to coping the impacts of climate change from federal through to local levels.

Evidence based data and understanding of the drivers and impacts of climate change, vulnerabilities and perceptions of stakeholders to inform policy makers and sectoral institutions so as to promote successful adaptation strategies for the country is scanty. As impacts will differ regionally, based on the bio-physical and socioeconomic situations within Ethiopia, adaptation and mitigation technology options will need to be defined for each ecosystem based on the analysis of current information and practices, the scope for variability within these systems and the possibility of alternative farming systems and livelihoods. Therefore, Ethiopia needs to establish an agenda of well coordinated research and action built on an enhanced understanding of the relationship between climate change and the key social dimensions of vulnerability, social justice and equity. The action-oriented agenda requires a dual-track approach: pro-poor adaptation and appropriate mitigation actions.

Demonstrations and outreach efforts to scale up adaptation and mitigation technology options to coping climate change for local communities and particularly to the most vulnerable remains inadequate. The need for differentiated support for men and women in the community; based on their roles and access to resources, social networks and information; needs to be factored in to outreach programmes so that gender-sensitive adaptation approaches are promoted. Adaptation and mitigation efforts should target actions in selected

Woredas, so that adaptation approaches can be piloted and prepared for larger scale delivery (Belay Simane, 2006). The use of the Community-lead Environmental Conservation for Sustainable Development, the Local Level Participatory Planning Approach from MERET and the Local Environmental Action Plan of EPA, together with engagement of all stakeholder groups will ensure local demonstration and outreach in target.

The understanding of climate change, its manifestation and its impacts is limited to a few experts and decision-makers. Therefore, there is a need for a greater awareness creation of climate change and its response measures for policy makers and development workers through a carefully articulated communications process that draws on evidence and experience from the field with key stakeholders.

Ethiopia is experiencing the effects of climate change. Besides the direct effects such as an increase in average temperature or a change in rainfall patterns, climate change also presents the necessity and opportunity to switch to a new, sustainable development model. It is also aware of the important role that developing countries play in fighting climate change, and has consequently taken on a constructive role in international climate negotiations.

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REFERENCES

- Alemneh, Dejene, 2003. "Environment, Famine, and Politics in Ethiopia: A View from the Village; Lynne Rienner: London." FAO, Lynne Rienner: London.
- Belay Simane. 2006. Local-level Environmental Action-plan for Development (LEAD). Institute of Development Research Addis Ababa University. Training manual, pp 87.
- Calzadill, A, Zhu, T., Rehdanz, K., Tol, R.S.J and C. Ringler. 2009. Economy-Wide Impacts of Climate Change on Agriculture in Sub-Saharan Africa. Working Paper FNU-170.
- CSA (Central Statistical Authority). 2007. Statistical Abstract of Ethiopia, Addis Ababa. Pp115.

- NAPA (Climate Change National Adaptation Program of Action of Ethiopia). 2007. National Meteorological Agency. Ministry of Water Resources. Addis Ababa. p 85.
- EM-DAT (The International Disaster Database. Centre for Research on the epidemiology of disasters_ OFDA/CRED). 2010., www.emdat.be - Université catholique de Louvain - Brussels - Belgium". Accessed May 19, 2010.
- EPA (Environmental Protection Authority). 2008. Ethiopian Environment Outlook: Environment for Development. Addis Ababa. p147.
- EPA (Environmental Protection Authority). 2010a. Nationally Appropriate Mitigation Actions for Ethiopia. Environmental Protection Authority, Addis Ababa, Ethiopia. Pp 4.
- EPA (Environmental Protection Authority). 2010b. Ethiopia's Program of Adaptation to Climate Change (draft). Addis Ababa. Ethiopia. pp 5.
- EPA (USA.) 2009. High Global Warming Potential (GWP) Gases Web site. High Global Warming Potential (GWP) Gases – Science. accessed August 31, 2009. Global Temperature Change Scenarios and its Consequences
- Erdoğan, M., Marcinkowski, T. and Ok, A. 2009. Content analysis of selected features of K – 8 environmental education research studies in Turkey, 1997-2007. *Environmental Education Research*, 15 (5): 525-548.
- CRGE (Ethiopia's Climate-Resilient Green Economy). 2011. Green economy strategy. Addis Ababa, Ethiopia. Pp. 188.
- Hurni, H. 1988. Degradation and Conservation of Resources in Ethiopia. *Mountain Research and Development*, 8(2/3): 15-22.
- IPCC (Intergovernmental Panel on Climate Change). 2001. Climate Change 2001: Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Third Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA,
- IPCC (Intergovernmental Panel on Climate Change). 2007a. Climate Change 2007: Synthesis Report. Contribution of Working Groups I, II and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate. IPCC, Geneva, Switzerland.
- IPCC (Intergovernmental Panel on Climate Change). 2007b. Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.
- IPCC (Intergovernmental Panel on Climate Change). 2007c. Summary for Policymakers. In Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA. accessed August 31, 2009.
- IPCC (Intergovernmental Panel on Climate Change). 2007d. Climate Change 2007: Mitigation of Climate Change. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change.

- Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.
- Lakew Desta, Carucci, V., Asrat Wendem-Ageñehu and Yitayew Abebe (eds.). 2005. Community Based Participatory Watershed Development: A Guideline. Parts 1 and 2. Ministry of Agriculture and Rural Development, Addis Ababa, Ethiopia. Pp. 176.
- MoFED (Ministry of Finance and Economic Development). 2010. Ethiopia's Growth and Transformation Plan (GTP), 2011/12-2014/15. Addis Ababa
- NASA(*The National Aeronautics and Space Administration*). 2009. Earth Observatory, based on IPCC Fourth Assessment Report (2007), accessed August 31, 2009.
- NCCF (The National Climate Change Forum). 2009. Proceedings of the First National Climate Change Conference. January 15, 2009, UNECA Conference Center, Addis Ababa, Ethiopia. Oxfam America. Pp. 106.
- NCDC (National Climatic Data Center). 2008. Climate of 2007 – in Historical Perspective Annual Report. Accessed August 31, 2009.
- NOAA (*National Oceanic and Atmospheric Administration*). 2006. [NOAA Magazine. NOAA Reports 2006 Marked by Severe Heat Waves, Widespread Drought, Wildfires.](#) December 14, 2006. www.noaaneews.noaa.gov/stories2006/s2759.htm, accessed August 31, 2009.
- PASDEP (Plan for Accelerated and Sustained Development to End Poverty). 2005. Ethiopia: Building on Progress: A Plan for Accelerated and Sustained Development to End Poverty (PASDEP). Ministry of Finance and Economic Development (MoFED), The Federal Democratic Republic of Ethiopia. Pp 133.
- Shibru Tedla. 2004. Community-Based Natural Resources Management in Ethiopia. In Aimbo, J., Barrow E., and Karaba, M. (eds). Community Based Natural Resource Management in IGAD Region; pp. 77-106. IGAD.
- Copenhagen Accord, 2009. The Copenhagen Accord, Advanced Unedited Version, http://unfccc.int/files/meetings/cop_15/application/pdf/cop15_cph_auv.pdf
- UNDP (United Nations Development Programme). 2008a. 2007/2008 Human Development Report, Fighting Climate Change: Human Solidarity in a divided world. United Nations Development Programme, 1 UN Plaza, New York, New York, 10017, USA. <http://hdr.undp.org/en/reports/global/hdr2007-2008/>
- UNDP (United Nations Development Programme). 2008b. 'The Bali Road Map: Key Issues Under Negotiation, UNDP Environment & Energy Group. New York, NY 1007. Pp 298.
- UNDP (United Nations Development Programme). 2010. The outcomes of Copenhagen: The Negotiations and the Accord. UNDP Environment and Energy Group, Climate Policy Series. . New York, NY 1007. Pp 298.
- World Bank. 2005. "Managing Water resources to maximize Sustainable Growth. A Country Water Resources Assistance Strategy". 270 Madison Ave, New York, NY. 10016., Pp 35.