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Climate Change Education for Climate Resilient Green Economy (CRGE) of Ethiopia

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Abstract
Climate change will affect all of us, but most seriously affected will be those countries and people that depend primarily on agriculture and have few opportunities for economic diversification and structural change. Ethiopia, where the majority of the population lives in rural areas and is engaged in agriculture, is one of the most vulnerable countries. Its dependence on rain fed agriculture makes the country particularly exposed to 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. To this end, the Government of the Federal Democratic Republic of Ethiopia (FDRE) has recently 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. The central theme of this paper is on the salient issues that underpin the importance of climate change education for the implementation of the CRGE initiative and thereby achieving sustainable development in the country.

1. INTRODUCTION

Climate change is one of the most pressing environmental challenges facing the world this century. Most scientists have agreed that the concentration of greenhouse gases (GHGs) in the earth's atmosphere has been increasing rapidly due to anthropogenic (human) activities, and this has consequently led to changes in the climate. These days, there is a scientific consensus that the inexorable growth in CO_2 and other GHG concentrations must be halted if dangerous climate change is to be avoided. The UNFCCC has identified two separate options (mitigation and adaptation) for addressing climate change; and many governments have responded to this consensus by taking mitigation and adaptation actions to limit GHG emissions (IPCC, 2001; UNFCCC, 2007).

Climate change is a serious threat to sustainable development, resulting in adverse impacts on the environment, food security, human health, economic activity, natural resources, and physical infrastructure. Thus, achieving the aims reflected in the international sustainable development agenda will require a drastic reduction in emissions in both developed and developing countries, in accordance with the principle of common but differentiated responsibilities and respective capabilities. To this end, raising people's awareness about the causes, consequences and solutions of climate change through education is pivotal (UNDESA, 2009).

Climate change will affect all of us, but most seriously affected will be those countries and people that depend primarily on agriculture and have few opportunities for economic diversification and structural change. In many parts of the developing world, particularly in the least developed countries, climate change has a negative impact on people's livelihoods, weakening their resource base and limiting their options and capabilities. It is anticipated that climate change will have a direct and significant adverse impact on economic growth in many countries in Africa, primarily in the Sub-Saharan region (FAO, 2011). In this regard, Ethiopia is not an exception. It is experiencing the effects of climate change.

Ethiopia, where the majority of the population lives in rural areas and is engaged in agriculture, is one of the most vulnerable countries. Its dependence on rain fed agriculture makes the country particularly exposed to the effects of climate change (Alebachew and Weldeamlak, 2011). 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. To this end, the Government of the Federal Democratic Republic of Ethiopia (FDRE) has recently 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.

This paper centers on the salient issues that underpin the importance of climate change education in achieving sustainable development. The paper first describes the current knowledge on climate change, its impacts and remedial measures. It then tries to explain the linkages between climate change and sustainable development. Then, it gives a brief explanation on the role of climate change education for sustainable development. Finally, it looks in to climate change from the Ethiopian context, particularly on the role that Climate Change Education plays in the implementation and attainment of the CRGE of Ethiopia.

2. CLIMATE CHANGE: THE DEFINING CHALLENGE OF OUR TIME

2.1 Definitions and Issues

Climate change is viewed by the Inter governmental Panel on Climate Change (IPCC) as a statistically significant variation in the mean state of the climate or in its variability persisting over an extended period, typically decades or longer. Climate change may be due to natural internal processes, natural external forcings, or persistent anthropogenic-induced changes in atmospheric composition or land use (IPCC, 2001).

The United Nations Framework Convention on Climate Change (UNFCCC) offers a different definition. The UNFCCC defined climate change as a change of climate which is attributed directly or indirectly to human activity that alters the composition of the atmosphere and which is in addition to natural climate variability observed over comparable timescales. This definition is useful in that it makes a clear distinction between natural processes and anthropogenic influences (UNFCCC, 2007).

Similarly, climate change is also defined as a significant and lasting change in the statistical distribution of weather patterns over periods ranging from decades to millions of years. It may be a change in average weather conditions, or in the distribution of weather around the average conditions i.e., more or fewer extreme weather events. Climate change is caused by factors that include oceanic processes (such as oceanic circulation), variations in solar radiation received by Earth, plate tectonics and volcanic eruptions, and human-induced alterations of the natural world. These latter effects are currently causing global warming, and climate change is often used to describe human-specific impacts (Roger and Richard, 2010).

Climate variability and change have considerable differences. While climate variability refers to variations in the prevailing state of the climate on all temporal and spatial scales beyond that of individual weather events, global climate change indicates a change in either the mean state of the climate or in its variability, persisting for several decades or longer. Regional fluctuations and shorter term global fluctuations may be viewed as expressions of natural climate variability, a term which allows for the influence of non anthropogenic radiative forcing; whereas changes in average weather conditions on Earth, such as a change in average global temperature, as well as changes in how frequently regions experience heat waves, droughts, floods, storms, and other extreme weather can be viewed as expressions of climate change (Donald, 2009)

The climate of the globe is always changing. Evidence shows that climate has changed in the past, and nothing suggests that it will not continue to change. The last decade of the 20th Century and the beginning of the 21st have been the warmest period in the entire global instrumental temperature record. While the evidence is strong that much of the global warming over the past 100 years is a response to rising concentrations of atmospheric GHGs, it has been seen that the global temperature time series is characterized by fluctuations from inter-annual to decadal and even longer timescales (Donald, 2009; Roger and Richard, 2010).

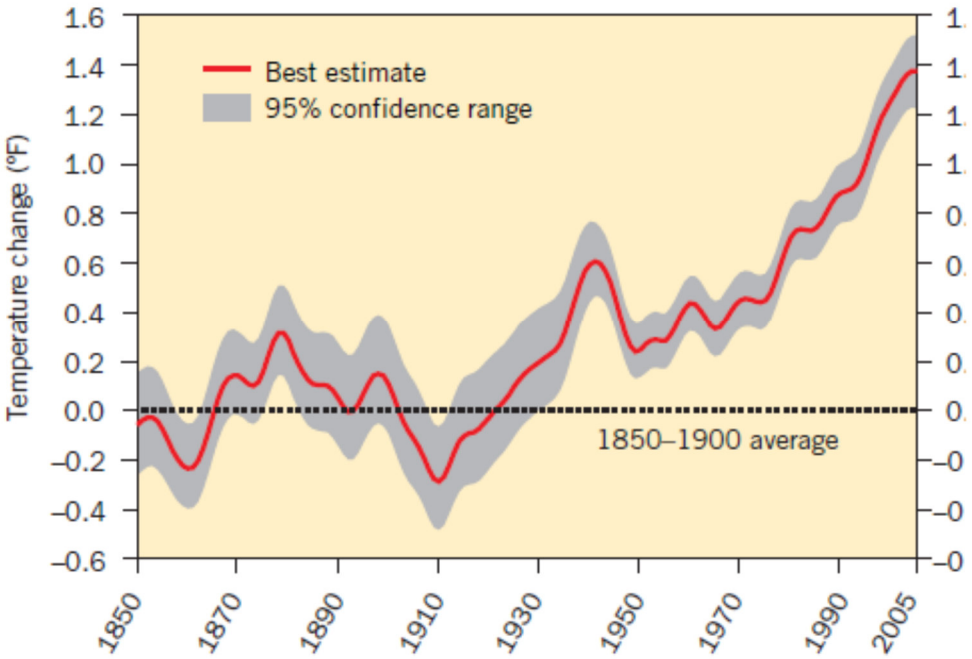
Scientists actively work to understand past and future climate by using observations and theoretical models. Borehole temperature profiles, ice cores, floral and faunal records, glacial and periglacial processes, stable isotope and other sediment analyses, and sea level records serve to provide a climate record that spans the geologic past. More recent data are provided by the instrumental record. Physically based general circulation models are often used in theoretical approaches to match past climate data, make future projections, and link causes and effects in climate change.

2.2 Impacts of Climate Change

These days, scientists have become certain that climate change is happening. And, they predict that the global climate will continue to change in the centuries ahead, with significant impacts on sea levels and weather patterns, and consequences for human health, ecosystems, and the economy. Some of the impacts of climate change are elucidated as follows:

- **Rising temperatures (global warming):** The world is getting warmer. Early decades of the twenty-first century will see a moderate warming of 1-2^{o}C. The ten warmest years occurred between 1995 and 2005. The World Meteorological Organization (WMO) has reported that 2005 was the second hottest year on record, surpassed only by 1998. Scientists further say that the increase in global temperatures will continue in the decades ahead (Figure 1).

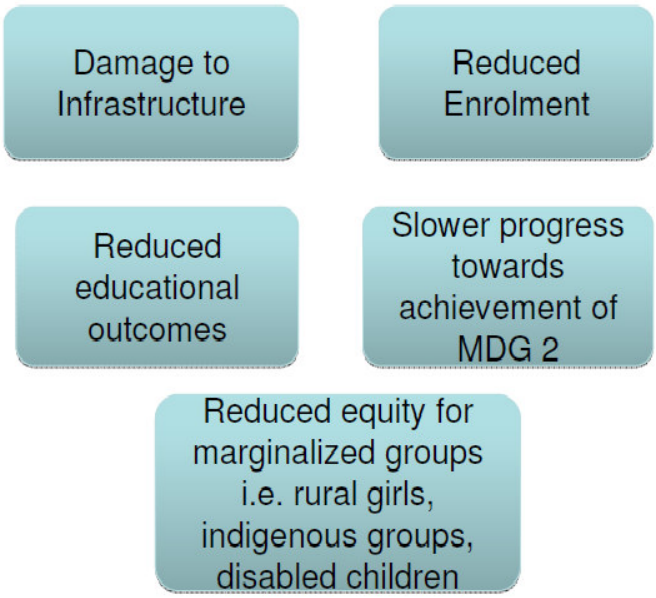
Figure 1: Global surface temperature trend from 1850 to 2005



Source: *IPCC, 2001;2007*

- **Rising sea level:** Among the most serious and potentially catastrophic effects of climate change is sea level rise. After at least 2,000 years of little change, sea level rose by roughly 8 inches over the past century. Satellite data available over the past 15 years show sea level raising at a rate roughly double the rate observed over the past century. By the end of this century, if nothing is done to rein in emissions of GHGs, global sea level may be three feet higher than today. Rising sea level will have severe impacts in low-lying coastal communities throughout the world (IPCC, 2001).
- **Changing precipitation patterns:** Scientists predict that climate change will have a significant impact on global precipitation patterns, causing both more floods and more droughts. These changes in weather patterns will have serious and potentially severe impacts on human societies and the natural world. The widespread trend towards more heavy rainstorms is expected to continue, with precipitation becoming less frequent but more intense (IPCC, 2007).
- **Extreme climate events:** Increased frequency and severity of extreme climate events, such as more heat stress, droughts and flooding, is expected in coming decades due to climate change. It will increase negative impacts on agriculture, forestry and fisheries in all regions. By 2020, for instance, 75-250 million people in Africa will be exposed to water scarcity due to climate change. During the same period, yields from rain-fed agriculture in some African countries could be reduced by 50 percent (IPCC, 2007).
- **Impacts on Human Health:** Climate change can affect human health directly (for example, because of extreme temperatures and heat waves) and indirectly (for example, by contributing to the spread of infectious disease or threatening the availability and quality of food and water). The elderly, the infirm and the poor will be especially at risk. A recent UN report blamed climate change, along with worsening air and water quality and poor disposal of solid waste, for an increase in malaria, cholera and lower respiratory tract infections in African societies (UNFCCC, 2007).
- **Impacts on ecosystems:** Climate change holds the potential of inflicting severe damage on the ecosystems that support all life. Researchers have established that climate change is driving some species to extinction. Ecosystems around the world already are reacting to a warming world. For example, plants and animals have responded to this warming by changing their timing of flowering, migration and other spring activities (IPCC, 2001).
- **Impacts on education:** Climate change has also significant impacts on education. Some of these impacts are highlighted in the figure below.

Figure 2: Climate change impacts on education



Source: UNICEF, 2012

2.3 Responses to the Impacts of Climate Change: Adaptation and Mitigation

Science indicates that our planet faces dramatic and lasting changes due to warming of our global surface temperature. Unless we take significant actions today to reverse GHG emissions and to enhance climate resilience, we will experience irreversible damage to our planet. As a result, attention has now increasingly focused on how to cope with changing climate (Van Aalst, 2008). To this end, the UNFCCC has identified two separate responses for addressing climate change, namely adaptation and mitigation (UNFCCC, 2007).

Climate change policy has now become a choice between mitigation and adaptation activities. Which one is better? Even if GHG concentrations are stabilized as a result of mitigation, extreme climate events and sea level rise will still continue for several years due to inertia of the atmospheric system, therefore adaptation will be a necessary compliment to mitigation efforts (Kwok and Rajkovich, 2010). Hence, both responses are mutually inclusive and are vital to the sustenance of lives on earth, one is not better than the other!

2.3.1 Climate change adaptation

Adaptation to climate is the process through which people reduce the adverse effects of climate on their health and well-being, and take advantage of the opportunities that their climatic environment provides (Burton 1992, as cited in Smit et al., 2000). Adaptation is a knowledge-intensive task; it entails an analytical process of interpreting climate data and incorporating the knowledge gained into decision-making (UNFCCC, 2007). Adaptation issues involve adjustments to enhance the viability of social and economic activities and to reduce their vulnerability to climate, including its current variability and extreme events as well as longer-term climate change (IPCC, 2001). Here an attempt has been made to highlight some of the key adaptation measures that can be implemented to cope up with the adverse impacts of climate change in different sectors of the economy and in different vulnerable areas.

- **Agriculture**: Use of tolerant/resistant crop and livestock varieties, irrigation, improved drainage, food storage, land management
- **Water supply**: Water conservation, water storage
- **Health sector**: Improvement of living standard, increase hygiene awareness, vaccination and development of health infrastructure
- **Education sector**: Human resources development and information, capacity building, technology transfer
- **Arid and semi-arid:** Improved crop, grassland and livestock management, dissemination of improved crop varieties and breeds, community grain storage for food distribution and, water harvesting and storage.
- **Humid areas:** Change to dam and infrastructure specifications, storm and flood resilient building codes, river defences, watershed management, restricting development in high risk (flood, mudslides) zones (GEF, 2006; UNFCCC, 2007).
- **Coastal islands:** Construction of coastal defences: hard defences – revetments, embankments; soft defences – mangroves, coral reefs. Wetland conservation, restoration of beach vegetation, prevention of soil erosion, relocation of settlements and infrastructure, integrated coastal zone management, the use of desalination plants for salty waters (IPCC, 2007).

2.3.2 Climate change mitigation

Mitigation refers to efforts toward reducing the accumulation of GHGs in the atmosphere. It is defined as technological change and substitution that reduce resource inputs and emissions per unit of output. Mitigating climate change is central to the development and poverty reduction agenda. Early mitigation of GHG emissions will significantly reduce the need for future adaptation, especially the burden on the poor (IPCC, 2001; 2007).

The primary objective of the UNFCCC is the stabilization of GHG concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. This can be achieved by limiting GHG emissions through mitigation activities (UNFCCC. 2007). Accordingly, the following key mitigation measures, that can be implemented to limit GHG emissions and reverse the impacts of climate change, are worth mentioning:

- **Renewable energy sources/use:** Solar PV, wind turbines, biomass energy, hydropower and geothermal energy.
- **Improving energy efficiency in industries**
- **Cleaner fossil technology**
- **Improvement of transportation:** Use of improved rapid public transportation, use of hybrid/electric cars, and improvement of non motorized transport system like bicycles.
- **Efficient energy use:** Home appliances, industrial and office appliances, and attitudinal changes (reduced water use, reduced energy consumption, etc).
- **Promotion of forestry activities:** Forest conservation and restoration, afforestation and reforestation activities, and reduced deforestation and improvement of forest management.

3. CLIMATE CHANGE AND SUSTAINABLE DEVELOPMENT

3.1 Setting the Context

Sustainable development is the foremost challenge to humanity in the twenty-first century. It affects every human being on the planet, and therefore we are all stakeholders. Traditional development has focused on material-based economic growth to overcome problems such as poverty, hunger, sickness and inequality. However, despite impressive progress during the last century, especially in the OECD and middle-income countries, these issues have grown worse in most of the poorest countries, and even among poorer communities in the industrial world. New challenges, such as environmental degradation, violent conflicts, climate change and runaway globalization could exacerbate problems and make them unmanageable (Munasinghe, 2009).

Since the United Nations Conference on Environment and Development (UNCED) in 1992 and the subsequent World Summit on Sustainable Development in 2002, significant efforts have been made in pursuit of sustainable development. At the political level, sustainable development has grown from being a movement mostly focusing on environmental concerns to a widely recognized framework utilized by individuals, governments, corporations and civil society that attempts to balance economic, social, environmental and inter-generational concerns in decision-making and actions at all levels (Yohe et al., 2007).

At the global level, several thousand leading scientists in the IPCC have clearly confirmed that human activities that emit GHGs are leading to potentially catastrophic climate change (IPCC, 2001; 2007). Similarly, the recent Millennium Ecosystem Assessment (MEA), commissioned by the UN and written by foremost ecologists, has chronicled the steady decline of ecosystem services, which support all life on the planet. They have urged early action to reverse this alarming trend. Yet, the alleviation of poverty among billions (who lead their existence on less than one dollar a day) will require continued economic growth in those areas (Munasinghe, 2009). Thus, maintaining this balance among economic, social and environmental needs is the essence of sustainable development.

In the forthcoming sub sections, a brief look in to the concept of sustainable development, its linkages with climate change from the perspectives of the developed and developing world will be given due consideration.

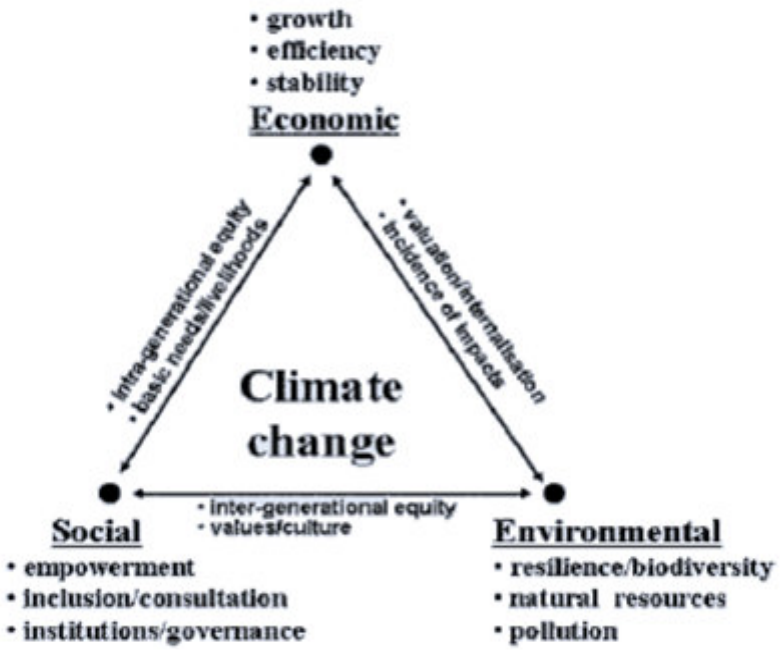
3.2 The Concept of Sustainable Development

Literally, sustainable development refers to maintaining development over time. However, it has been suggested that there are more than seventy definitions of sustainable development currently in circulation, and none is universally accepted (Holmberg and Sandbrook, 1992; Elliott, 2002). Nonetheless, they all emphasize on one or more of the following critical elements: identifying what to develop, identifying what to sustain, characterizing links between entities to be sustained and entities to be developed and envisioning future contexts for these links (NRC, 1999). The core concept of sustainable development, therefore, lies in meeting fundamental human needs in ways that preserve the life support systems of the planet, and in reconciling real and perceived conflicts between the economy and the environment and between the present and the future.

While no universally acceptable practical definition of sustainable development exists, the Brundtland Commission's brief definition of sustainable development as the "ability to make development sustainable—to ensure that it meets the needs of the present without compromising the ability of future generations to meet their

own needs" is the standard definition when judged by its widespread use and frequency of citation (WCED, 1987). Despite an on-going debate on the actual meaning, the 2002 World Summit on Sustainable Development marked a further expansion of the standard definition with the widely used three pillars of sustainable development: economic, social, and environmental (Figure 2). Each pillar corresponds to a domain (and a system) that has its own distinct driving forces and objectives. The economy is geared mainly towards improving human welfare, primarily through increases in the consumption of goods and services. The environmental domain focuses on protection of the integrity and resilience of ecological systems. The social domain emphasizes the enrichment of human relationships, achievement of individual and group aspirations, and strengthening of values and institutions (Munasinghe, 2002).

Figure 3: Sustainable development triangle – key elements and interconnections

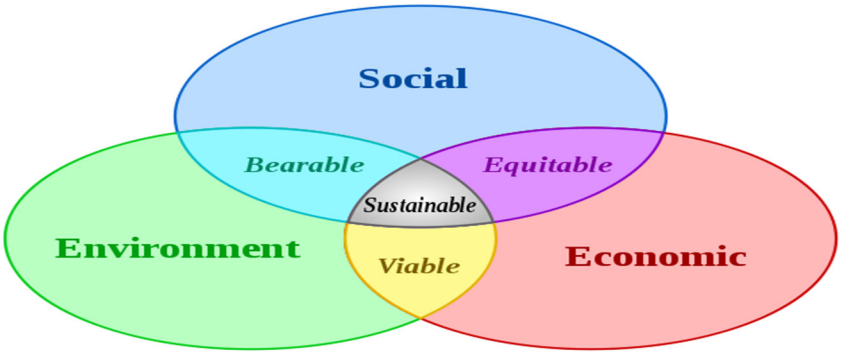


Source: *adapted from Munasinghe, 2002*

Furthermore, the Johannesburg Declaration created a collective responsibility to advance and strengthen the interdependent and mutually reinforcing pillars of sustainable development—economic development, social development and environmental protection—at local, national, regional and global levels. In so doing, the World Summit addressed a running concern over the limits of the framework of environment and development, wherein development was widely viewed solely as economic development (Yohe et al., 2007). For many, such a narrow definition obscured their concerns for human development, equity, and social justice (Munasinghe, 2002).

In general, it can be said that sustainable development ties together concern for the carrying capacity of natural systems with the social challenges facing humanity. Ecologists have pointed to The Limits to Growth, and presented the alternative of a "steady state economy" in order to address environmental concerns (IISD, 2010). Accordingly, sustainable development can be conceptually into three constituent parts: environmental sustainability-bearable and viable, economic sustainability -viable and equitable and socio political sustainability-bearable and equitable (Figure 3).

Figure 4: Scheme of sustainable development: at the confluence of three constituent parts



Source: *IISD, 2010*

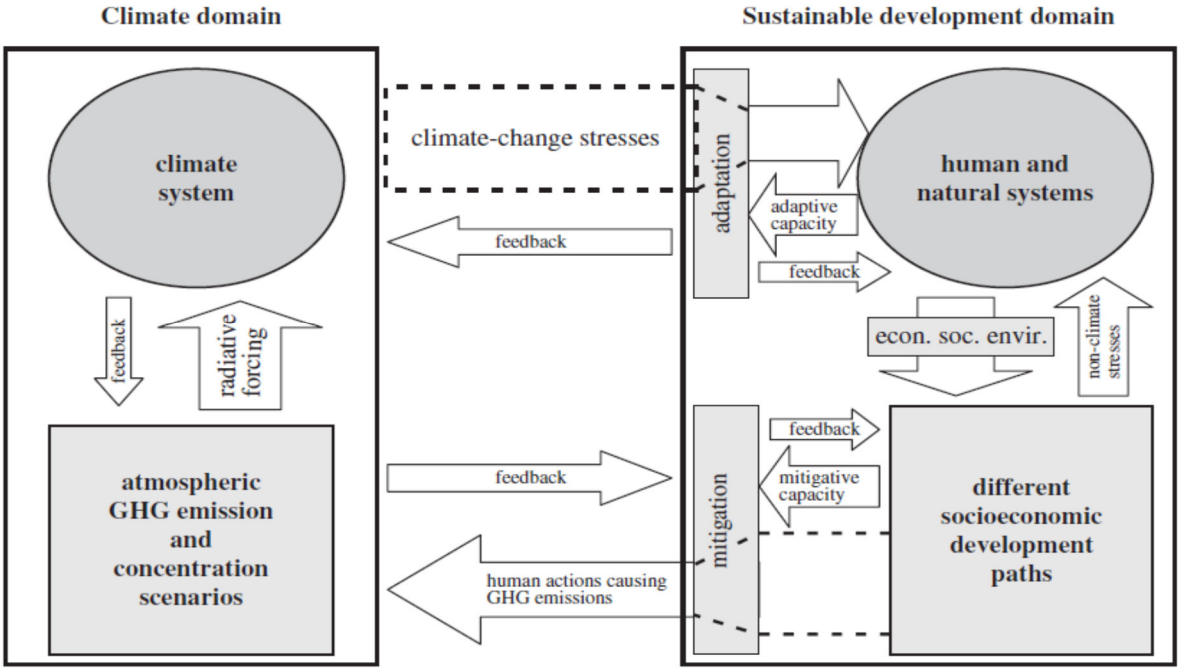
3.3 Linkages between Climate Change and Sustainable Development

The Parties to the UNFCCC pledged to work towards achieving the "stabilization of GHG concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system … within a timeframe sufficient … to enable economic development to proceed in a sustainable manner". When climate change is acknowledged as a key issue within the wider sustainable development context, it becomes imperative that incentives be provided for sustained economic growth along pathways that enhance capabilities and options among people and societies (UNFCCC, 2007).

Even so, Prospects for sustainable development are undermined by a three-dimensional threat from climate change. The first dimension is climate change itself and its implications for human development, prosperity and health. The changing climate will have a direct impact on the progress made in achieving several key Millennium Development Goals (MDGs). The second dimension of the climate change threat is the spillover effects of climate-related policies implemented in the industrialized world. The third dimension of the threat from climate change relates to the repercussions of the adaptation and mitigation activities undertaken by developing countries themselves (UNDESA, 2009).

Climate change and sustainable development interact in a circular fashion. Climate change will have an impact on prospects for sustainable development, and in turn, alternative development paths will certainly affect future climate change. Figure 4 below shows an Integrated Assessment Modeling (IAM) framework, including the full cycle of cause and effect relationship between climate change and sustainable development (IPCC, 2001).

Figure 5: Circular interaction between climate change and sustainable development



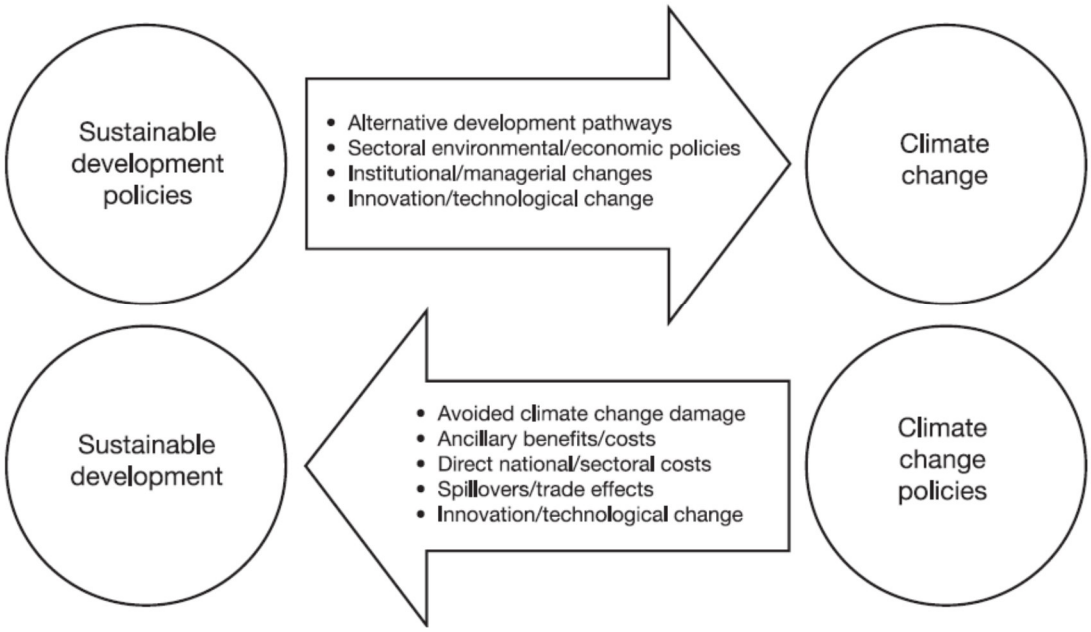
Source: *Munasinghe, 2009*

Each socioeconomic development path in the bottom right-hand quadrant (driven by the forces of population, economy, technology and governance) gives rise to different levels of GHG emissions (carbon dioxide,

halocarbons, methane and nitrous oxide). These gases accumulate in the atmosphere, disturbing the natural balance between incident solar radiation and energy re-radiated from the Earth, as shown in the climate-domain box on the left-hand side. Such changes underlie the enhanced greenhouse effect that increases radiative forcing, which will change the climate well into the future and impose stresses on the human and natural systems shown in the top right-hand quadrant (sustainable development domain). Such impacts on human and natural systems will ultimately have effects on socio-economic development paths (Munasinghe, 2009).

Furthermore, researchers also argued that there exists a two-way linkage between climate change and sustainable development sustainable. They dictate that development measures and climate change policies can reinforce each other (Swart et al., 2003). Figure 5 portrays some of the texture of the interaction that they envisioned.

Figure 6: Two way linkages between climate change and sustainable development



Source: *Swart et al., 2003*

Generally, in many respects climate change and sustainable development have strong ties. It is no longer a question of whether climate change policy should be understood in the context of sustainable development goals; it is a question of how. Sustainable development and climate change share strong complementary tendencies: they are multi-sectoral, they both require international cooperation to solve the problem, and the problem is inter-woven through economic and technological development in increasingly complex networks (IPCC, 2001).

4. CLIMATE CHANGE EDUCATION FOR SUSTAINABLE DEVELOPMENT

4.1 Essence and Goals of Climate Change Education

4.1.1 Essence of climate change education

The global scientific community has now unequivocally accepted that human activities cause global climate change (IPCC, 2007; NRC, 2011). Although information on climate change is now readily available, the global community still seems unprepared or unwilling to respond effectively to climate change, due partly to a general lack of public understanding on climate change issues and opportunities for effective responses (NRC, 2011). The reality of global climate change lends increasing urgency to the need for effective education on earth system science, as well as on the human and behavioral dimensions of climate change. This has laid the foundation for climate change education (Gardner and Stern, 2008).

Climate Change Education (CCE) is a concept that deals with introducing new content about climate change science, causes, consequences and solutions. It also focuses on introducing new values, creative thinking and problem solving-skills at all school levels through teaching and learning methodologies that are participatory, experimental, critical and open-ended. CCE is about helping learners understand and address the impacts of global warming today, while at the same time encouraging the change in attitudes and behavior needed to put our world on a more sustainable path in the future (UNESCO, 2010).

According to UNESCO (2010), CCE requires people everywhere to understand and respond to the nature, causes and consequences of climate change. This requires educational programs that attend to:

- clear distinctions between different scientific concepts and processes associated with climate change;
- knowledge of, and abilities to distinguish between, certainties, uncertainties, projections and risks

associated with climate change;

- knowledge of the history and interrelated causes of climate change (which include technical, scientific, ecological and social dimensions; economic dimensions; and political dimensions);
- knowledge of mitigation and adaptation practices that can contribute to wider social transformation towards sustainability, including abilities to participate in such practices;
- knowledge of consequences and what is being learned about mitigation and adaptation to climate change;
- good understanding of the time-space dynamics of climate change, including the delayed consequences that current greenhouse gas emissions hold in store for the quality of life, security and development options of future generations;
- understanding of different interests that shape different responses to climate change (e.g. business interests, consumer interests, farmers' interests, political interests, future generations' interests, etc.) and abilities to critically judge the validity of these interests in relation to the public good; and
- critical media literacy to address the causes of overconsumption and develop capacity to make better lifestyle choices and to participate in climate change solutions.

Nowadays, CCE is on the agenda all over the world – but is still in its infancy. There are a lot of calls to address climate change in education, as well as sporadic initiatives in policy and practice, but a clarification of what CCE implies and how it should be promoted is still lacking. This means that CCE is still open to negotiation. Different positions are at stake: one that regards climate change education as the domain of the natural sciences; and another that stresses climate change as an integral part of the challenge of sustainable development, (IALEI, 2009). If the first approach gains a footing, it may counteract efforts to promote Education for Sustainable Development (ESD) as part of UN Decade of Education for Sustainable Development (DESD) (2005-2014). Meanwhile, if CCE is approached as an integral part of ESD, the global attention to climate change could serve as a vehicle for the further promotion of ESD.

4.1.2 Goals of climate change education

CCE has various goals, which include understanding the basic science of climate and climate change; supporting informed decision making by individuals, organizations, and institutions; behavior change; and stewardship where appropriate all of which are often summarized under the term "climate literacy." The ultimate goal is sometimes stated as positive impacts on the climate, mostly in terms of stabilizing and mitigating emissions of GHGs, but increasingly also including the increased capacity to adapt to the consequences of climate change (UNESCO, 2010).

More specifically, some educational efforts focus on improving understanding of the climate system, climate science, the impacts of climate change, mitigation and/or adaptation to climate change, and related issues. Others strive to draw connections between climate change and economics, social justice, and other societal issues. Still others aim to go beyond improving understanding to changing behavior, for example, by improving the quality of decision making toward stewardship. These differences in the underlying the goals of CCE efforts pose barriers to developing a community of practice with a common language (NRC, 2011).

4.2 Mainstreaming Climate Change into the Education Sector

Mainstreaming means the integration of climate change into the development process and related activities, in this case educational activities and processes. The process of mainstreaming climate change requires a well-thought-out and carefully planned strategy demonstrating strong technical knowledge of the impacts of climate change. Mainstreaming ensures that CCE becomes a sustainable and holistic part of education sector processes and systems, including policies and legislation, plans and budgets, curricula and examinations, teacher education, school infrastructure and facilities, learning environments, and school governance and management (UNESCO, 2012).

The level of integration of climate change issues in to the education sector will vary greatly depending on the level of education, and the local and national contexts being addressed. In primary education, for instance, a core concern is when to introduce the issue of climate change. This decision is important in order not to frighten children and young people, but to empower them to understand and critically engage with environmental change. In secondary education, tensions exist between a centralized curriculum and the need to promote locally based and locally appropriate knowledge. Overloaded curricula frequently present additional challenges (UNESCO, 2012).

CCE plays a unique and critical role in making a healthy, just and sustainable society and a stable climate a reality. Mainstreaming climate change into educational programs can increase the sustainability and impact of interventions in sectors such as water, agriculture, livelihoods and health (Bangay and Blum, 2010). Hence, CCE needs to include a focus on the causes, consequences and solutions to climate change, if the necessary changes in society are to be effected in time. Addressing the causes and the consequences of climate change requires content and methodologies that will build capacity in society for mitigation, adaptation, and transformability (IALEI, 2009).

Consequently, it is important for sectors other than education to take part in the process of mainstreaming CCE. The cross-sectoral nature of CCE begins with child friendly schools. From early childhood through

secondary school and beyond, health care, water, sanitation, nutrition, protection and education and other sectors must come together around the implementation of environmental issues in schools. A cross-sectoral approach can help apply educational principles to global and national frameworks around climate change and sustainable development programs (UNESCO, 2012).

4.3 The future of CCE

At present, CCE is still a peripheral topic in both educational research and practice. In research literature, CCE has been addressed almost exclusively as a domain of science education. Within the realm of practice, climate change is situated within CCE and ESD, a minor theme within a peripheral area of the curriculum (UNESCO, 2012). Despite this, however, it is important to anticipate the possible scenarios under which it could develop into a central focus of education, and become an independent concept and focus area (UNESCO, 2012).

According to Læssøe et al. (2009), there are three different possibilities:

- One scenario is that CCE will develop independently of ESD, becoming a major theme within science education. This tendency is found in the USA, where CCE has so far been interpreted as education about the scientific understanding of global climate change. A similar picture can be seen in China, where CCE is comprised of science popularization activities aimed at raising awareness and motivating students to follow behavioral advice.
- Another possibility is that CCE will develop as an integral element of ESD, emerging as a truly interdisciplinary pursuit. This tendency is mentioned in the case of Australia, UK, South Korea and Singapore. This interdisciplinary scenario may have different variations due to the fact that ESD is not an exact category. For example climate change may be integrated with ESD as part of a Green Growth strategy, or alternatively as an issue which includes global ethics, transformation of lifestyles, social equity, limits to growth and other key topics of sustainable development.
- A third scenario is a hybrid of the first two, in which CCE is treated as an independent element under the umbrella of ESD, with ESD serving as a collective term for a variety of independent focus areas thematically related to sustainable development. This scenario is embodied in the Danish national ESD strategy, which contains a number of CCE initiatives that conspicuously do not place climate change within the context of ESD, seeking instead to promote a general science education.

Different stakeholders will prioritize different scenarios and wish to influence outcomes. There are multiple opportunities for intervention. CCE features various stakeholders, like NGOs, teacher networks, consultants, and others who interpret CCE and influence whether it will be integrated in a broader ESD framework or whether it will imply a re-interpretation of ESD. As the same stakeholders are present in other countries as well, there is good reason to believe that the ongoing international negotiation among them will have a decisive influence on CCE and ESD over the next few years, thereby determining the role that education will play with respect to both climate change and sustainable development more broadly.

5. THE ETHIOPIAN CONTEXT: CLIMATE CHANGE EDUCATION AND SUSTAINABLE DEVELOPMENT

5.1 Climate Change and Its Impacts in Ethiopia

It is now widely recognized that climate change is rapidly emerging as one of the most serious threats that humanity may ever face. Developing countries who have contributed the least to GHG emissions are among the most vulnerable to the impacts of climate change. African countries are likely to be the worst affected. Ethiopia is especially vulnerable to climate change because of its limited financial resources, skills and technologies, high levels of poverty, and their excessive reliance on climate sensitive economic sectors such as agriculture. IPCC's regional review of the impacts of climate change identified the three vulnerable sectors in Ethiopia as food security, water resources and health (IPCC, 2001, 2007).

Climate change is already taking place in Ethiopia. Over the last decades, the temperature in Ethiopia increased at about 0.2° C per decade. The increase in minimum temperatures is more pronounced with roughly 0.4° C per decade. Precipitation, on the other hand, remained fairly stable over the last 50 years when averaged over the country. However, the spatial and temporal variability of precipitation is high. The country also has a history of experiencing climate extremes, such as droughts and floods (NMA, 2007). Droughts and floods are very common phenomena in Ethiopia with significant events occurring every three to five years. The country has experienced at least five major national droughts since the 1980s, along with dozens of local droughts (Edwards, 2010).

Generally, the detrimental impacts of climate change that are prevalent in both socio-economic and natural systems of the country include:

- **Agriculture, Food Security:** The increasing year-to-year variability and in-creases in both droughts and heavy precipitation events lowers agricultural production with corresponding negative effects on food security.

- **Water:** The availability of clean drinking water is likely to decrease due to the increasing evaporation and the increasing variability of rainfall events.
- **Health:** Incidences of malaria in areas of the highlands where malaria was previously not endemic. The warming is further expected to cause an in-crease in cardio-respiratory and infectious diseases.
- **Ecosystems, Biodiversity:** Climate change but also human drivers such as forest fires threaten forest ecosystems. Furthermore, a large number of plant and animal species is threatened by extinction, as climate conditions are changing too quickly for them to adapt.
- **Infrastructure:** Heavy rainfall events and floods cause damages to roads and buildings.

5.2 Climate Change and Sustainable Development in Ethiopia

Climate change and development are highly intertwined i.e., the risks of climate change could jeopardize decades of development efforts. In Ethiopia, climate change is fundamentally a sustainable development issue (Alebachew and Weldeamlak, 2011). Key natural resources and ecological systems (e.g. land resources, water, wetlands and natural habitats), all of which are vital to sustainable development, are sensitive to changes in climate including the magnitude and rate of climate change as well as to changes in climate variability. Economic activities such as crop farming, livestock herding, energy production and water supply that depend on these natural resources are, therefore, also sensitive to climate change and variations. Thus, climate change represents an additional stress on the natural resource base of Ethiopia (Edwards, 2010).

In Ethiopia, agriculture remains to be the dominant means of production for the national economy. The contribution of agriculture to the country's total Gross Domestic Product (GDP) clearly explains the relationship among the performance of agriculture, climate and the total economy. Accordingly in Ethiopia, years of drought and famine (1984/1985, 1994/1995, 2000/2001) are associated with very low contributions to the country's GDP, whereas years of good climate (1982/83, 1990/91) are associated with better contributions to GDP. Though agriculture is expected to play a key role in ensuring food security and overall development of the country's economy, its performance is primarily constrained by changing and unreliable weather conditions and the associated disasters such as drought and flooding (Hansen, 2006).

In response to the threat posed by climate change and in its path to sustainable development, the Government of Ethiopia (GoE) has already promulgated a new five year (2010/11-2014/15) development plan, known widely as Growth and Transformation Plan (GTP) which directly addresses climate change and environment issues. The GTP recognizes climate change as a threat as well as an opportunity for Ethiopia, and has thus considered climate change adaptation and mitigation issues. In its subsection about environment and climate change the plan recognizes the role that environmental management plays in sustainable development and clearly stipulates the country's ambition to build a climate resilient green economy (CRGE) by 2025.

5.3 CCE and the CRGE of Ethiopia: the Path to Sustainable Development

5.3.1Concepts behind Climate Resilience and Green Economy

5.3.1.1 Climate Resilience

Climate resilience is the ability to cope with, and manage the change brought by weather stresses and shocks. A climate resilient economy is thus one which is protected against the negative impacts of extreme climate events, normally referred to as the weather, and climate change so that the well-being of the people and the economic growth and prospects of the country are not damaged by the impacts. Building a climate resilient economy is, therefore, about adapting effectively to climate change to minimize the potential damage and to maximize the potential benefits. Adaptation actions are required irrespective of a deal on global GHG emissions. The GHGs already emitted by the industrialized nations are already causing dangerous climate change and Ethiopia will need to adapt, or adjust to this change and continue adjusting since the climate is going to continue changing (CRGE, 2011).

A recent study by the World Bank projects that unless steps to build resilience are effective, climate change will reduce Ethiopia's GDP growth by between 0.5 and 2.5% each year. As a worst case scenario, in 25 years time, Ethiopia will have only half the potential total GDP it could have attained and this will be because of the negative impacts of climate change. Building resilience to avoid this damage to our economy depends on understanding the threats and the priority areas for focusing adaptation efforts (World Bank, 2008).

5.3.1.2 Green Economy

A green economy is defined as an economy that results in improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcities. In its simplest expression, a green economy can be thought of as one which is low carbon, resource efficient and socially inclusive. In a green economy, growth in income and employment should be driven by public and private investments that reduce carbon emissions and pollution, enhance energy and resource efficiency, and prevent the loss of biodiversity and ecosystem services. The development path should maintain, enhance and, where necessary, rebuild natural capital as a critical economic asset and as a source of public benefits, especially for poor people whose livelihoods and security depend

on nature (UNEP, 2011).

Similarly, a green economy can also be defined as a resilient economy that provides a better quality of life for all within the ecological limits of the planet. It is an economy in which, value and growth are maximized across the whole economy, while natural assets are managed sustainably. Such an economy would be supported and enabled by a thriving low carbon and environmental goods and services sector. Environmental damage would be reduced, while energy security, resource efficiency and resilience to climate change would all be increased (UNEP, 2012).

At its most basic level, the green economy is the clean energy economy, consisting primarily of four sectors: renewable energy (e.g. solar, wind, geothermal); green building and energy efficiency technology; energy-efficient infrastructure and transportation; and recycling and waste-to-energy. The green economy is not just about the ability to produce clean energy, but also technologies that allow cleaner production processes, as well as the growing market for products which consume less energy, from fluorescent light bulbs to organic and locally produced food. Thus, it might include products, processes, and services that reduce environmental impact or improve natural resource use (UNCTAD, 2011).

The concept of green economy does not replace sustainable development, but there is now a growing recognition that achieving sustainability rests almost entirely on getting the economy right. Decades of creating new wealth through a "brown economy" model have not substantially addressed social marginalization and resource depletion, and we are still far from delivering to the MDGs. Sustainability is still a vital long-term goal, but we must work on greening the economy to get us there (UNEP, 2011).

In general, in the face of the global environmental challenge and its manifold dimensions, such as climate change, biodiversity losses, water shortages, desertification, deforestations, unsustainable land uses, the future needs to maintain climate resilience and develop a green economy and society. The green economy must be accompanied by the vision of a global green society, which will accelerate the path to sustainable development.

5.3.2 The CRGE of Ethiopia

Although international climate negotiations have made little progress since the largely failed talks of Copenhagen in 2009, developing countries have started the race towards low carbon development. Low-Carbon Development Plans (LCDPs) have been developed that describe goals and measures of the respective country's climate change efforts and lay foundations for overall sustainable development planning. One year later, the Cancún talks have reanimated the UN climate negotiations process to some degree. In fact aggregate climate change mitigation commitments are still far apart from a level of ambition that effectively creates a realistic chance of limiting global warming to a maximum of 2°C or possibly even lower (Alebachew and Weldeamlak, 2011).

However, with the Cancún Agreements, developing nations are for the first time officially encouraged to develop low-carbon development strategies or plans. Yet, many developing countries seem to have already begun this process. In this regard, Ethiopia is among the developing countries that are in the early stages of developing a new national strategic framework for a smooth transition to a climate resilient green economy by 2025 (Alebachew and Weldeamlak, 2011).

The strategic aim of the Ethiopian government is to use low carbon solutions to leapfrog other economic sectors while realizing the ambitions set out in its five year national GTP. The Environmental Protection Authority (EPA) has been mandated to co-ordinate the country's national response to climate change. Through its two national climate change programs, Ethiopia's Program of Adaptation to Climate Change (EPACC) and Nationally Appropriate Mitigation Action (NAMA), EPA has made a strong start. The next step is to broaden and deepen this response. Each ministry and the regional governments are expected to play major role in marshalling a coherent response to climate change (CRGE, 2011).

A climate resilient green economy is a long-term ambition of Ethiopia. The mission statement developed to facilitate the development of the Ethiopian CRGE strategy sets out a five step roadmap for moving towards a climate resilient low carbon economy. The roadmap identified the need for more work on Ethiopia's climate change institutions, monitoring and finance systems and sectoral and regional action plans. When combined, the work is expected to enable the EPA to draft a CRGE Strategy which will identify a clear path to the goal of a climate resilient green economy by 2025 (CRGE, 2011).

The CRGE strategy focuses on four pillars that will support Ethiopia in developing green economy:

1. Adoption of agricultural and land use efficiency measures;
2. Increased GHG sequestration in forestry, i.e., protecting and re-establishing forests for their economic and ecosystem services including carbon stocks;
3. Deployment of renewable and clean power generation; and
4. Use of appropriate advanced technologies in industry, transport, and buildings.

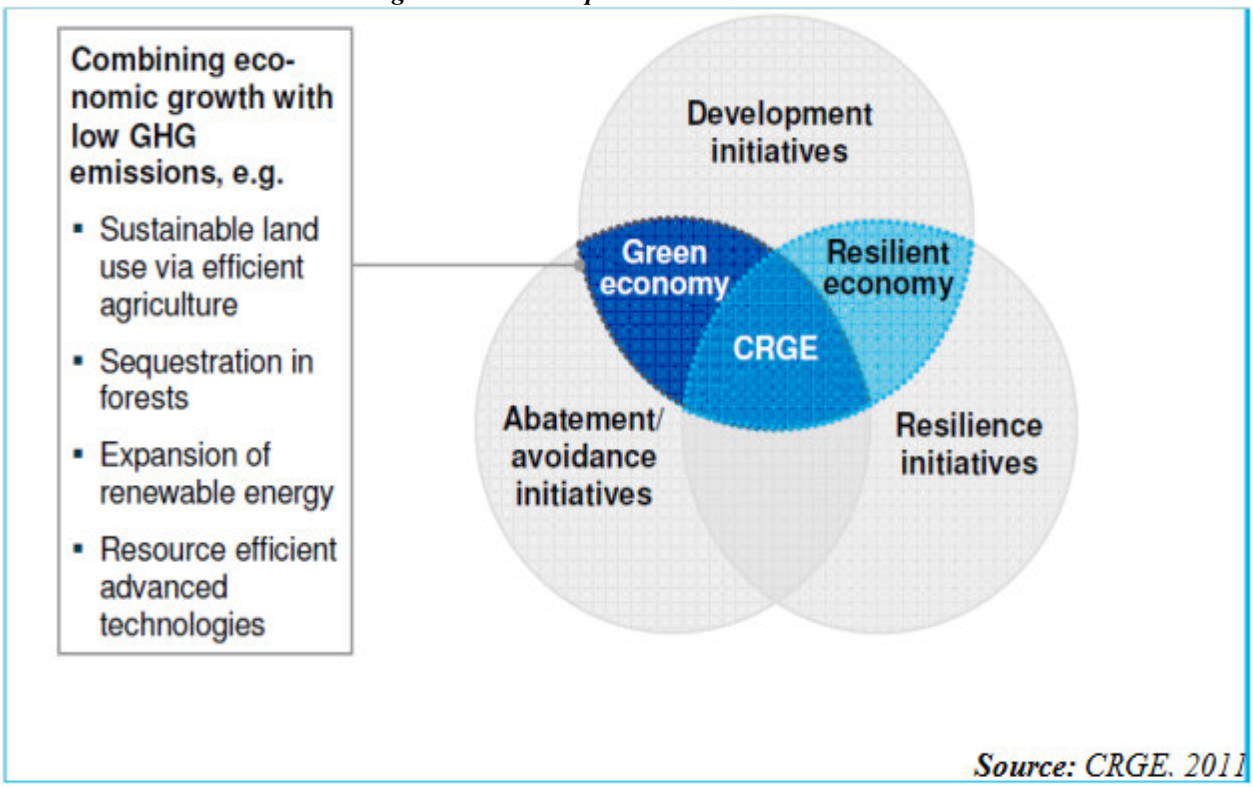
In general, four initiatives for fast track implementation have been selected under the CRGE:

i. Exploiting Ethiopia's vast hydropower potential;
ii. Large-scale promotion of advanced rural cooking technologies;
iii. Efficiency improvements to the livestock value chain; and

iv. Reducing emissions from deforestation and Forest degradation (REDD).

Generally, developing a green economy requires the integration of economic development and GHG abatement/avoidance and climate resilience initiatives. These initiatives, combined with the CRGE's major activities in the four pillars, will support Ethiopia in implementing the CRGE strategy and in developing green economy that paves the way for sustainable development in the country (Figure 6).

Figure 7: CRGE implementation initiatives



5.3.3 The Role of CCE for CRGE of Ethiopia

While there is emerging awareness of the current and potential impacts of climate change on education provision and learning, it is also clear that education, formal and non-formal, public awareness and training, from primary through to tertiary and adult education, has an important role to play in addressing climate change. In this regard, CCE is critical for promoting green economy pathways and sustainable development and improving the capacity of the people to address environment and development issues. CCE provides the foundation for any environmental and development education, and hence it needs to be incorporated as an essential part of learning (UNCED, 1992; Bangay and Blum, 2010).

There are a number of reasons why Ethiopia should be concerned about CCE. The country's vital natural resources, namely water, forest, rangeland, agricultural land, biodiversity, energy, etc are very much the reflection of climate. Socioeconomic activities such as agriculture (both crop production and livestock herding) and agro-forestry which are the main sources of livelihood to rural majority and backbone of the country's economy are sensitive to climate variations. Recurrent drought, unseasoned flooding and livestock and crop diseases are also the main challenges in the country. Evidences that could be associated with climate change have already started appearing in Ethiopia in the last 50 years. Hence, CCE equips citizen of the nation with the necessary knowledge so that they play a role in combating the adverse impacts of climate change (NMA, 2007).

In Ethiopia, CCE demands a reorientation away from focusing entirely on providing knowledge towards dealing with problems and identifying possible solutions. Therefore, CCE should retain its traditional focus on individual subjects and at the same time open the door to multi- and inter-disciplinary examination of real life situations. This could have an impact on the structure of learning programs and on the teaching methods, demanding that educators change from being solely transmitters and learners change from being solely recipients. Instead both should form a team (UNESCO, 2006, 2012).

Specifically speaking, CCE plays a crucial role for the implementation of Ethiopia's CRGE strategy, thereby bringing the dream of reaching middle income status in 2025 come true. In this regard, the following key points are worth mentioning:

- **Builds capacity:** CCE plays an important role in capacity building from an early age, providing knowledge and influencing attitudes and behavior. It is important to ensure that all pupil and students

acquire appropriate knowledge of climate change and green economy and related issues and are aware of the impact of decisions that do not support sustainable development.

- **Improves professional skills and knowledge:** CCE has a role in improving professional skills and knowledge of climate change and sustainable development. CCE can consequently be part of the lifelong learning of individuals including those in sectors such as public administration, the private sector, industry, transport and agriculture.
- **Promotes international cooperation:** CCE promotes international cooperation among nations and peoples all over the world as the issue is global in its nature. Cooperation on education for climate change and sustainable development, apart from contributing to the strengthening and improvement of growth and development in countries, could help to ensure mutual understanding, strengthen trust and develop respect for cultural values, thereby building friendly relations between peoples and nations and contributing to peace and wellbeing.
- **Helps address climate change:** CCE helps learners to acquire the necessary knowledge on climate change, prepares them to adapt to the impacts of climate change, and empowers them to address its causes.
- **Builds green societies and climate resilient economies:** CCE equips students with skills for green jobs that help preserve or restore the quality of the environment. CCE needs to avoid the pathway of business-as-usual development by limiting GHG emissions so as to encourage the build-up of low carbon and climate resilient green economies. In this regard, CCE endeavors to harmonize economic growth with environmental sustainability, while improving the eco - efficiency of economic growth and enhancing the synergies between environment and economy.
- **Political and policy dimensions:** CCE also plays a role in understanding the political and policy dimensions of climate change. This includes understanding of recent legislation or international agreements; the position of political parties, interest groups, and leaders on these proposals; the range of policy solutions proposed or available at the international, national, or local level, and their relative trade-offs.

All in all, these and other roles show that CCE has a paramount importance in filling the knowledge gap that hinder the implementation of CRGE in Ethiopia. This in turn paves the way for its implementation, thereby speeding up the ambition to reach middle income status and achieve sustainable development in the country.

5.3.4 Challenges of climate change responses in the education sector of Ethiopia

Nowadays, CCE is on the agenda all over the world – but is still in its infancy. In Ethiopia, there is trivial initiation to incorporate CCE in the country's curriculum, i.e. education sector responses to climate change are in early stages, and building a culture of climate resilience at all levels is a long-term strategy. This is mainly because of the following crucial challenges:

- **Limited teacher qualifications:** Pre- and in-service training of teachers is essential to the implementation of CCE within schools. Meanwhile, a lack of sufficient teacher education is a recurring theme. As CCE comprises a new, open and wide-reaching field, it is not immediately obvious for teachers what they are supposed to do with it. For this reason, extensive and concentrated efforts which can offer the necessary inspiration and competences are needed to kick start CCE in schools.
- **Subject divisions within schools:** Developing student competences to participate in solving real-world problems means structuring teaching in ways that allow the use of various forms of knowledge and facilitate the ability to thinking terms of contexts and interdependencies. The currently predominant division of teaching into separate subjects therefore constitutes a significant structural barrier.
- **Narrow focus on vocational qualifications:** In an attempt to be competitive in a global market, educational policy in many countries should focus on controlling the effectiveness of education by means of tests and performance indicators. This reduces willingness among teachers and schools to experiment with new approaches to teaching and learning. In turn, this has an impact on the spread of CCE, with innovativeness, interdisciplinarity, and a broad focus on competence development regarded as vague and idealistic goals which school administrators and teachers find overwhelming and in conflict with the more straightforward requirements concerning vocational qualifications.
- **Overcrowded curriculum:** CCE is generally added to an already overcrowded curriculum and is given low priority because it is not an examination subject. In some countries, attempts have been made to integrate CCE within a single discipline (science education); while in other countries, it has been divided into components and integrated within the various existing school subjects. In both cases, CCE becomes an 'add-on' to an already overcrowded curriculum. As a new and a highly complex and wide-ranging area, CCE struggles to compete with the more straightforward and clear-cut examination subjects.
- **Shortage of scientific knowledge and expertise:** The chronic shortage of scientific knowledge and expertise around climate change and its impacts in many developing countries are also a key concern for educators and policy makers at both secondary and tertiary levels.
- **Scarcity of relevant instruction materials:** The Scarcity relevant instruction materials like publications,

textbooks, visual aids, brochures, cases studies and good practices, electronic, audio and video resources could impede the incorporation of CCE in the country's curriculum.

- **Meager research works:** Though climate change related research projects are wide spread in the country, researchers have not yet given a due emphasis on CCE research works that are vital in integrating climate change issues into the country's school curriculum.

5.4 Recommendations

As it is mentioned earlier CCE in Ethiopia is at its early stage of development owing to the challenges described earlier. To avert these challenges and incorporate CCE in Ethiopian schools, the following recommendations are critical:

- CCE will make demands on all of society but schools will play a critical role, through what they teach and how they model sustainable practices. Governments need to ensure that schools are able to play a leading role in Education for climate change through the way education systems are managed, schools are organized and students taught.
- One of the key obstacles to CCE is teacher knowledge and understanding, because of the lack teacher training in CCE. We recommend allocating resources to remedy this: universities should offer climate change science courses for teachers and governments should implement policies which help all teachers to develop their capacity to implement CCE.
- CCE related research projects should be improved. It should focus on documenting the state of practice and identifying promising practices, exploring educational outcomes and their evaluation in respect of CCE, and identifying and explaining opportunities and problems of general relevance.
- It is important to support non-formal and informal CCE activities, since they are an essential complement to formal education. Non-formal CCE has a special role as it is often more learner-oriented, participatory and promotes lifelong learning. Informal learning in the work place adds value for both employers and employees. Therefore, the cooperation among the different actors involved in all forms of CCE should be recognized and encouraged.
- CCE should be supported by relevant instruction materials, such as, methodological, pedagogic and didactic publications, textbooks, visual aids, brochures, cases studies and good practices, electronic, audio and video resources.
- Cooperation and partnerships among members of the educational community and other stakeholders should be expanded. Further involvement of the international community in educational processes will help to address rapid technological development and changing working conditions. Learning activities in close relation with society will add to learners' practical experience.
- Governments should be supportive of non-formal and informal learning because informed citizens and knowledgeable consumers are essential in enacting sustainability measures through their choices and actions.
- NGOs are important providers of informal and non-formal learning, able to implement processes of civil empowerment as well as integrating and transforming scientific knowledge and facts into easily understandable information. Their role as mediators between governments and the general public should be recognized, promoted and supported. Partnerships among NGOs, governments and the private sector would add significant value to CCE.
- Mass media is a powerful force in transferring reliable information and key messages on climate change related issues. Hence, it is vital to use all the available media channels for this purpose.

6. CONCLUDING REMARKS

Climate change is already taking place in Ethiopia. Throughout its long history, Ethiopia has struggled with climate variability and associated disasters. Droughts, food shortages and famines, epidemics and floods have affected the country at different times. Some of these have been associated with rainfall variability. Rain failures have contributed to crop failure, death of livestock, hunger and even famine in the past. Even relatively small events during the growing season like too much or too little rain at the wrong times can spell disasters. Small farmers and pastoralists, who are already struggling to cope with the impacts of current climate variability and poverty, are likely to face daunting tasks to cope with climate variability and adapting to future climate change.

Climate change is already impacting populations, livelihoods and ecosystems in Ethiopia. The potential for natural environmental hazards and future climate change to undermine the country's economic development and social progress is great and growing. The pace of change in the pattern of climate and different forms of environmental hazards in the country often exceeds the capacity of local institutions to adapt to or mitigate the effects of such changes. It is widely recognized that failure to respond to the challenges posed by climate change would impede national efforts aimed at alleviating poverty, and achieving economic growth and transformation.

In response to the threat posed by climate change and in its path to sustainable development, the GoE has

already promulgated a new five year Growth and Transformation Plan (GTP) which directly addresses climate change and environment issues. In its subsection about environment and climate change the plan recognizes the role that environmental management plays in sustainable development and clearly stipulates the country's ambition to build a climate resilient green economy (CRGE) by 2025.

The CRGE of Ethiopia is a long-term ambition of the country to grow in low carbon and resource efficient development pathways. This requires educational schemes, particularly education on climate change. CCE has an important role to play in addressing climate change. It is critical for promoting green economy pathways and sustainable development and improving the capacity of the people to address environment and development issues. It also provides the foundation for any environmental and development education, and hence it needs to be incorporated as an essential part of curricular learning in the country.

Despite this, CCE is still in its infant stage in Ethiopia and one can seldom find CCE incorporated in the country's curriculum. And also, the response education sector to climate change at all levels is not promising. This is, in fact, owing to challenges like limited teacher qualification, overcrowded curriculum, shortage of scientific knowledge, expertise, relevant instruction materials, etc. As a result, all concerned bodies including the government, NGOs, the media, the academia, private sectors and the international community should jointly work hard so as to resolve these challenges, and thereby backing up the country to benefit out of CCE, ESD and other related activities.

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