African Eco-Labelling Mechanism and the potential for climate change mitigation and adaptations in Africa

Final Draft

Report

To

UNEP ROA

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Table of Acronyms

AEM	Africa Eco-labelling Mechanism
AfDB	African Development Bank
EMA	Eco Mark Africa
EAOPS	East African Organic Production Standards
FSC	Forestry Stewardship Council
GHG	Green House Gas
GP	General Principles
GDP	Gross Domestic Product
IPCC	Intergovernmental Panel on climate change
IFOAM	International Federation of Organic Movements
ISO	International Organization for Standardization
LCA	Life cycle analysis
MSC	Marine Stewardship Council
NGO	Non Governmental Organization
REDD	Reducing Emissions from Deforestation and Forest Degradation
SSA	Sub Saharan Africa

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Executive Summary

The potential to mitigate climate change impacts and to increase adaptations to climate change through application of eco-labelling is high. Among other environmental benefits, eco-labelling standards aim to enhance soil fertility by increasing the rate at which CO_2 is sequestered and carbon is retained in the soil thus increasing the rate at which soils act as carbon sinks. As the soils get richer in carbon content, they also increase the ability to retain more water.

Lands managed under the eco-labelling framework have higher vegetation cover compared to those managed through conventional ways of production. This enhances carbon retained in the biomass, and contributes to conserving water in the soils, reservoirs, and rivers and also reduces soil erosion. Eco-labelling standards put emphasis on reducing wastes at all levels of production and where it occurs, the standards have better ways of management that increase re-use, recycling and generation of energy from the wastes which all reduce emissions of green house gases.

The following is a summary of how applications of eco-labelling standards contribute to climate change mitigation.

Increase in soil fertility: Application of eco-labelling framework in agriculture leads to better management of soil fertility through greater enrichment of soil carbon stocks compared to conventional agriculture. This makes the agricultural soils to play a bigger role as a carbon sink, effectively absorbing and reducing the CO_2 emitted into the atmosphere. Land managed through eco-labelling has higher soil carbon content than one managed through conventional agriculture.

Increase in vegetation cover: Cultivated land managed through eco-labelling has a higher vegetation cover than land managed through conventional agriculture. A higher vegetation cover sequesters more CO_2 from the atmosphere and incorporates it into the plant biomass. Through the carbon cycle, some of it is added into the soil carbon sink. Increased vegetation cover contributes to reductions in soil erosion, soil water loss through evaporation and contributes to increased soil fertility in agricultural lands.

Better biodiversity conservation: One of the climate change impacts is reducing biodiversity. Application of all the four AEM eco-labelling standards (agriculture, forestry, fisheries and tourism) will enhance biodiversity conservation in the habitats where they are applied. The increase can occur in all types of ecosystems within the land under eco-label management. The standards employ ecological principles in the management of grazing areas like maintaining the number of grazers and browsers at or below the carrying capacity. Higher biodiversity increases resilience to climate change and increases the ability of the ecosystems to adapt to climate change.

Better water conservation: Eco-label standards promote water conservation through water saving technologies in the farming practices like conservation agriculture, water harvesting, mulching and avoidance of cultivation along the riparian areas and wetlands. Reduction in water availability is one of the projected impacts of climate change. Measures to water availability will therefore increase adaptations to climate change.

Reductions in wastes: Waste disposal is major source of GHG worldwide. Eco-label standards employ techniques to minimize wastes and recycle organic matter back into the soil to increase soil fertility. The standards promote composting, among other techniques of waste management. Waste managed, through eco-label standards, reduces CO_2 and other GHG emissions, produces organic manure for use in farming and reduces dependence on chemical fertilizers and pesticides.

Increase in energy use efficiency: Energy use efficiency is a major consideration in the implementation of eco-label standards. Tourism is one of the major areas where eco-label standards provide regulations and procedures to conserve energy. Increase in energy use efficiency reduces the amount of fossil fuels combusted to generate energy, thereby, reducing on carbon dioxide emissions.

Adaptation to climate change strategies: Activities that enhance the potential of systems (human and ecosystems) to adjust to conditions that are created by, or resulting from climate change, are considered to contribute to adaptations to climate change. Implementation of eco-labelling standards will contribute to climate change adaptations in the following ways:

Cropping diversity: Climate change will in most places reduce both the abundance and extent of biodiversity in most ecosystems, including those in agricultural lands. Loss of diversity leads to environmental degradation and ultimately reduction in productivity. Implementation of eco-label standards promotes diversification of cropping systems as a way of managing productivity. Diversification of cropping system increases resilience to climate change. Farmers who practice crop diversification are better placed to cope with climate change.

Selection of breeds that suit the environment: Selection of breeds is one of the principles in eco-labelling standards. The practice ensures that high productivity of crops, livestock, or feeds is maintained, and adjustments are made from time to time according to changes in environmental conditions. This gives an opportunity to change the breeds as may be required due to climate change, especially for crops.

Protection of Livelihoods: One of the impacts of climate change on people is the destruction of livelihood support systems. Communities that are highly dependent on natural resources, like those living around the forests, lakes and other centres of natural resources are at risk of losing their livelihoods due to climate change. Application of eco-labelling standards will enable people to adjust their lifestyles in accordance with the changing conditions, and, thus, help them to protect their livelihoods.

Some indicators of potential tangible reductions in CO_2 emissions

The Intergovernmental Panel on Climate Change (IPCC, 2007) estimates that improved agricultural and land management practices in Sub Saharan Africa (SSA), including improved cropland and grazing land management, restoration of peaty soils, restoration of degraded land and other practices, could reduce GHG emissions by well over 265 Mt CO_2 eq. per year by 2030. Afforestation in Africa can sequester over 665 Mt CO_2 per year, while reduced deforestation and forest degradation in Africa could reduce emissions by 1,260 Mt CO_2 equivalents in 2030. These potential emission reductions in Africa represent about 6.5% of global GHG emissions in 2000.

African top soils are estimated to store approximately 316 billion tons of CO_2 eq. but with 2/3 of sub-Saharan Africa's cropland, rangeland and woodland already being degraded, this stored carbon is being released to the atmosphere. If eco-labelling standards are implemented fully this loss can be substantially reduced through better soil and water management.

If all the agricultural land in Africa is put under Eco-label management and assuming that most of it is in the warm dry areas every single hectare managed can mitigate 0.39 tCO_2 equivalent per year. This would reduce emissions by approximately 24 million tCO_2 per year based on 2009 FAO estimates of total arable land in Africa.

Agro forestry alone has a potential to mitigate 0.35 tonnes of CO_2 per ha per year in the warm dry areas and 0.72 tonnes of CO_2 equivalent per ha per year in the warm moist areas. If all the land deforested in Africa between the year 2000 and 2010 which amounts to about 38 million km^2 is put back into forest and managed through eco-labelling the CO_2 mitigation potential would approximately be 13 million tCO_2 per year

If all the land currently under cultivation of maize, sorghum and wheat is managed under eco-labelling framework the potential of CO_2 mitigation would range from 200 $MtCO_2$ in Central Africa to nearly 1400 $MtCO_2$ in North Africa depending on the amount of land utilized for production. Figure 1 shows some of the CO2 mitigation potential for applying eco-labelling standards in agriculture in different parts of Africa.

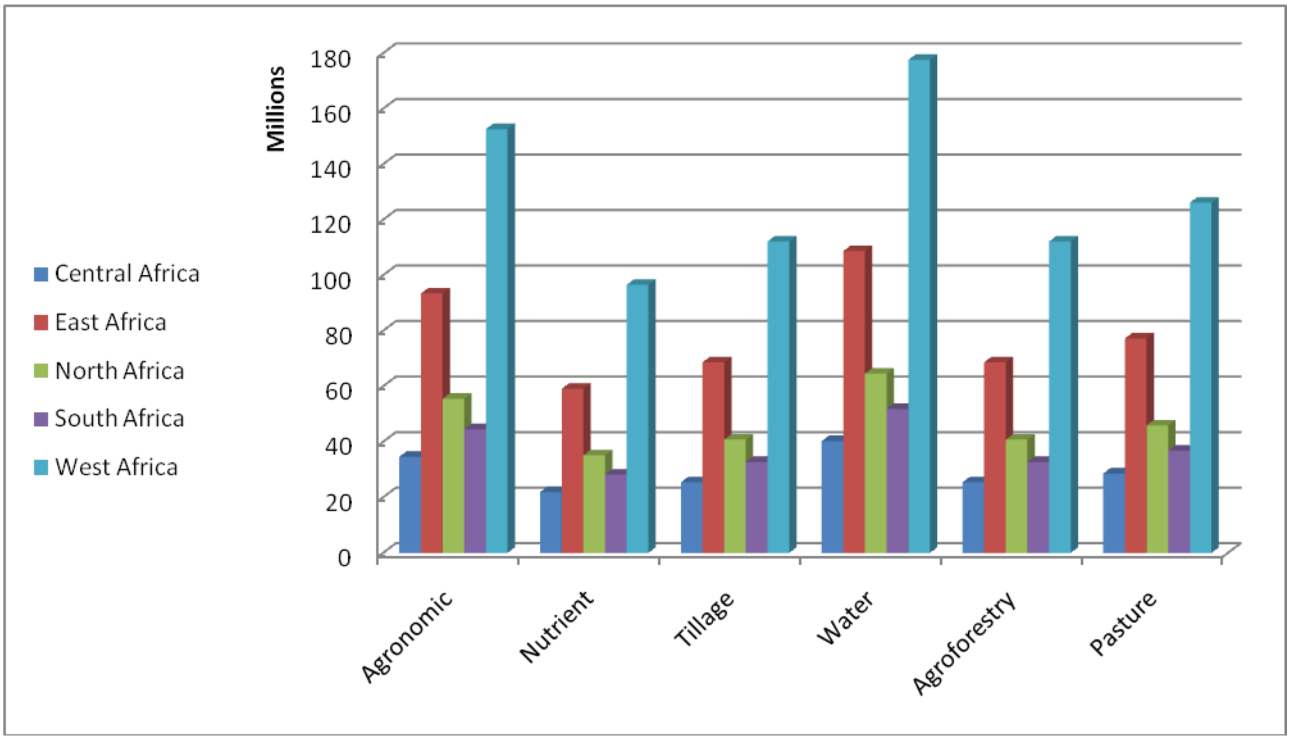

Figure 1: CO_2 Mitigation potential by different land management in Africa if all arable land is cultivated. **(Source: www.faostat.org)**

Degraded lands in Africa have not been well calculated but estimates show that about 60% of land under cultivation is degraded meaning that there is a need for restoration. When degraded lands are put into eco-label standards of management, there will be double gain in terms of CO_2 mitigation. First about 3.45 tonnes per ha per year of CO_2 will be mitigated

through the restoration programme and then secondly CO_2 mitigation through crop management another 70.18 tonnes per ha per year if the same land is put under production using agricultural eco-label standards.
Application of sustainable production in the management of rice fields is known to increase yields by about 22% and sequester carbon at the rate of 0.34 tonnes of C per ha per year especially for the wetland land rice. Applying eco-label standards in rice management in Africa has a potential to mitigate about 3.0 million tonnes of carbon per year. Since better rice management results into better water use efficiency further gains on CO_2 emissions can be made due to application of better water use strategies.

Manure application is known to sequester about 1.54 tonnes of CO_2 per ha per year. This rate of sequestration will vary from soil to soil due to variabilities in soil physical properties including environmental characteristics. Taking a sequestration rate of 1.54 tonnes of CO_2 per ha per year that is reported to apply in warm dry conditions. The total CO_2 mitigation potential by manure application is approximately 90.6 $MtCO_2$ eq. per year.

Pasture management is known to mitigate about 0.81 tonnes of CO_2 per ha per year. Figure 2, shows the CO_2 mitigation potential if all livestock production systems in Africa are management through eco labelling.

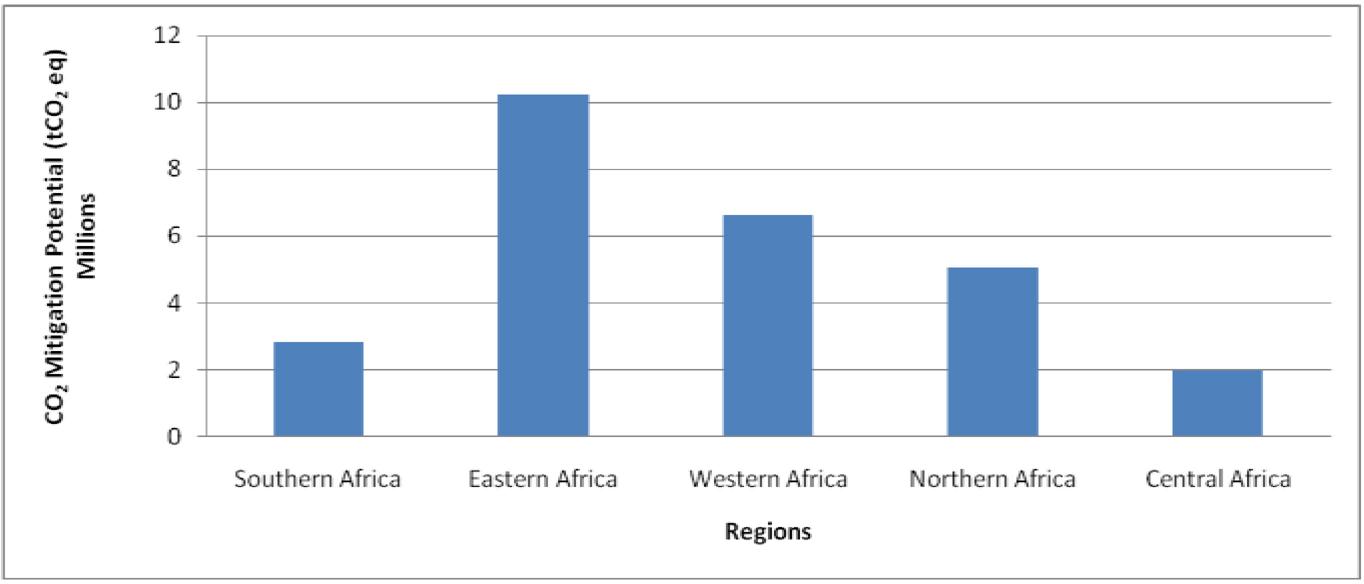

Figure 2: CO2 Mitigation potential on pasture management in Africa by regions (www.faostat.org)

African Eco-labelling Mechanism promotes making of compost from organic wastes in all stages of production, processing and consumption in all the four sectors. This by extension would include municipal wastes where most of the products are consumed and most industrial processing is done. The application of compost promotes high rates of soil carbon sequestration and also increases soil fertility which enhances food security. 1 tonne of organic waste composted mitigates 0.44 metric tonnes of CO_2 equivalent. If all municipal wastes in Africa are sorted out to isolate organics that can be composted the total amount of CO_2 emissions mitigation potential can be significantly high. The total amount of waste generated by African cities and municipalities is hard to estimate accurately due to lack of data. Working with estimates of Nairobi city which based on 2009 statistics is thought to be 2,600 tonnes per day, a total of 950,000 tonnes is generated per year with compostable material of about 489,000 tones that if all composted have a potential sequester about 215, 160 $MtCO_2$ per year.

One big benefit AEM can bring to Africa countries is a huge amount of savings in the national GDP on the amount that countries would spend in responding to catastrophes caused by climate extreme events like droughts, floods, landslides which bring with them famine, livestock deaths, people displacements, diseases, loss of lives, and damage to property. If countries adapt AEM and other climate change mitigating measures saving on GDP can be as much as 10% for some counties by the year 2030.

1 Introduction

"Eco-labelling" is a voluntary certification exercise that aims to achieve a worldwide production and consumption procedure to safeguard the environment. An "eco-label" identifies a product that meets specified performance criteria or standards. In contrast to "green" symbols or claim statements made by manufacturers and service providers, an eco-label is awarded by a third-party organization to products or services that are determined to have met specific environmental sustainability, standards (Hale, 1996).

Different types of organizations including governments, non-profit and for-profit organizations have developed eco-labelling programs based on specific standards. Eco-labels address life cycle environmental concerns including specific social and workers' conditions, health and safety issues. Environmental performance labels and declarations vary greatly. The International Organization for Standardization (ISO) has identified three broad types of voluntary environmental labels table 1.

Table 1: Types of Eco-labelling

Eco-label type	The nature of environmental accountability
Type I	Voluntary, multiple-criteria based, third party program that awards a license for authorizing use of environmental labels on products indicating overall environmental preferability of a product within a particular product category based on life cycle.
Type II	Informative environmental self-declaration claims.
Type III	Voluntary programmes that provide quantified environmental data of a product under pre-set categories of parameters that are set by a qualified third party based on a life cycle assessment, and verified by another qualified third party

African Eco-labelling Mechanism (AEM) is setting up a multiple criteria based standards in four sectors that will be applied by a producer of a product or a service provider and verified by a third party before certification. AEM has developed a label "Eco Mark Africa" (EMA) that will be used to indicate a product or a service that will conform to the standards (see www.ecomarkafrica Federal Electronics 2007; Schneider and Maitima 2012).

2 Origins of Eco-labelling

Over the last few decades there has been many global concerns calling for concerted efforts on environmental protection by governments, businesses and the general public. Initially, among the developed countries, there was recognition that commercial enterprises could be transformed into a market advantage for certain products (Gulbrandsen, L.H. (2006). This recognition was followed by a number of environmental declarations and claims in association with certain products such as “recyclable”, “eco-friendly”, and “low energy”. Such claims or labelling attracted a number of consumers who were looking for ways to reduce the adverse effects to the environment through their purchasing choices. However, due to the number of such labels that proliferated without a check on the authenticity of the claims by the labels, consumers were confused and could not ascertain the claims made by companies (Federal Electronics 2007). This concern on the credibility and impartiality led to the formation of private and public organizations providing third party labelling. In many instances, such labelling took, and continues to take, the form of eco-labels awarded by programs operated at national and regional (i.e. multinational) levels (Federal Electronics 2007).

Due to popular demand, today there are many third party labelling systems either in operation, or being developed mainly focussing on single sector (e.g. agriculture, forestry, etc.), on a specific environmental parameter (e.g. air quality, energy consumption, etc.) and sometimes considering a single life cycle phase in their application (e.g. product use, product disposal, etc.). A good example of this is the East African Organic Produce standards that have developed an eco-label specifically for organic Agriculture in East Africa (EAC, 2007). Eco-labelling programmes that have gained popularity have their criteria determined by an independent organization with assistance from a complimentary technical advisory group. Generally, once a category is chosen, some form of life cycle review is conducted to assess the environmental impacts on each phase of production or consumption. This review may include raw material extraction, manufacture, distribution, use and disposal. Companies or individuals who want to participate in an eco-labelling program make application and submit their products for third party compliance testing and/or verification. If approved, the participants pay license fees for permission to use the program's distinctive eco-label symbol for a specified period or for specified batches of products. Use of the eco-label is restricted to the approved product(s), and is usually monitored by the managing agency (Gulbrandsen, (2006).

3 About this report

This report provides the result of assessment carried out to determine the potential of eco-labelling to reduce green house gas emissions in Africa, especially CO_2 emissions and the contribution it can make towards climate change mitigation and adaptations.

The report describes the concerns, especially by the consumers, that led to the origination of eco-labels and how eco-labels have evolved to meet the expectation of the consumers. Since all eco-labels are aimed at blending environmental sustainability with the sustainability of production and consumption as well as service providers in the context of development, the report sets the environmental characteristics that are addressed in eco-label standards especially the climate change related parameters, the effects of changes in these parameters to the environment, and how interventions of eco-label standards can mitigate the effects.

The report pays attention mainly to the four development sectors (Agriculture, Forestry, Fisheries and Tourism) that are the focus of the African Eco-labelling Mechanism. The report presents scenarios of the climate trends, the stressors or drivers of the climate change to set the stage on the problems that eco-labelling attempt to address. We set the green house gas emissions scenarios from different sectors of the economy both at global and regional levels to show both the comparative emission scenarios and the magnitude of the problem. The report outlines the standards and the management criteria for each sector and discusses the emission potential that each management criterion is capable of mitigating in the continent as a whole and where possible a breakdown on regions, especially for the agriculture sector where data per region is available. The report discusses qualitatively the climate change adaptation and mitigation potentials that application of each eco-label criteria can achieve.

Finally, the report discusses the projections on impacts of climate change on the national economies in Africa and the benefits to be achieved in terms of percentage gains on the GDP by implementing measures on climate change mitigation and adaptations such as those presented by eco-labelling standards.

3.1 Eco-labelling Objectives

Eco-labelling has gained popularity as a tool used to encourage sound environmental practices and for businesses to identify and establish domestic or international markets for their products. Eco-labels, therefore, have been used for certain specific objectives. These include: 1) environmental protection (Hale, 1996); 2) market creation and trade opportunities (Gulbrandsen, 2006); 3) Building consumer awareness of environmental issues (Hale, 1996).

The unique characteristic of all eco-labels is the objective to protect the environment. Through application of eco-label programmes, governments, NGOs and other authorities seek to influence consumer decisions and encourage the production and consumption of environmentally preferred goods and the provision of environmentally sound services. Eco-labels, therefore, tend to serve as a market-based instrument to increase demand for products that make environmental improvement in the way they are produced (Gulbrandsen, 2006).

The specific environmental objectives of eco-labels include:

- encouraging efficiency in the management of renewable resources to ensure their sustainable utilization and continued availability even to future generations;
- promoting efficiency in the use of non-renewable resources, including fossil fuels;
- facilitating the reduction, reuse and recycling of industrial, commercial and consumer waste;
- encouraging the protection of ecosystems and species diversity;
- encouraging the proper management of chemicals in products and
- reducing the emissions of green house gases into the atmosphere through better management of land, production processes, materials and also consumption of products.

3.2 Market creation and trade opportunities

Eco-labelling awards a label that acts as a market incentive for products and services produced according to the standards set for the eco-label. By offering products that reduce environmental stress, the business can establish and reinforce a market niche and positive or attractive corporate image among consumers, thereby, creating a market and maintaining good trading relations. Generally, these market segments offer top premium prices that become rewards for better business (Thidell, Ake, 2009).

In Africa, there are opportunities for international and intra-African trade if the standards are developed and harmonized across the region. Learning from the developed countries, most programs start with few stakeholders and a few standard criteria. The markets develop them gradually and incrementally raising the standards which encourage producers and service providers to keep pace with new and emerging performance improvement opportunities and market shifts (Janisch, 2007).

3.3 Building consumer awareness of environmental issues

Eco-labelling increases consumer awareness of the environmental issues associated with production of the commodities they buy, and the implications of their continued use of the products. This awareness extends to impacts on personal health, environmental impacts and sustainability of production. A consumer, for example, will choose to buy an organically produced product because it may contain less pesticide residues that may affect his/her health. Others may chose to buy timber that has been produced sustainably due to the fact that they will not be contributing to deforestation that hurts the environment. Tourists may chose to go to a hotel that is known through an eco-label to have good standards in energy saving and water use efficiency (Gulbrandsen, 2006).

In countries where consumers are not as highly motivated by environmental concerns, eco-labelling can be used to promote environmentally beneficial actions like organic agriculture, conservation tillage or water harvesting among others.

3.4 Sustainable Development

Sustainable development was defined by the United Nations World Commission on Environment and Development in 1987 as "*those paths of social, economic and political progress that meet the needs of the present without compromising the ability of future generations to meet their own needs.*"This definition is presented in the Brundtland Report (Brundtland 1987).

There are many definitions of sustainable development basically reflecting the sectors being addressed. There are 10 issues or challenges that sustainable development tends to address (Manasinghe, et. al. 2007). These are as follows:

1. Air quality
2. Water quality and availability
3. Food availability
4. Energy type and usage
5. Land Use
6. Transportation
7. Housing
8. Jobs
9. Waste disposal
10. Health care

In addressing these challenges, many development programmes have to integrate three main domains of social, economic and environmental sustainability that forms the basic elements of sustainable development (Figure 1).

The concept of sustainability relates to the maintenance and enhancement of environmental, social and economic resources, in order to meet the needs of current and future generations. The three domains of sustainability are:

- Social sustainability – which requires that the cohesion of society and its ability to work towards common goals be maintained. Individual needs, such as those for health and well-being, nutrition, shelter, education and cultural expression should be met.

- Economic sustainability – which occurs when development, that moves towards social and environmental sustainability, is financially feasible.

- Environmental sustainability – which requires that natural capital, remains intact. This means that the source and sink functions of the environment should not be degraded. Therefore, the extraction of renewable resources should not exceed the rate at which they are renewed, and the absorptive capacity of the environment to assimilate wastes should not be exceeded. Furthermore, the extraction of non-renewable resources should be minimised and should not exceed agreed minimum strategic levels.

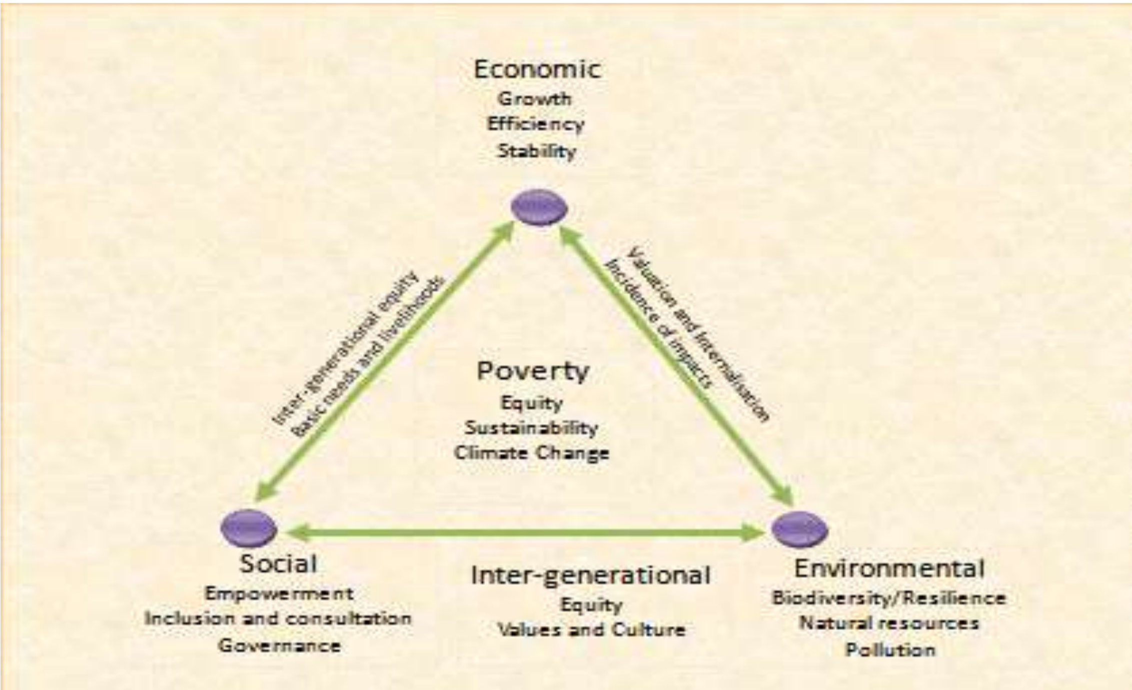

Figure 3: Sustainable development triangle: Elements and Interconnections

(*Source: Manasinghe et. al. 2007*)

The need for eco-labelling is to guide development in all the three main domains of development so as to maintain sustainability. An economic development exerts pressure on the environmental resources through commercial and or consumptive exploitation of the resources to serve the needs of the society. The three domains are interrelated in such a way that a change in one will definitely affect the dynamics in the other two. Without rules to guide sustainable utilization of environmental resources, there is a likelihood that over exploitation of natural resources will lead to collapse of the natural processes and dynamics that govern productivity in each of the environmental components. This will adversely affect not only the environment but also the social and economic domains. Eco-labelling standard guides the management and utilization of natural resources so that the environmental process can sustain the social needs and economic growth.

4 Trends of Climate Change in Africa

Climate change in Africa, like in the rest of the world, has been characterized by increase in temperatures (Figure 2) and a remarkable variability in precipitation patterns. During the 20th century, Africa warmed up by about 0.5^{o}C with the most rapid warming occurring between 1910 -1930 and after 1970 (SEI, 2009). Rainfall trends and patterns are more difficult to determine and significant regional differences are evident, for example, the alternating wet and dry periods in the Sahel, particularly the dry period after 1970. There is some evidence that rainfall increased in parts of Eastern Africa during the 20th century. Other areas of the continent, such as Southern Africa have experienced marked inter decadal variability, which adds to the difficulty of managing complex risks in several African environments.

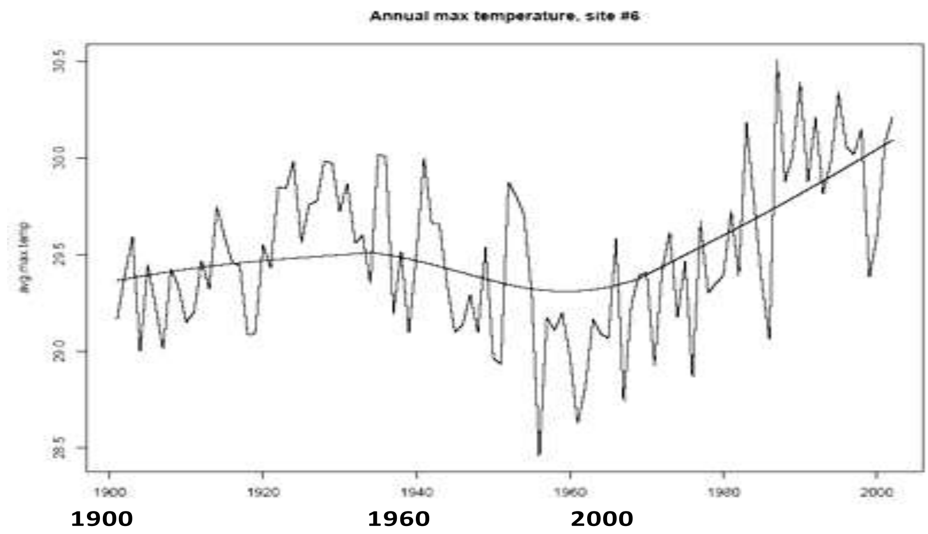

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Figure 4: Temperature increases since 1960
(Source: IPCC 2007)

Available evidence shows clearly that the temperature increases have been significantly influenced by anthropogenic activities (Fig.3).

Between 1910 and 1930, models showed no significant variation between the effects of anthropogenic and those of natural causes. At the beginning of the century, anthropogenic activities had fewer effects on global temperatures than those from natural forces. After 1930, anthropogenic causes started to exert higher forcing than the natural forces and by around 1970, human causes surpassed natural forces.

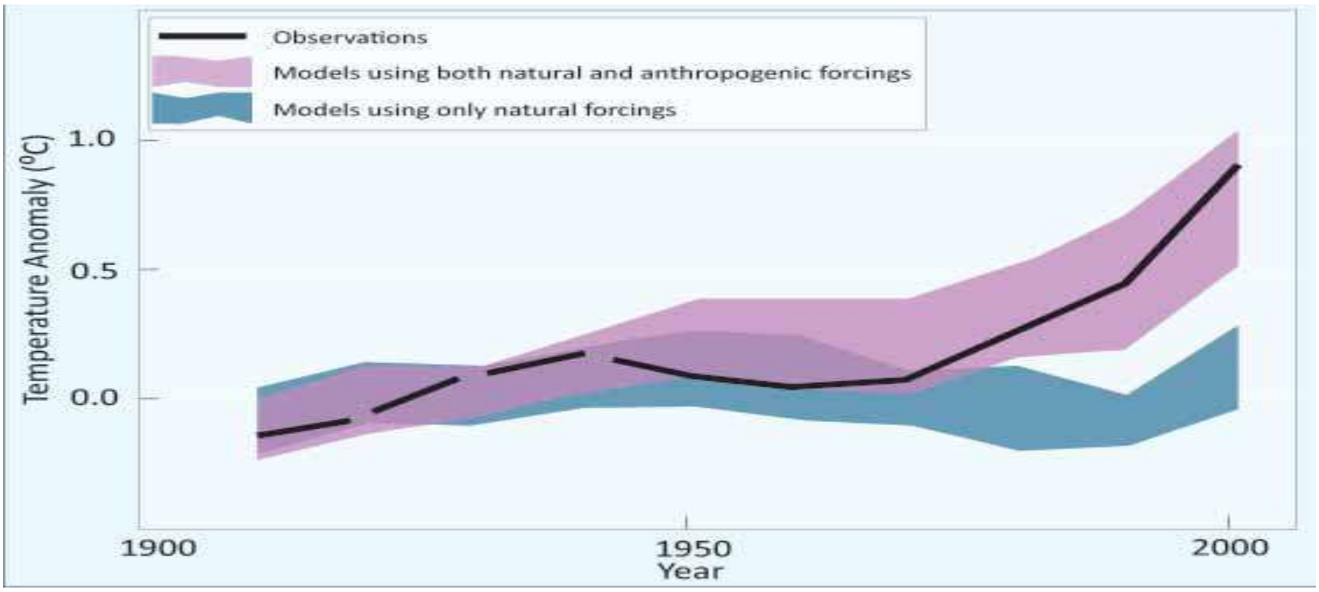

Figure 5: Comparing temperature changes from natural and anthropogenic forcing
(Source: IPCC 2007)

Projections of future climate change from a suite of downscaled global models show the following situations / observations:

- Temperature: The projections indicate future increases in mean annual temperature (average monthly temperatures) of broadly 1 to 3.5 ºC over the range of models by the 2050s (2046 -2065). There will also be increases in sea level.

- Rainfall: The changes in precipitation are more uncertain (Fig. 4). All the climate models show that rainfall regimes will change but these vary with season and region. Most models project rainfall will increase on average, though some models project rainfall reductions in some months for some areas.

- Extreme events: The information on extreme events (floods and droughts) is much more variable and future projections vary widely. Many models indicate an intensification of heavy rainfall in the wet seasons, particularly in some regions and, thus, greater flooding risks. Droughts are likely to continue but the projections are more varied - some models project an intensification of these events, particularly in some regions, though other models indicate reductions in severity.

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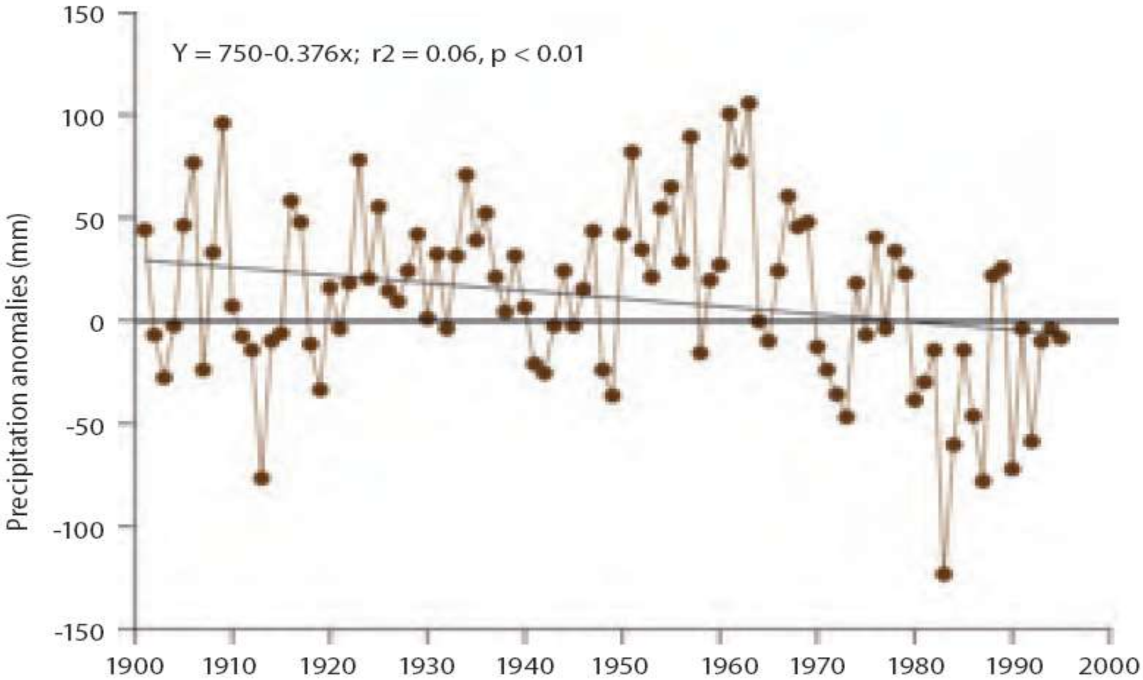


Figure 6: Trends in precipitation anomalies over Africa based on IPCC prediction

Observations in changes on annual precipitation in Africa indicate a small but significant decline in rainfall (IPCC 2007) during the 1900s particularly after 1960s (Fig.4). This is further emphasized by Nicholson and Kim (1997) , who observed a decline in precipitation by about 2.4±1.3% per decade in the moist forest zones of Africa since the mid-1970s; a rate which has been stronger in West Africa (-4.2% per decade) and North Congo (-3.2% per decade) (Nicholson and Entekhabi 1987; Nicholson and Kim 1997).

5 Climate change projections

A number of models have projected that the global annual mean surface temperature will increase by between 1.5 and 5.8 by 2100. The IPCC report indicates that warming in the entire continent of Africa and in all seasons is very likely to be larger than the global annual mean warming (IPCC 2007). The projection shows that the drier sub tropical regions are likely to be warmer than the moister tropics. The warming is likely to range from 0.5 to 5.8 based on different scenarios, and that it will be greater in the semi arid regions bordering the Sahara and central Southern Africa (Nicholson and Selato 2000).

Observed patterns of annual rainfall anomalies of the climate change models indicate that there are increases in precipitation in East Africa, contrasted with reduced precipitation for southern Africa. Models project these trends will continue in the next 100 years and probably beyond (SEI 2009; Olson, 2008). Whereas, for East Africa, an increase in rainfall as projected would be welcome, it will be accompanied by an increase of extremely wet events, from the current 5% to about 20%, characterized by flush floods, which could seriously impact on forest resources, biodiversity, food production systems, water supply systems and infrastructure (SEI 2009; Nicholson and Selato 2000).

6 Impacts on natural resources and livelihoods in Africa

The IPCC indicated that Africa's economies have already been adversely affected by the global warming and are likely to experience further effects in the coming years (IPCC 2007). These adverse primary effects will lead to other secondary effects in African countries resulting into lower subsistence capacities of people due to diminishing natural resource base and the loss of ecological potential of the productive systems. These effects include availability and quality of water resources, less availability of quality pastures, less biodiversity, and low fertility of soils. These effects will increase migrations from rural to urban areas, displacement of populations, poor infrastructure and increase in the spread of epidemics. It is, therefore, necessary to develop adaptation strategies as the probability of these changes taking place is very high due to the fact that many of them are already evidently observable.

The challenge lies in the fact that Africa's adaptive capacity is low due to the extreme poverty of many of its people, compounded by frequent natural disasters such as droughts and floods, and poor institutional and infrastructural support.

6.1 Impacts on water

The major impacts of climate change on African water systems is, and will continue to be, changes in the hydrological cycles, due to the changes in the balance of temperature, and rainfall (IPCC 2007). The water volumes and rates of flow in rivers have been observed to decrease, and are predicted to continue to decrease in the future if the current climate patterns continue with their current trends. In the Nile region, for example, most scenarios estimate a decrease in river flow of up to 75% by 2100.

The regions of Africa that are experiencing longer periods of drought and shorter period of sufficient rainfall are particularly vulnerable to further reductions in precipitation. The most vulnerable are the arid, semiarid, and dry sub-humid areas where the ratio of precipitation to potential evaporation (PET) ranges from 0.05 to 0.65. These areas cover 13 million km^2 or 43% of the continent's land area, where 270 million people or 40% of the continent's population live.

The amount of renewable water resources in Africa is about 4,050 km^3 per year based on the year 2000 statistics that give an average of about 5,000 m^3 per capita per year. This water availability is far less than the world average of 7,000 m^3 per capita per year. Further projection on the impacts of climate change on water resources indicate that water availability per capita for Africa will decrease by 53% in Southern Africa, 54% in East Africa and 60% in West Africa by the year 2025. Over twenty five countries in Africa are expected to experience further water stress over the next 20 to 30 years affecting an estimated 480 million people.

6.2 Impacts on biodiversity

Africa has 20% of the global land surface and contains more than one fifth of the world's known plant and animal species. Biodiversity is an important resource for African people as it provides sources for food, fibre, fuel, shelter and medicine. In addition, biodiversity offers a range of non-consumptive ecosystem services like recreation facilities, tourism as well as attracting rainfall in the case of forests. Given the heavy dependence on the natural resources it provides in Africa, many communities are highly vulnerable to the loss in biodiversity that could result from climate change.

A review of climate change impacts on African biodiversity suggests strongly that ongoing global warming is likely to exert substantial stress on African species and ecosystems. Bioclimatic niche-based models (SEI, 2009), suggest strong potential for sharp changes in vegetation structure, particularly in the savannah systems. These changes will result in species loss and changes in ecosystem composition in the continent's biodiversity.

6.3 Impacts on agriculture

The effects of climate change to the agricultural sector are as follows:

- *Reduction in crop yields and agriculture productivity:* There is growing evidence that climate change is changing crop yields in many parts of Africa. In many areas where precipitation is declining, crop yields are declining depending on water requirements for different crops. Reduction in crop yields is projected to continue declining as temperature continues to rise and water stress continues to increase.
- *Increased incidence of pest attacks:* As temperature rises, the conditions for insect pests reproduction and distribution will be enhanced especially in areas where temperature rise will be accompanied by slight increases in precipitation
- *Limit the availability of water:* It is expected that availability of water in most parts of Africa would decrease as a result of climate change. In particular, there will be a severe down trend in the rainfall in southern African countries.
- *Exacerbation of drought periods:* An increase in temperature and a change in the climate throughout the continent are predicted to cause recurrent droughts in most of the regions.
- *Reduction in soil fertility:* An increase in temperature is likely to reduce soil moisture, moisture storage capacity and the quality of the soil, which are vital nutrient sources for agricultural crops.
- *Low livestock productivity and high production cost:* Climate change will affect livestock productivity directly by influencing the balance between heat dissipation and heat production and indirectly through its effect on the availability of feed and fodder.

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

7 CO2 Emission Scenarios in the selected sectors

Land use activities in Africa are characterized by subsistence crop production in small scale farming systems across the countries. These systems involve low inputs but are highly labour intensive compared to the high input and mechanized systems of the developed countries. Both crop and farm management in subsistence land use systems are not highly developed except in areas where growing crops for food is mixed with growing crops for market. One of the biggest environmental issues in African agriculture is expansion of cultivation into forest lands or conversion of un-cultivated lands into farmlands

As primary land cover is converted into cultivated land, there is massive release of CO_2 into the atmosphere because most of the vegetation is burnt or like in the case of grazing lands, much of the vegetation is either cut down by herders or grazed by livestock. The resulting cultivation or grazing lands are exposed to erosion leading to degraded soils and natural ecosystems turning into man-made.

African agriculture has the potential to sustainably improve productivity and economic gains for betterment of livelihoods of the rural communities. Eco-labelling gives an opportunity to make these improvements by reducing production loss due to land degradation and improvement of gains made through sustainable land use practices.

One significant gain to be made by applying eco-labelling standards in agricultural production is in reduction of emissions of GHG associated with agriculture.

The following sections outline the improvements that eco-labelling can bring to various aspects of agriculture and its potential role in reducing CO_2 and other GHG emissions.

8 Agriculture

Agriculture is the highest contributor to the economies of many African countries. The contribution to the gross domestic product (GDP) averages at 21% and ranges from 10 to 70% among the sub Saharan Africa countries. However, agriculture is critically dependent on environmental resources such as land, water, forest and air. The use of any one of these resources can affect agriculture directly or indirectly through dynamic and complex interrelationships existing in the natural systems and also the productivity of cropping.

On the other hand, agriculture is one of the major causes of GHG emissions. Globally agriculture contributes about 13% of all anthropogenic green house gases emitted to the atmosphere (Fig.5). Between 1990 and 2005, agricultural GHG emissions increased to 17% with an annual emission increase of 60 $MtCO_2$ eq. per year.

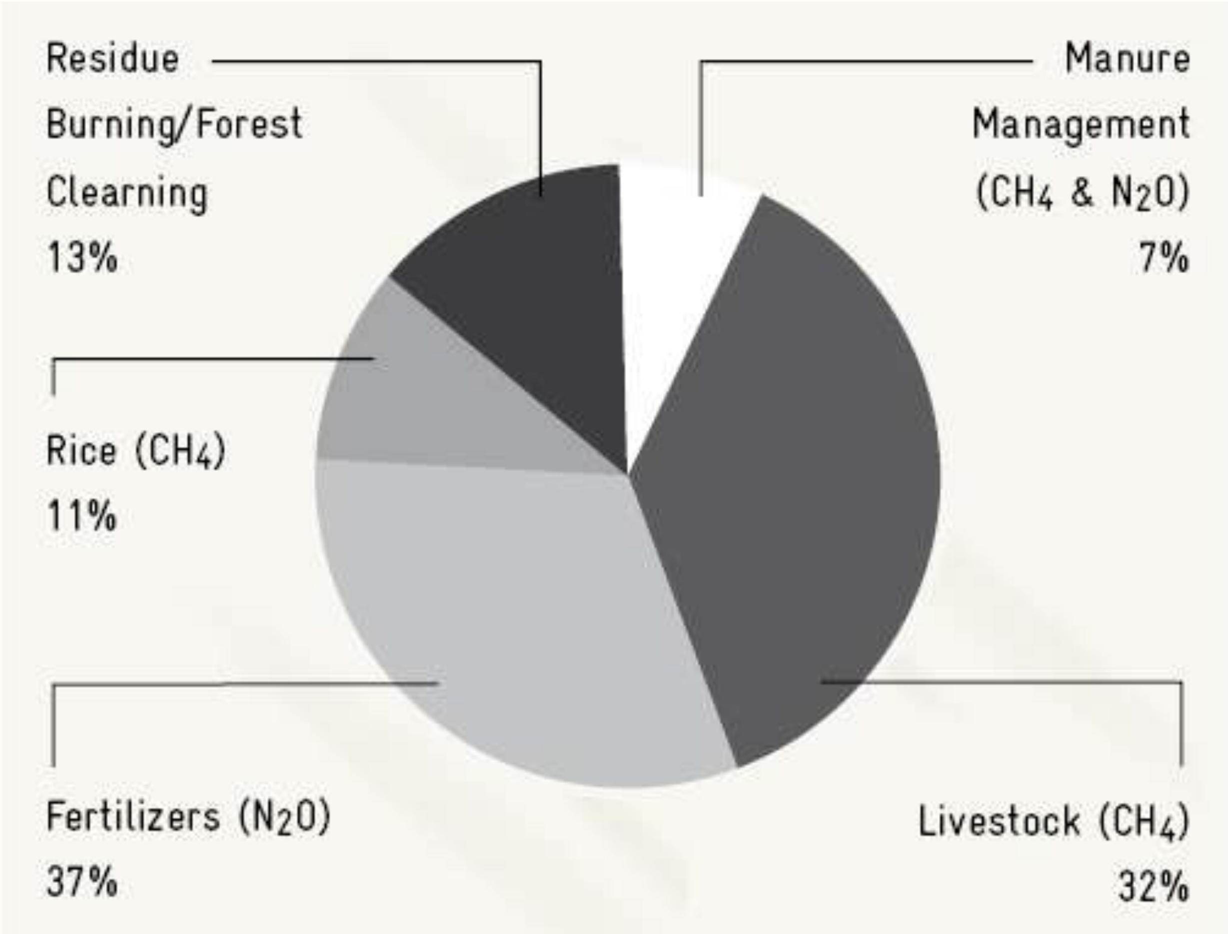


Figure 6: Share of global GHG emissions by 2000 in the agriculture sector
(Source: Drawn from data from USEPA (2006 presented in Rosegrant et. al. 2008)

Energy contributes the highest share due to fossil fuel combustion, and the renewable and non-renewable energy sources in world. However most of the emissions in these sectors are in the developed countries. Regionally, Africa's share to global emissions amount to 3.5% of the global total. Africa's contribution to climate warming through greenhouse gas emissions is insignificant, but, in terms of impacts due to climate change Africa will be the hardest hit, especially in relation to impacts on households. This is due to the fact that most African countries lack the financial capacity to cope with the impacts. Comparative analysis shows that per capita green house gas emissions in a typical European country and the USA is roughly 50–100 times and100–200 times more, respectively, than a typical African country. This is mainly due to much higher energy consumption in the industrial countries (Figure 5).

Land use change and forestry as shown in figure 5, contribute about 18% of global GHG emissions. In the context of this analysis land use change refers to land clearing for cultivation or from a more vegetated land cove to a more open farmland, grazing land, or other less vegetated land use. Land use change usually involves changes in vegetation and, thus, alterations on biodiversity and many of the ecological characteristics including the potential to sequester carbon dioxide. Figure 6 below illustrates some of the pathways of land use change from primary land cover to intensive and extensive land use systems

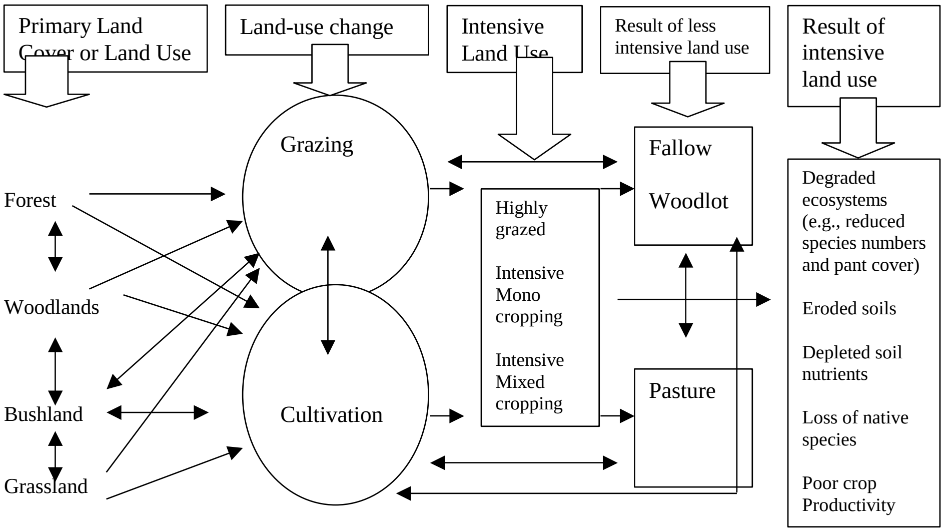


Figure 7: A schematic presentation of land use changes

(Source Maitima et.al. 2004)

The changes from one use type to another may result in GHG emissions depending on how the change is managed. In 1980s, the rate of deforestation as a result of land use change in Africa was about 15 million hectares per year. This reduced slightly to 12 million per year in the 1990's. This is a rate of 0.6% of deforestation per year for the past 15 years and is among the highest globally. About 26% of this deforestation is estimated to pave the way for smallholder agriculture (UNECA and AUC 2009).

Within the agricultural sector in general, the biggest emission is N_2O from fertilizer usage, which accounts for 37% of GHG emissions and CH_4 from livestock second with 32%. CO_2 emissions from residue burning and forest clearing contribute 13%. Methane and nitrous oxide from manure management contribute 7% and methane from rice production account for 11% (Fig. 7) (Rosegrant et. al. 2008).

Forestry practices in Sub Saharan Africa (SSA) play an important role in mitigating GHG emissions by reducing agricultural emissions of GHG and sequestering carbon in vegetation, litter and soils. The Intergovernmental Panel on Climate Change (IPCC, 2007) estimated that improved agricultural and land management practices in SSA, including improved cropland and grazing land management, restoration of peaty soils, restoration of degraded land and other practices, could reduce GHG emissions may sequester well over 265 $MtCO_2$ eq. per year by 2030 (IPCC, 2007). Further, (IPCC 2007) reports that afforestation in Africa could sequester over 665 $MtCO_2$ per year, while reduced deforestation and forest degradation in Africa could reduce emissions by 1,260 $MtCO_2e$ in 2030. These potential emission reductions in Africa represent about 6.5% of global GHG emissions in 2000.

A number of options exist for mitigating GHG emitted from agriculture and all of them are prescribed in eco-labelling standards as outlined in the EAOPS. The most prominent are improvement in crop and grazing land management (improving agronomic practices, nutrient use, tillage, and residue management), restoration of organic soils that are drained by crop production, restoration of degraded lands, and improvements in water management.

9 Potential GHG emission reductions by use of eco-labels and their contributions to climate change adaptations in four selected sectors

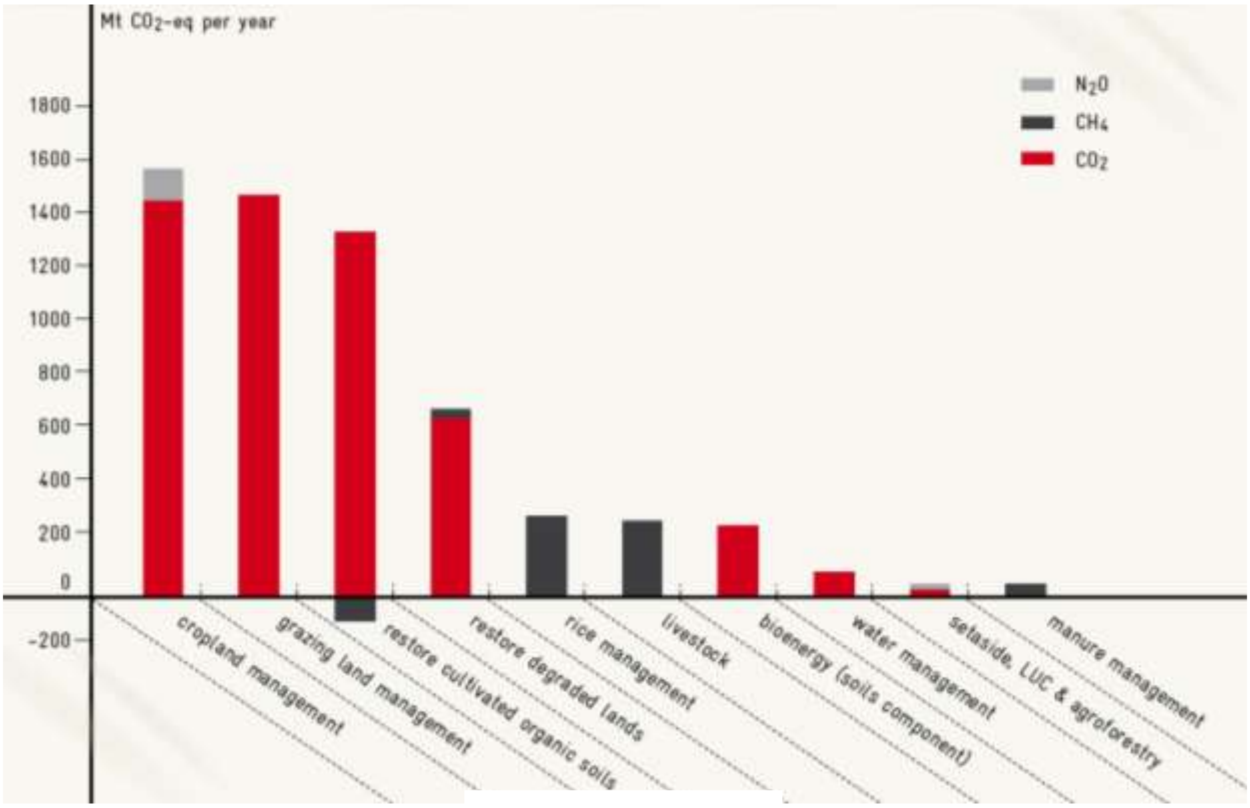
Eco-labelling standards present a number of opportunities to implement major interventions geared at preventing environmental degradation, including restoration of already degraded lands. African Eco-labelling Mechanism (AEM) is developing standards in four key sectors (Agriculture, Forestry, Fisheries and Tourism), which are considered most important for food security, socio-economic development, and poverty reduction. Eco-labelling standards in agriculture give a number of conditions referred to in the East African Organic Production Standards (EAOPS) as General Requirements (GR). The standards for parent International Federation of Organic Movements (IFOAM) from which the EAOPS were developed, guide production and consumption and are referred to as General Principles (GP). In this report we present a section on the opportunities for reducing CO_2 emissions through application of eco-labelling standards and the CO_2 mitigation potential that each of the relevant general conditions or general principles can make based on data available.

9.1 Opportunities for CO2 emission reductions through Eco-labelling in the agriculture sector

On a global scale, IPCC projects the mitigation potential on soil carbon in agriculture by 2030 to be approximately 6,000 $MtCO_2$-eq/yr (Smith et al. 2007). Therefore, agriculture has the potential to significantly reduce its GHG emissions, and possibly increase the net carbon sink within the next 50 years. The most important opportunity for GHG mitigation is the application of carbon-rich organic matter (humus) into the soil that would significantly reduce the need for fossil fuel-based and energy intensive mineral fertilisers and be a cost-effective means of sequestering atmospheric carbon. Further GHG mitigation gains could be achieved by improving yields on currently farmed lands and reducing deforestation pressures and by adopting no/low tillage practices that reduce fuel usage (UNEP 2011)

Alternative agricultural tillage, crop rotations, livestock waste disposal, and other practices influence the level of carbon in farm soils. The growing popularity of conservation tillage, including no-till, which adds to carbon in the soil has heightened the interest in the role that agriculture might play in sequestering carbon to diminish greenhouse gases and global warming.

Figure 8 below shows the projections of global technical mitigation potential by 2030 for different agricultural practices. The figure shows that the three most important agricultural practices in relation to reductions of CO_2 emissions are: 1) crop management, 2) grazing land management, and 3) restoration of organic soils in the cultivated lands.



Management practice

Figure 8: Global technical mitigation potential by 2030 for each agricultural management practice showing corresponding GHG impacts.

(Source: Smith et al. (2007)

Other agricultural practices with global significance in mitigating CO_2 emissions include restoration of degraded lands, management of rice production, livestock management, management of bio-energy, water management, land use change, agroforestry, and manure management.

Each of these activities have specific amounts of CO_2 emission reductions based on the amount of land the eco-labelling standards applied. To guide our understanding on the significance of each of these practices in CO_2 mitigation potential, Smith *et al.* 2007 conducted a study to assess the confidence for each based on wide literature survey. Table 2 below gives a breakdown of opportunities for CO_2 reductions through farm practices. The measures assessed in this study were the same measures that eco-labelling standards give as the general requirements (EAOPS) or general principles (IFOAM).

Table 2: Breakdown on opportunities for different farm activities:

		Mitigative effects[a]			Net mitigation[b] (confidence)	
Measure	Examples	CO_2	CH_4	N_2O	Agreement	Evidence
Cropland management	Agronomy	+		+/-	***	**
	Nutrient management	+		+	***	**
	Tillage/residue management	+		+/-	**	**
	Water management (irrigation, drainage)	+/-		+	*	*
	Rice management	+/-	+	+/-	**	**
	Agro-forestry	+		+/-	***	*
	Set-aside, land-use change	+	+	+	***	***
Grazing land management/ pasture improvement	Grazing intensity	+/-	+/-	+/-	*	*
	Increased productivity (e.g., fertilization)	+		+/-	**	*
	Nutrient management	+		+/-	**	**
	Fire management	+	+	+/-	*	*
	Species introduction (including legumes)	+		+/-	*	**
Management of organic soils	Avoid drainage of wetlands	+	-	+/-	**	**
Restoration of degraded lands	Erosion control, organic amendments, nutrient amendments	+		+/-	***	**
Livestock management	Improved feeding practices		+	+	***	***
	Specific agents and dietary additives		+		**	***
	Longer term structural and management changes and animal breeding		+	+	**	*
Manure/biosolid management	Improved storage and handling		+	+/-	***	**
	Anaerobic digestion		+	+/-	***	*
	More efficient use as nutrient source	+		+	***	**
Bio-energy	Energy crops, solid, liquid, biogas, residues	+	+/-	+/-	***	**

Source: adapted from Smith et al., 2007

Notes:

a. + denotes reduced emissions or enhanced removal (positive mitigative effect);
   - denotes increased emissions or suppressed removal (negative mitigative effect);
   +/- denotes uncertain or variable response.
b. A qualitative estimate of the confidence in describing the proposed practice as a measure for reducing net emissions of greenhouse gases, expressed as CO_2-eq: Agreement refers to the relative degree of consensus in the literature (the more asterisks, the higher the agreement); evidence refers to the relative amount of data in support of the proposed effect (the more asterisks, the more evidence).

According to climate change historical patterns and projections into the future, the climates will be generally warmer in all places but due to variabilities in precipitation between regions, some places will be dry and others will be wetter. Therefore, two main contrasting conditions will prevail in different places. Some place will be warm and dry while other places will be warm and moist. Mitigation potential will vary between the dry and the moist places even if the farm practice is the same. Table 3 below gives the CO_2 mitigation potentials for land management in warm-dry; warm-moist and the potential of all GHG emissions per ha/yr. These mitigation potentials can be used to calculate GHG emission reductions potentials for different land management practices.

Table 3: Mitigation potential of alternative management practices on the soil carbon

SLM	Warm – dry Areas		Warm – moist Areas	
Practice	tCO2/ha/yr	All GHG tco2~eq/ha/yr	tCO2/ha/yr	All GHG tco2~eq/ha/yr
Agronomic practices	0.29	0.39	0.88	0.98
Nutrient management	0.26	0.33	0.55	0.62
Tillage and residue management	0.33	0.35	0.70	0.72
Water management	1.14	1.14	1.14	1.14
Set aside	1.61	3.93	3.04	5.36
Agroforestry	0.33	0.35	0.70	0.72
Pasture management	0.11	0.11	0.81	0.81
Restoration of organic soils	73.33	70.18	73.33	70.18
Restoration of degraded land	3.45	3.45	3.45	3.45
Manure application	1.54	1.54	2.79	2.79

(Source Smith and Martino (2007)

The following are mitigation potentials and contributions to climate change adaptations based on provisions of standards of eco-labelling. The standards used in this chapter are the east African Organic Production Standards (EAC, 2007) which were adapted from IFOAM (International Federation of Organic Agriculture Standards). These east Africa organic production standards were developed under the auspices of East African Community in collaboration with IFOAM in consultation with various stakeholders in East Africa. The standards endorsed by IFOAM and implemented by national organizations in each of the East African member states.

9.2 Seeds, seedlings, and planting materials (EAOPS GR 5.8; IFOAM GP 4.1)

Some of the traditional African subsistence farming that is dominant in a large part of the continent does not rely on seeds sold by breeders. They instead obtain seeds for planting from the previous harvest and sometimes treat them with chemicals before planting. In addition to polluting the soils with chemicals, they result into poor yields from lack of proper cross breeding due to re- cycling of seeds over a number of seasons. This in-breeding reduces productivity and also may render the crops to be more susceptible to diseases.

This has primary impacts in food security due to loss of crop productivity and has serious secondary environmental impacts as farmers tend to either practice extensive cultivation where they clear more land to increase harvest or to intensive cultivation where they use fertilizers to increase harvest. Both extensification and intensification of agriculture have effects on green house gas emissions as they contribute to emissions through deforestation or crop management respectively.

Application of eco-label standards (EAOPS GR 5.8; IFOAM GP 4.1) requires farmers to diversify their planting material by planting seeds that are known to do well in the climatic zones where the land is located. It is only when such seeds (usually available from breeding companies) are not available that farmers can use alternative seeds but nevertheless chemicals may not be used. Generally, seeds and seedlings are available for crops that are on commercial production.

This general requirement has benefits both in mitigating climate change and in increasing adaptations to climate change. Choice of seeds is one of agronomic mitigation practices under eco-label standards. Following good agronomic standards like the ones stipulated in eco-labelling standards is known to have a potential to mitigate 0.39 tonnes of CO_2 equivalent per ha per year in the warm dry areas and 0.98 tonnes in the warm – moist areas. If all the agricultural land in Africa is put under Eco-label management, and assuming that most of it is in the warm dry areas, every single hectare managed can mitigate 0.39 tCO_2 equivalent per year.

Good selection of seeds and seedlings is an act of adaptation to climate change. Seeds and seedlings planted as specified in the eco-label standards are those that are suitable for the climatic conditions of the place the farm is located. This is therefore an act of climate change adaptation.

9.3 Land preparation

(EAOPS, GR: 5.1, 5.2; IFOAM, GP 3.1)

Land preparation involves site selection, land clearing and planting. Eco-label standards require that sites selected for agricultural use are not in forested or wetland areas to avoid deforestation and drying up of the wetland. Application of this requirement of eco-label standards will contribute both to reductions in GHG emissions and increase adaptations to climate change as follows:

- Avoidance of land clearing will reduce emissions from deforestation.
- Avoidance of clearing of the wetlands will reduces agricultural effects on water stress
- Maintain ecosystem diversity and, thus, protecting biodiversity.

Land clearing turns a valuable carbon sink into a major source of greenhouse gas (GHG) emissions. 43% of Africa's total CO_2 emissions come from land-clearing for agricultural use, including croplands and shifting cultivation. An estimated 3.5 million hectares of forest are lost annually through deforestation, releasing over 2 billion tons of CO_2 eq. each year, or 13% of annual global emissions from forestry and agriculture combined. African top soils are storing approximately 316 billion tons of CO_2 eq. but with 2/3 of sub-Saharan Africa's cropland, rangeland and woodland already being degraded, this stored carbon is being released to the atmosphere.

Eco-label standards prohibit clearing of forests or other natural vegetation for purposes of growing crops. Crops grown from an area that has been previously a forest will not qualify to have the eco-label until a certain period of time of production under the specified standards. They also require farms to have sufficient amount of vegetation including trees along the edges, boundaries and walk paths to increase ecosystem diversity rather than clearing vegetation. The more the vegetation cover there is, the more is CO_2 sequestered from the atmosphere, and as litter accumulates and decays, the more the carbon is stored in the soil. This adds to soil fertility and supports soil organisms, important for detritus food chain. The climate change related increase in intensity and durations of drought, or floods reduces both the diversity and abundance of soil organisms and, thus, the ability of soil to mineralize and accumulate soil nutrients. Applying eco-label standards will reduce vulnerability of soils to these climate related problems and, thus, contribute to climate change adaptations.

9.4 Biodiversity and farming system diversity

(EAOPS GR: 5.3 and 5.4; IFOAM GP: 2.1, 4.3)

Anthropogenic causes of biodiversity loss, mainly, come through clearing for agriculture and other similar uses. Eco-labelling standards require the participant to take good care of biodiversity on the farm mainly by maintaining agro biodiversity, protecting natural ecosystems around the paths, edges, along the water ways and wetlands to the extent possible and allowing trees to grow on the farm. According to the standards, culturally or legally protected primary ecosystems, such as primary forests and wetlands, shall not be cleared or drained for the purpose of establishing production.

Agro forestry alone has a potential to mitigate 0.35 tonnes of CO_2 per ha per year in the warm dry areas and 0.72 tonnes of CO_2 equivalent per ha per year in the warm moist areas (*Smith and Martino (2007)*. If the cultivated areas that fall under dry moist characterization is disaggregated, and the right sequestration levels for such areas accounted for, more accurate amounts of GHG emissions associated with afforestation would be realized.

9.5 Protecting biodiversity as an act of adaptation to climate change

The diversity of landscapes, farming activities, fields and agro biodiversity is greatly emphasized in eco-labelling standards, which make these farms more resilient to unpredictable weather patterns that result from climate change. Eco-label standards in agriculture build on a foundation of conserving and improving diversity by using diverse crops, rotations and mixed farm strategies. This reduces depletion of soil nutrients as different crops are rotated over the seasons.

Enhanced biodiversity reduces the impacts of pests on crops especially those that are species specific. Similarly, diversified agro-ecosystems reduce the severity of losses from plant and animal diseases, while improving utilization of soil nutrients and water.

9.6 Soil and water conservation

(EAOPS: GR 5.5; 5.6; IFOAM: GP 4.4)

One of the most important requirements by eco-labelling standards is the adoption of measures to conserve soil and prevent soil erosion within the farms. The East African Organic Standards, for example, require soil and water conservation to be an integral part of the organic farming system and to prevent erosion by wind and water. The standards require the operators to take measures appropriate to the specific local conditions in terms of climate, soil, slope and land use. Examples include the use of windbreaks, soil cover crops, minimum tillage, fallowing (with vegetation cover), mulching, terraces and contour planting. The operator must prevent or remedy the salinization of soil and water, and take measures to restrict and control burning of vegetation to protect organic matter and biodiversity. The operator shall not deplete or excessively exploit water resources and shall seek to conserve water resources and quality. Where necessary, the operator shall collect or harvest rainwater.

Perhaps, the biggest incentive for farmers to apply eco-label standards in regards to soil and water conservation lies in the direct benefits both at individual and community level. Soil and water conservation maintains soil fertility and makes water more available for production.

Climate change is reducing water availability in most places in Africa. Even in the areas where more than normal precipitation is predicted, it may come in short but intense flushes or in much reduced growing seasons, making it necessary to conserve the water that is available. Eco-labelling standards are there to contribute to adapting productivity with less water available.

If all the land currently under cultivation of maize, sorghum and wheat is managed under eco-labelling framework (Table 4) the potential of CO_2 mitigation would range from 200 mtCO_2 in Central Africa to nearly 1400 mtCO_2 in North Africa (Fig. 9) depending on the amount of land utilized for production.

Table 4: Land Areas (hectares) under cultivation of Maize, Sorghum and Wheat from 2005 to 2009 by regions

(Source: World Bank Data:http://data.worldbank.org/topic/environment) Accessed in September 2012)

REGION	CROP	2005	2006	2007	2008	2009
CENTRAL AFRICA		**3,222,312**	**3,052,868**	**3,001,917**	**2,950,112**	**3,269,142**
	Maize	1,126,049	1,111,245	1,042,449	1,071,539	1,112,445
	Sorghum	169,038	120,742	145,495	165,776	162,706
	Wheat	1,927,225	1,820,881	1,813,973	1,712,797	1,993,991
EAST AFRICA		**15,575,335**	**15,825,898**	**14,346,295**	**15,664,554**	**15,991,123**
	Maize	13,350,428	13,521,226	12,218,837	13,424,917	13,915,289
	Sorghum	1,397,946	1,514,427	1,483,624	1,473,466	1,409,889
	Wheat	826,961	790,245	643,834	766,171	665,945
NORTH AFRICA		**18,489,793**	**19,232,919**	**18,644,438**	**18,590,270**	**19,784,776**
	Maize	7,287,690	7,535,079	7,813,294	8,168,234	7,692,977
	Sorghum	4,083,243	4,376,977	4,113,217	4,342,036	4,586,469
	Wheat	7,118,860	7,320,863	6,717,927	6,080,000	7,505,330
SOUTH AFRICA		**13,541,080**	**10,253,989**	**10,480,696**	**10,339,197**	**11,052,205**
	Maize	3,430,301	3,520,378	3,751,210	3,502,923	4,176,231
	Sorghum	10,042,100	6,661,376	6,694,356	6,791,080	6,828,215
	Wheat	68,679	72,235	35,130	45,194	47,759

WEST AFRICA		**16,523,062**	**15,775,348**	**17,241,726**	**17,921,515**	**13,949,557**
	Maize	3,417,241	2,316,092	2,767,931	3,056,013	2,695,354
	Sorghum	13,092,306	13,448,214	14,459,999	14,851,638	11,239,479
	Wheat	13,515	11,042	13,796	13,864	14,724
GAND TOTAL		**67,351,582**	**64,141,022**	**63,715,072**	**65,465,648**	**64,046,803**

The data presented in table 4 was obtained from FAO (www.faostat.org) and sourced in October 2012. The data in hectares represents the areas used for production of maize, sorghum and wheat in the respective regions of Africa. This table shows the trends in changes of the amount of land used for production of various crops from 2005 to 2009. The purpose of the data is however, to show the extent of land area that eco-libelling intervention in agriculture can have the potential to influence in mitigating CO_2 emissions. Table 9 shows the amount of CO_2 that can potentially be mitigated through introduction of AEM standards in agriculture in different regions of Africa. Calculations have been made based on known rates of CO2 sequestration in Africa (Calculations based on data from world bank: http://data.worldbank.org/topic/environment).

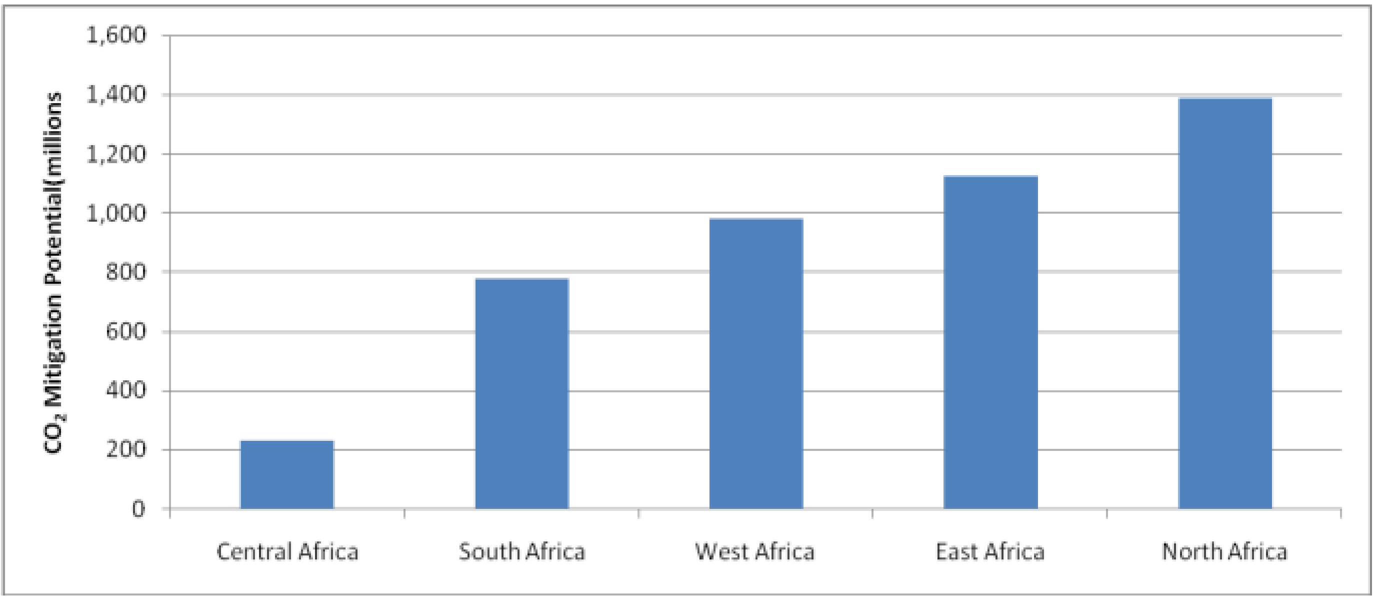


Figure 9: Soil carbon mitigation potential for land under maize sorghum and wheat cultivation
(calculated from World Bank: http://data.worldbank.org/topic/environment)

9.7 Crop management

Crop management entails all activities of farm-based technologies from selection of seeds to planting, land preparation before planting, methods and ways of planting, weed removal, pests and diseases control, harvesting and post harvest storage of crops. Further it includes means of watering the crop if not rain-fed, soil fertility management as well as crop wastes and plant materials management. In each of these stages, records are made on energy consumption, water usage, and carbon emissions during each stage operations. The result is a net carbon foot print in the entire process. The key principle at all these steps of crop management is that the standards give options that are carefully considered to be the minimum in terms of all considerations of environmental management.

Improved agricultural practices can reduce carbon emissions from soil and capture carbon from the atmosphere for long-term storage. Practices like cover cropping, applying crop residues, mulch, adding manure, reduced tillage, and rotational cropping with legumes increase organic matter in the soil, while also increasing crop yields.

Unlike annual crops, perennial trees and grasses live for years, sequestering and storing carbon in their roots and branches as they grow, as well as in the soil.

In conventional crop management, the producer is not required to make records on the environmental effects the production has at any of the stages, and therefore, cannot account for the impacts. Production through eco-labelling requires the producer to maintain records that can show effects on environment for every stage of production.

Most of GHG emission reduction through crop management is accounted for in various specific activities like better agronomic practices, conservation tillage, water management, nutrient management or soil conservation and so on. Emission reduction in these practices is presented in various sections of this report (see also Fig. 10).

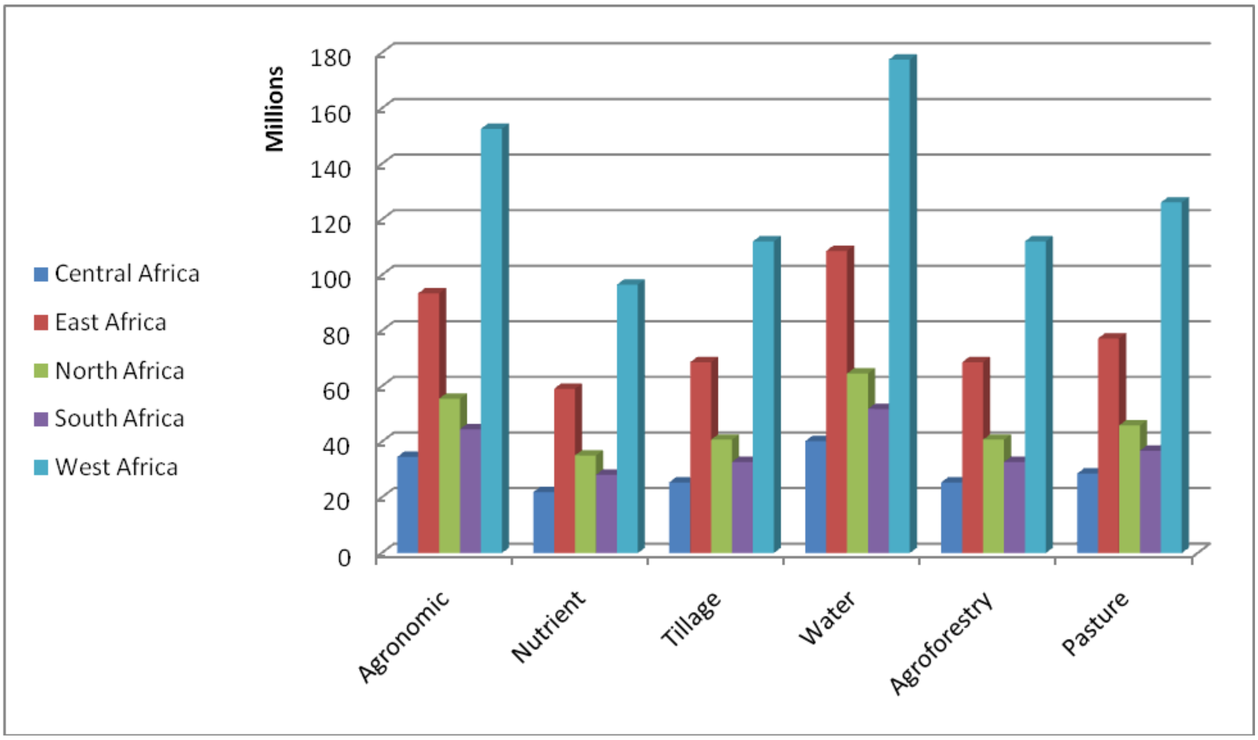


Figure 10: CO_2 Mitigation potential by different land management in Africa
(cultivated from FAO data www.faostat.org accessed September 2012)

9.8 Restoring cultivated soil organic content

Restoration of cultivated soil organic content is an important area for mitigating GHG emissions through agricultural management after cropland management and grazing land management. All eco-label standards require that productive lands are properly maintained and remain fertile especially in relation to organic content. For the soils with low organic nutrients, the standards require restoration of soil fertility through use of organic fertilizers. This enhances carbon storage in the soils.

Globally, restoration of organic matter in cultivated soils has a potential to mitigate approximately 800 metric tonnes of CO_2 equivalent per year. Since there is low concentration of carbon in croplands, there is great potential to increase carbon content through management practices.

On agricultural lands, restoration of the organic carbon content in cultivated soils has a high per unit area potential and has the greatest mitigation potential in agriculture.

In Africa, arable land amount to 60,601,880 ha as of 2009, based on World Bank data (http://data.worldbank.org/topic/environment). Organic carbon in a hectare of cultivated land has a potential to sequester about 70.18 tonnes of CO_2 eq. per year. If all the cultivated lands in Africa are put under the management of eco-label standards, the amount of CO_2 mitigation potential would be significantly high.

According to World Bank database, West Africa has the highest amount of arable lands followed by East Africa while Central Africa has the least due to differences in land areas and that much of Central Africa is forested.

9.9 Restoring degraded lands

Dregne and Chou (1993) classified 216 million ha or 47% of global rain fed cropland as degraded (moderate to very severe desertification), 43 million ha or 30% of irrigated land as degraded, and 3,333 million ha or 73% of rangeland as degraded. The worldwide total of 3,592 million ha of degraded lands includes arid and semiarid tropical rangeland with limited capacity to sequester carbon.

Bringing degraded lands back into productive use through sustainable land management (SLM) can sequester carbon while restoring critical watersheds. Re-vegetation can sequester 3.5 and 4.5 tons of CO_2eq per hectare in a year in dry environments and cool-moist ones, respectively.

Degraded lands in Africa have not been well calculated but estimates show that about 60% of land under cultivation is degraded meaning that there is a need for restoration. When degraded lands are put into eco-label standards of management, there will be double gain in terms of CO_2 mitigation. First about 3.45 tonnes of CO_2 will be mitigated through the restoration programme and then secondly CO_2 mitigation through crop management as described above will gain another 70.18 tonnes per ha per year if the same land is put under production using agricultural eco-label standards.

A large proportion of agricultural lands have been degraded by excessive utilization leading to, erosion, organic matter loss, salinization, desertification, or other processes that curtail productivity. Often, carbon storage in these soils can be partly restored by practices that reclaim productivity including: re-vegetation; improving fertility by nutrient amendments; applying organic substrates such as manures, bio-solids, and composts; reducing tillage and retaining crop residues; and conserving water. Where these practices involve higher nitrogen amendments, the benefits of carbon sequestration may be partly offset by higher N_2O emissions.

9.10 Rice management

Rice is gaining popularity as staple food among Africans. The area under rice cultivation in Africa has risen from about 1 million hectares in 1963 to over 9 million in 2008 according to FAO data (www.faostat.org). Despite the challenges of climate variability the area under cultivation of rice has continued to increase.

Application of sustainable production in the management of rice fields is known to increase yields by about 22% and sequester carbon at the rate of 0.34 tonnes of CO_2 per ha per year especially for the wetland land rice. Applying eco-label standards in rice management in Africa has a potential to mitigate about 3.0 million tonnes of carbon per year (Rosegrant et.al., 2008). Since better rice management results into better water use efficiency further reductions on CO_2 emissions can be made due to application of better water use strategies. Figure 11 shows how these sequestration potentials are distributed across the region of Africa. The land area under cultivation in Southern Africa has reduced significantly over the years.

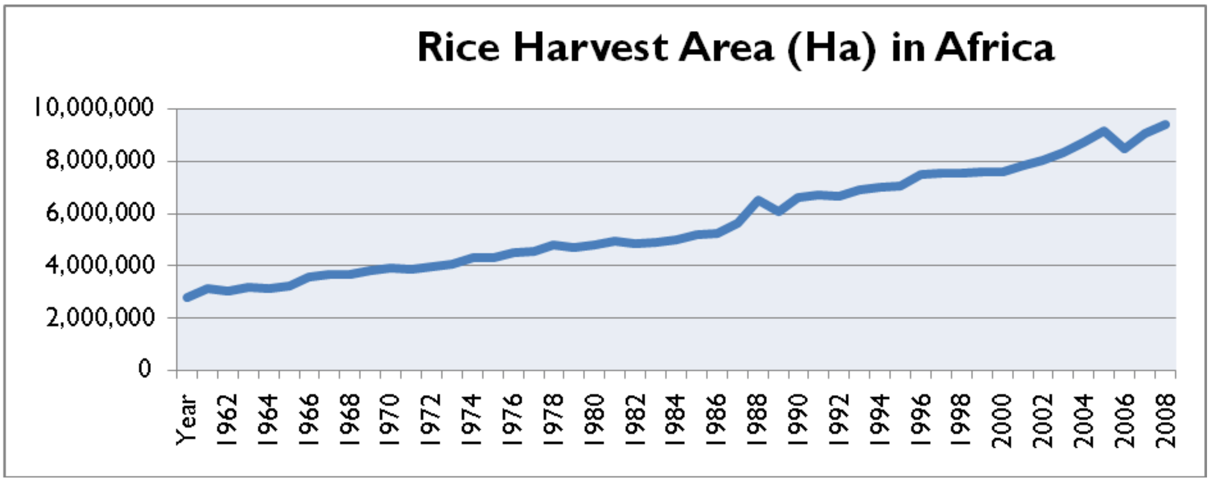


Figure 11: Area under rice cultivation in Africa up to 2008

(Source: www.faostat.org Accessed October 2012)

Figure 12 shows the amounts of potential sequestration of CO_2 by regions based on the land area under rice cultivation. West Africa has the highest potential followed by East Africa. South Africa's land under rice cultivation is very low to show in the figure.

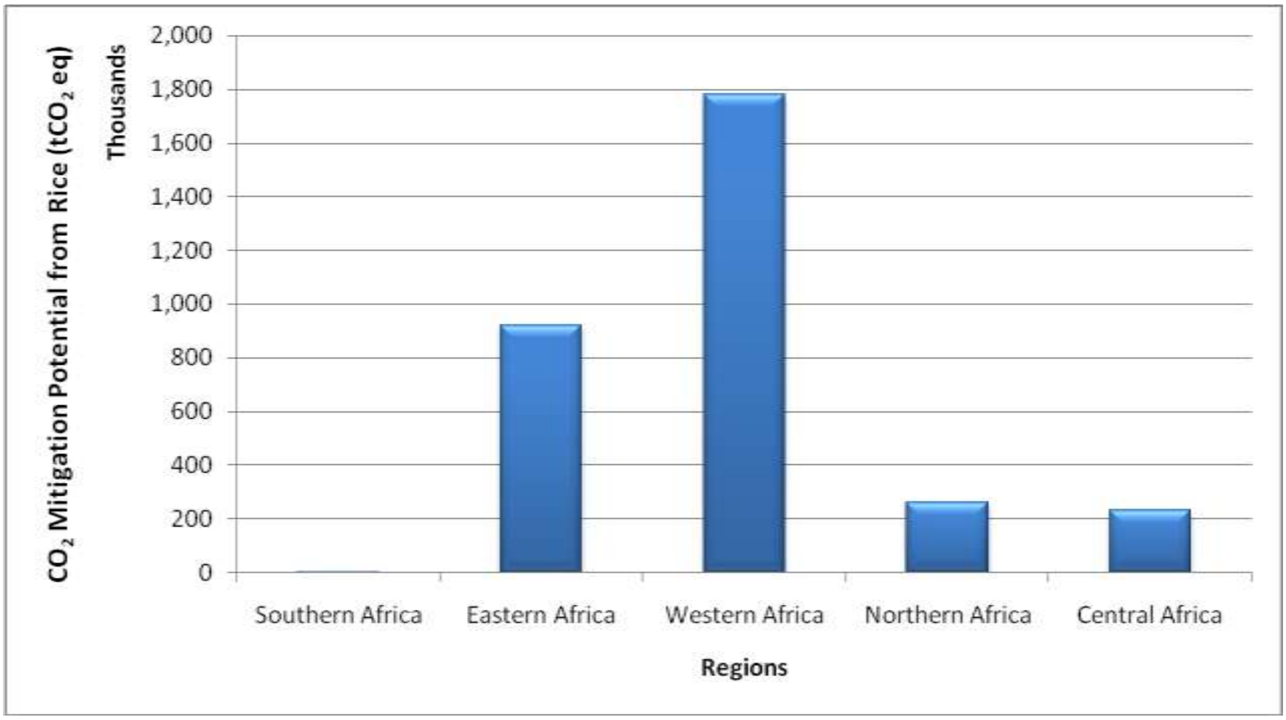


Figure 12: CO_2 Mitigation potential in rice cultivation by regions of Africa
(Source: http://data.worldbank.org/topic/environment; Accessed October, 2012)

Figure 13 shows the proportions by regions of the CO_2 mitigation potential based on the land area under rice cultivation. West Africa has the highest potential followed by East Africa. South Africa's land under rice cultivation is very low to show in the figur

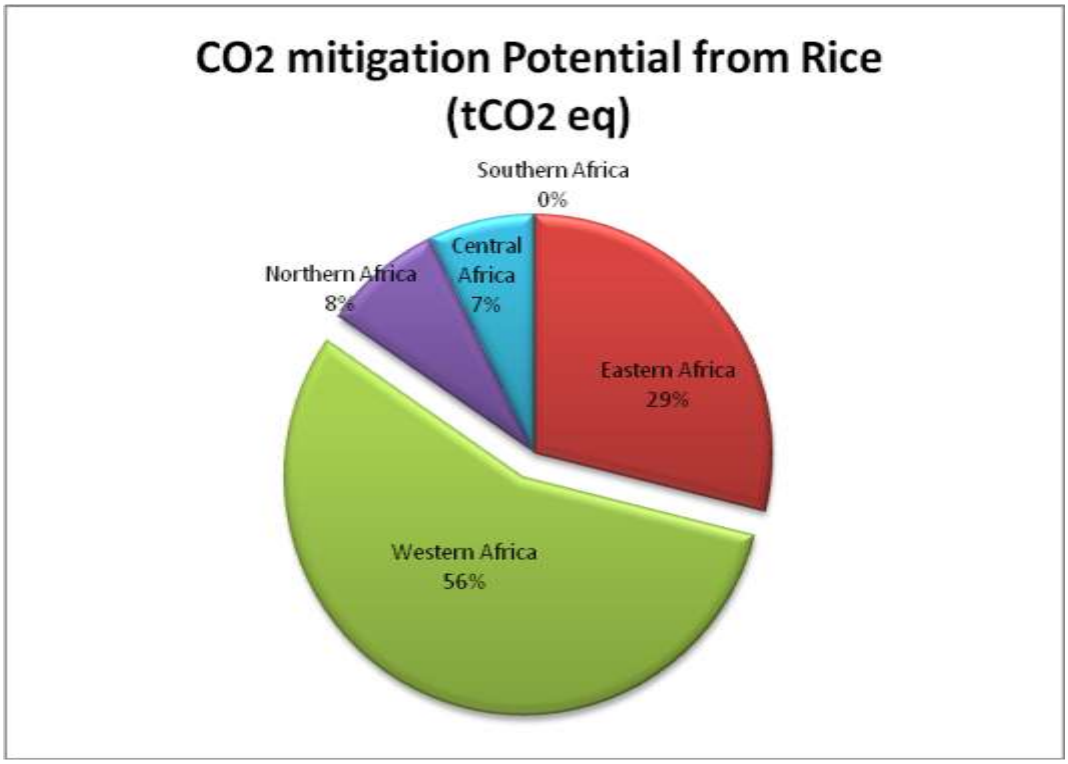


Figure 13:The percentage of regional mitigation potential from rice cultivation in Africa

(data source FAO: http://faostat.fao.org/site/291/default.aspx accessed October, 2012)

9.11 Water management

About 18% of the world's croplands now receive supplementary water through irrigation. Expanding this area (where water reserves allow) or using more effective irrigation measures can enhance carbon storage in soils through enhanced yields and residue returns.

The water and wastewater sectors fall within these initiatives. Many large-scale resource development options such as desalination, pumped storage reservoirs and effluent re-use are recognised as relatively energy intensive both in terms of operation and construction. Management under eco labelling mechanism may result in lower energy demand and, thus, lower use, which could offset future energy pressures and reduce carbon emissions. Box 1 below gives a success story of soil and water conservation in Niger where a barren land was converted into a productive land using water harvesting and conservation techniques.

Box 1: Soil and Water Conservation in Illela District, Niger

This project sought, and succeeded, to promote simple water harvesting techniques in a dry area with annual rainfall of about 400 mm/year. The project promoted simple works – contour stone bunds and half moons – without systematic food-for-work, in an area that had seen earlier projects with heavy machinery and continued recourse to food-for-work.

In 1990, a drought year, the pitted fields in the project were the only ones that produced a harvest, and from then on farmers began to adopt the improved pitting system. Use of wider and deeper pits resulted into significant shifts from a simple planting technique to a water harvesting and soil fertility management technique.

- By the end of 1998, the impact assessment considered that about 9,000 ha of barren, crusted land had been treated in the project area of Illela District, corresponding to 15% of the cultivated area. Spontaneous diffusion of improved planting pits was evident elsewhere in Illela District, in adjacent districts and, through project-funded farmer study and exchange visits, even in other parts of Niger. As planting pits were mainly used to rehabilitate strongly degraded land, it led to an expansion of cultivated area and reduced pressure, to some extent, on already-cultivated sandy soils;

- A market has developed for barren, crusted land. In a 1998 survey of farmers practising soil and water conservation, 40% said that they had purchased such land for rehabilitation purposes. Since 1992, the price of barren, degraded land has increased substantially doubling between 1992 and 1994 alone. In some cases farmers sold their cultivated sandy soils to generate cash to buy degraded land;

- With a project cost of $ 250/ha, on-farm incremental benefits are $ 65/ha/year after the first (break-even) year when compared with adjacent fields, but even more when compared with zero yield on barren, crusted land

- The economic rate of return at completion was 20%.

This project is a fine example of a small operation that succeeded in promoting technical change. It demonstrated perseverance, in abandoning traditional systematic agriculture and increased flexibility, by adding improved planting pits to its menu once interest had been aroused. Development of the land market, and continued incremental expansion of the treated area without further project assistance since 1995, indicate that the outcomes will be sustained.

From: UNESCO: Improving tassa planting pits using indigenous soil and water conservation techniques to rehabilitate degraded plateaus in the Tahoua region of Niger. www.nesco.org/maost/bpik10.htm

9.12 Land use change and agro-forestry

With the increase in population and dependence on agriculture to provide food and source of income for many, conversion of forests and land with natural vegetation into farmlands, is taking place at a very fast rate through deforestation. As trees and bushes are cut down and land is converted into farmlands, the carbon that is tied up in the biomass is burnt and turned into carbon dioxide. The GHG emissions from land use change and deforestation is discussed elsewhere in this report as part of land clearing for agricultural practices. In some instances GHG emissions from land use change is reported separately due to the fact that not all changes are for agriculture or cropping. Many changes are for other purposes like creating roads, towns and the expansion of grazing lands. In this report, land use change and deforestation is reported to globally contribute about 18% of GHG emissions exceeding that of agriculture, which is estimated to contribute 13%.

As indicated earlier, eco-labelling standards discourage vegetation clearing and encourage agro-forestry.

Box 2 below is a demonstration of a success story on how planting of perennial trees like cacao can increase carbon sinks while providing for livelihoods at the same time.

Box 2: Carbon gains by Cameroon Cacao farmers

With sustainable land management under eco-labelling, farmers grow trees in and around their farm fields, to harvest useful products such as fruit, livestock fodder and medicines. This benefits the climate as well as ecosystems. In humid zones of Africa, retaining shade and understory trees in cacao can provide vast carbon stores. For example, mature cacao agroforestry systems in Cameroon store 565 tons of CO_2eq per hectare. Even in semi-arid lands, agroforestry systems like intercropping or silvopasture, with 50 trees per hectare, can store 110 to 147 tons of CO_2eq per hectare in the soil alone.

Similarly farmer-managed natural regeneration in Niger has grown 200 million trees in 5 million hectares of land in two decades. This sequestered over 100 million tons of CO_2eq, while providing diverse livelihood benefits to farmers.

9.13 Manure management

Animal manure releases significant amounts of N_2O and CH_4 during storage, but the magnitude of these emissions varies. In Africa, most of the manure produced by livestock is applied to the farms to increase soil organic content, and, thus, soil fertility. Manure application soil carbon content and the carbon content in the soil making a carbon sink. Use of animal manure for management of soil fertility is highly encouraged by eco-labelling standards.

Manure application is known to sequester about 1.54 tonnes of CO_2 per ha per year. This rate of sequestration will vary from soil to soil due to variabilities in soil physical properties, including environmental characteristics. For purposes of this report, we take a sequestration rate of 1.54 tonnes of CO_2 per ha per year that is reported to apply in warm dry conditions.

9.14 Energy

Although energy as a sector is not addressed by AEM, a lot of eco-labelling standard requirements or principles have a lot to contribute to the energy sector and have implications on GHG emission in the energy sector. Some of the agricultural wastes, like organic agricultural wastes, produced mainly in urban centres, livestock manure and green vegetable materials, have been successfully used as a source of energy. One very successful source of energy that is encouraged by eco-labelling applications in the agriculture sector is biogas.

In Africa, access to energy present challenges to human health, environmental health, and economic development as a large part of Africa depends on firewood as a source of energy. In 21 sub-Saharan African countries, less than 10% of the population have access to electricity. The need for alternative renewable energy sources from locally available resources cannot be over emphasised. Appropriate and economically feasible technologies that combine solid waste management and energy production can enhance energy availability.

The production of biogas via anaerobic digestion of large quantities of agricultural residues, municipal wastes and industrial waste (water) would benefit African societies by providing a clean fuel from renewable feedstock and help end energy poverty.

Use of energy from biogas replaces use of fossil fuels to provide energy. This is of particular importance as the technology is feasible for domestic use in rural Africa, where it can replace firewood as a source of energy. This may reduce the extent of deforestation and, thus, reduce CO_2 emissions

Benefits from Biogas energy generation include:

- reduced deforestation,
- enhanced energy for domestic purposes,
- reduced indoor emissions and related deaths from long exposures to cooking fumes from biomass and paraffin,
- rural development,
- poverty reduction, and
- job creation

Box 3 presents a success story in the energy sector in which small hydro electric generation plants can feed into the national grid boosting the national energy capacity. This framework helps to reduce dependence on fossil fuels and thus contributes to CO_2 emission reductions.

Box 3: Feed-in tariffs in Kenya

Kenya's energy profile is characterized by a predominance of traditional biomass energy to meet the energy needs of the rural households and a heavy dependence on imported petroleum for the modern economic sector needs. As a result, the country faces challenges related to unsustainable use of traditional forms of biomass and exposure to high and unstable oil import prices. In March 2008, Kenya's Ministry of Energy adopted a feed-in tariff, based on the realization that "renewable energy sources (RES) including solar, wind, small hydros, biogas and municipal waste energy have potential for income and employment generation, over and above contributing to the supply and diversification of electricity generation sources".

A feed-in tariff (FIT) is a policy instrument that makes it mandatory for energy companies or "utilities" responsible for operating the national grid to purchase electricity from renewable energy sources at a pre-determined price that is sufficiently attractive to stimulate new investment in the renewables sector. This, in turn, ensures that those who produce electricity from identified renewable energy sources such as solar, wind and other renewable sources have a guaranteed market and an attractive return on investment for the electricity they produce. Aspects of an FIT include access to the grid, long-term power purchase agreements and a set price per kilowatt hour (kWh).

Kenya's FIT policy has as its objectives to: a) facilitate resource mobilization by providing investment security and market stability for investors in Renewable Energy Sources (RES) electricity generation b) reduce transaction and administrative costs by eliminating the conventional bidding processes, and c) encourage private investors to operate the power plant prudently and efficiently so as to maximize its returns. By taking a long-term commitment to the development of renewable sources of energy and stipulating a long-term power purchase agreements of a minimum of 20 years, the Kenya Government has taken a critically important step in the development of the country's significant potential for renewable energy generation, while pursuing equally important economic, environmental and social policy objectives.

In January 2010, Kenya revised the FIT policy, which resulted in the addition of three renewable energy sources: geothermal, biogas, and solar energy resource generated electricity. In addition, the revised policy extended the period of the power purchase agreements from 15 to 20 years and increased the fixed tariffs per kilowatt-hour for pre-existing wind and biomass under the FIT.

Expected benefits
The advantages of this policy include: a) environmental integrity including the reduction of greenhouse gas emissions; b) enhancing energy supply security, reducing the country's dependence on imported fuels; and coping with the global scarcity of fossil fuels and its attendant price volatility; and c) enhancing economic competitiveness and job creation. Initially covering wind, biomass and small hydro, the policy is planned to include geothermal sources of energy.

GoK 2012: Ministry of Energy Feed-in-Tariffs policy for wind, biomass, small hydros, geothermal, biogas and solar,2 nd revision, December 2012.

9.15 Livestock management

Livestock management in this report entails management of land used for pasture and management of livestock husbandry. In this regard, carbon dioxide and methane emissions from livestock management can be mitigated in four main ways, which are all contained in eco-labelling standards on livestock production.

1. Halting or slowing down deforestation due to expansion of pasture land or cultivation of feed crops. This can be achieved mainly through area protection, selective infrastructure development, and appropriate land tilling procedures.

2. Applying management the increases vegetation cover to enhance carbon sequestration and storage.

3. Management can adjust grazing pressure to climatic fluctuations, in particular, drought events.

4. Use of improved manure management to produce biogas, and use of animal feeds with higher carbon-to-nitrogen ratio can mitigate emission of methane. Use of biogas from manure has a potential to reduce methane emissions by 50-75%.

Eco-labelling standards require the grazing lands to operate within the carrying capacities of the land meaning that there will be no overgrazing. Managing grazing lands has even a greater potential to mitigate CO_2 than management of croplands. This is due to the fact that grazing in general causes more emissions than cropping. Globally better management of grazing lands has a potential to reduce CO_2 emission by over 1,500 metric tonnes of CO_2 equivalents per year (Rosegrant et. al. 2008).

In rotational grazing, livestock move from one pasture to another at frequent intervals, giving plants time to recover and, thus, preventing desertification and soil carbon loss. Proper pasture management can potentially store from 110 kg of CO_2 eq. per hectare per year in drylands to 810 kg of CO_2 eq. per hectare per year in humid (Rosegrant et. al. 2008).

In Africa land under livestock production is basically the extensive land described as rangelands used largely by pastoralists for livestock production. Except the land in the protected areas which measures approximately 48 million ha much of the rest land area in Africa is either used for livestock production or is suitable and can be used for livestock production.

Pasture management is known to mitigate about 0.81 tonnes of CO_2 per ha per year. To estimate the CO_2 mitigation potential on better livestock management practices we multiply the mitigation potential per ha by the number of ha of the land that is suitable for livestock production to show the potential for CO_2 mitigation pre region (Fig.14) and the proportions of mitigation per region (Fig. 15).

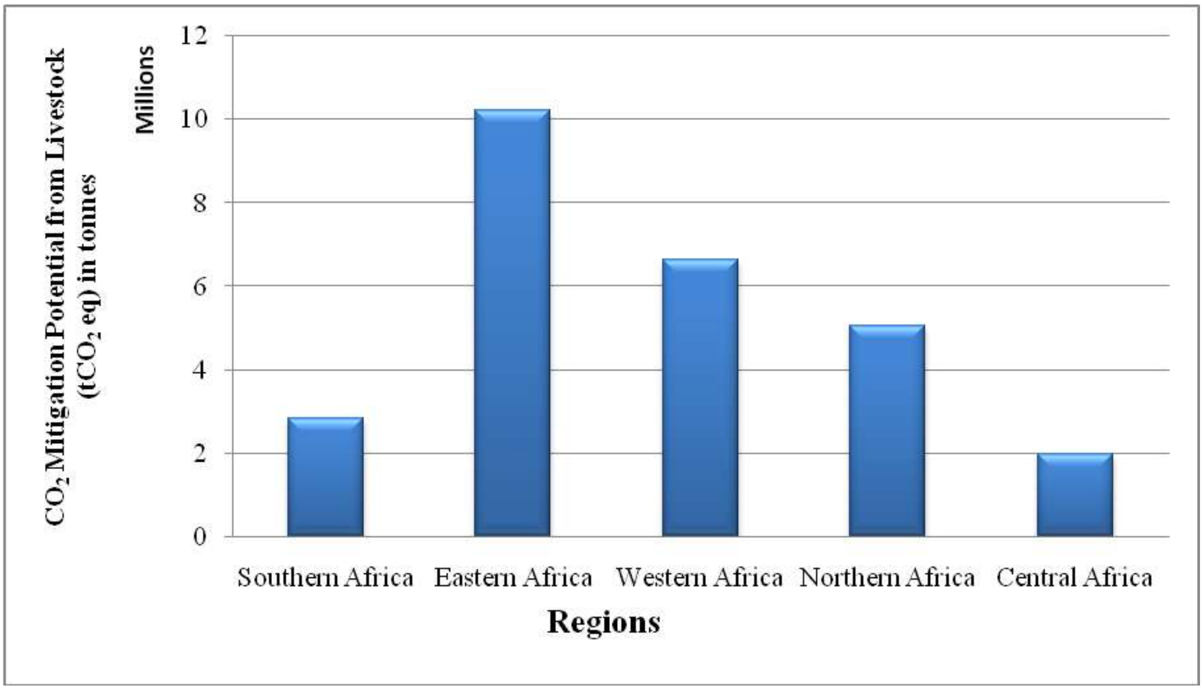


Figure 14: CO2 Mitigation potential on pasture management in Africa by regions
(Data source World Bank: http://data.worldbank.org: Accessed October, 2012)

Proportionally eastern Africa wich includes Sudan, Ethiopia and Somalia has about 38% of pastureland of Africa and, thus, has the greatest potential to mitigate climate change through pasture management. Western Africa comes second with 25% of Africa's pastureland. Central Africa due ot its vast forests has only 7% of Africa's pastureland and, thus, the least potential to mitigate climate change through pasture management (Fig.15).

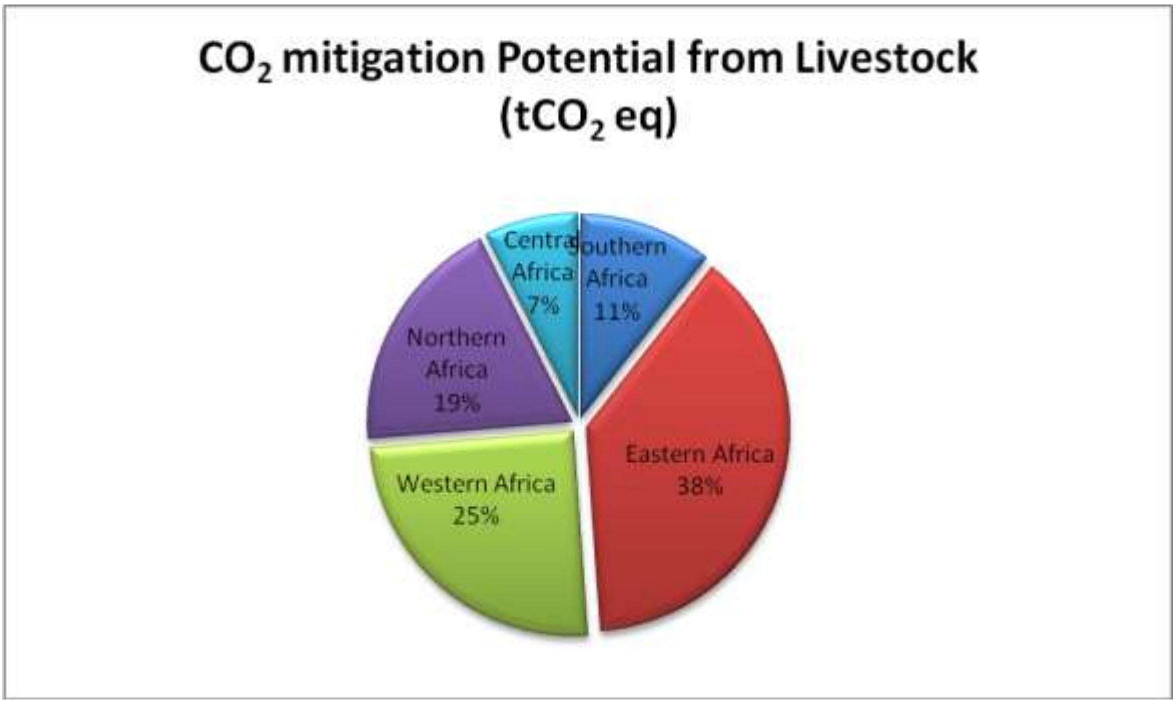


Figure 15: Relative proportions of CO2 Mitigation potentials on Pasture management
(Data source World Bank: http://data.worldbank.org: Accessed October, 2012)

9.16 Animal feed management

(EAOPS: GR 6.6; IFOAM: GP 5.1)

Livestock production systems in Africa vary mainly with the ecological potential of the area and can be characterized as follows:

(i) Pastoralism (livestock only);
(ii) Mixed crop–livestock production systems (mixed irrigated and mixed rainfed);
(iii) Dairy livestock production systems in rural and peri-urban areas.

The most extensive of these three livestock production systems is the pastoral production system followed by mixed crop – livestock production system. It is only the dairy production system and some of the mixed crop-livestock production system that utilize animal feed. Both the production and management of animal feeds have implications on GHG emission reduction potentials and adaptations to climate change.

The eco-label standards require the animal feeds to be produced in a very sustainable way either from an organically certified farm (observing the regulations of organic crop production) or obtained from the wild following wild harvesting regulations i.e. harvesting animal feeds without causing species depletion, biodiversity loss or ecosystem degradation. The harvesting must not affect the natural water quality and quantity, must not result into an increase in soil erosion and in all must not cause environmental degradation. The standards also require the number of animals kept to be in accordance with ecosystem carrying capacity such that excessive harvesting of animal feeds does not occur. Table 5 below gives an analysis of how animal feed management through eco-labelling standards can lead to CO_2 mitigation and contribute to climate change adaptations.

Table 5: Requirement by eco-labelling standards that can contribute to reductions in CO_2 emissions and contribute to climate change adaptations

Activity	Management practices related to feed production as required in Eco-labelling standards	Climate change stressor against which adaptation is achieved or Ways in which GHG emissions are reduced or emissions avoided
Growing of feed crops	Growing of the feed crops suitable to the environment and preserving in good storage facilities in the amounts required.	Increased temperatures and variable precipitation patterns reduce the abundance and quality of pastures in the pastoral areas (palatability). Climate change also reduces availability of water for grazing animals leading to conflicts with wildlife and humans.
Animal management	Feeding animals in an enclosure reduces animal movement and, thus, less trampling on soils to cause soil erosion.	Soil erosion is likely to increase in pastoral areas as soils become drier due to increase in temperatures and other changes associated with precipitation changes in patterns. Reduction in animal movement will reduce incidences of soil erosion
	Animals are more productive by selecting best for purpose breeds (milk and meat off take) thus the farmer can sustainably stock fewer numbers.	Keeping the right animal breed is an adaptation that will reduce overstocking and, thus, conserve ecosystem integrity
	Gives better water use efficiency and less polluting to water resources	Better water use efficiency is a vital adaptation to the increasing water stress
Cut and Carry	Sustainable harvesting of pastures thus maintaining biodiversity and all ecosystem services	Conservation of biodiversity in livestock production areas will be an adaptation to restore and maintain ecosystem goods and services that climate change is projected to impact on negatively
	Recycles crop residues and some household organic wastes as animal feeds thus reducing burning of crop residues and domestic wastes.	Management of crop residues and household organic wastes is major source of GHG emissions. Recycling of these wastes will be a major reduction in GHG emissions
	Maintains animal numbers	Overstocking of livestock is a major

Animal cropping	that a farmer can feed sustainably considering ecological aspects.	cause of deforestation and land degradation emitting large amounts of CO2 into the atmosphere. Management of animal numbers will reduce these emissions

9.17 Parasite and disease management

(EAOPS: GR 6.7;   IFOAM: GP 4.5)

Eco-label standards require herders to use fewer chemicals in parasite and disease management, prompt treatment of sick animals and prevention of animal diseases by feeding well with quality feed among others. In respect to adaptations to climate change, proper care of animal health is vital because climate change may increase disease challenges due to alterations in climatic patterns. These patterns may increase the prevalence of disease pathogens and vectors by creating more conducive environments for their habitat requirements and reproductive abilities. This requirement will increase awareness of the increasing challenges in maintaining animal health and, thus, prepare farmers on how to deal with the challenges when they occur and more helpful to value animal in livestock production. Use of less chemicals in animal health management (especially management of disease vectors) will lead to less pollution of the environment thus reducing the risk of contaminations in water resources that can affect people and micro organisms. This is an adaptation to maintaining biodiversity. Table 6 shows the gains in climate change adaptations that can be brought about through parasite and disease management as required by EAOPS.

Table 6: Gains in climate change adaptations

Activity	Management practices related to feed production as required in Eco-labelling standards.	Climate change stressor against which adaptation is achieved or Ways in which GHG emissions are reduced or emissions avoided .
Prompt treatment of sick animals	Eco-label standards require animals to be treated promptly by a qualified animal health practitioner.	Increases awareness of the importance animal health. An adaptation to climate change projected increase in animal diseases.
Disease management through good feeding	Eco-label standards require farmers to maintain good feeding of animals to keep them healthy so as to withstand or be less susceptible to diseases.	Less use of chemicals in animal disease management is an adaptation to reduce chemicals in the environment and, thus, preserve biodiversity.

9.18 Composting

Composting is commonly practiced in Africa to prepare manure for adding to gardens. Composting is a low emission practice because it reduces methane emissions from landfills**.** The use of compost to produce food also avoids emissions of nitrous oxide from the production and application of chemical fertilizers. The application of compost promotes high rates of soil carbon sequestration and also increases soil fertility which enhances food security. One tonne of organic waste composted mitigates 0.44 metric tonnes of CO_2 equivalent. If all municipal wastes mitigation in Africa are sorted out to isolate organics that can be composted, the total amount of CO_2 emissions potential can be quantified.

Box 4 below presents a success story on how composting can be used to reduce methane production from organic wastes and increase soil fertility and turn degraded lands into productive lands, and create employment. Box 4 shows the benefits of a project in Egypt to reduce methane production through controlled microbial compost production that avoids methane production from decomposing organic matter.

Box 4: Composting in Egypt

In Egypt the most common practice for disposing agricultural waste is by dumping it at municipal waste sites, dumping it in the desert or by simply burning it. The organic agricultural waste consists of wood, straw, coffee residues, fresh green material and manure. The problem with dumping is that the organic waste decomposes anaerobically, leading to methane emissions into the atmosphere which is a very potent Greenhouse Gas.

An agricultural production facility initiated a project to reduce methane production from organic wastes through a controlled microbial compost (CMC) production. In this project methane emissions are avoided by composting organic waste. Through use of well known international standards and techniques to produce high quality compost out of waste, suitable for organic and conventional farming agricultural waste is obtained from farms, animal husbandry industries, municipalities as well as private and public organizations and put through a composting process to produce manure which is used to fertilize degraded desert soils.

Benefits of the project include that:

• the fertility of the degraded desert soil is improved sustainably without exposing people and nature to chemicals.

• a substantial amount of the returns are re-invested into other sectors of the economy.

• the water holding capacity of the soil is improved by up to 70%, which means more effective use of irrigation water (crucial in a desert environment).

• in addition around 100 workers are employed at the project site.

Compost Project Egypt; Climate Neutral Group: www.climateneutralgroup.com

10 Forestry

Forestry is one of the four sectors that AEM is developing standards to guide management in order to enhance sustainability in utilization and protection. Forests in Africa range from the dry savannah woodlands in the expansive African rangelands, to moist forests represented by rain forests and montane forests in the highland areas.

Forests and woodlands cover an area of about 675 million hectares, or 23% of Africa's land area and about 17% of global forest area. Tropical moist forests in Central and parts of West Africa and woodlands in southern Africa are the dominant formations. Africa has extensive areas classified as 'other wooded land', with an area of 350 million hectares

The five countries with the largest forest area are the Democratic Republic of Congo, Sudan, Angola, Zambia and Mozambique; together they contain 55% of the forest area on the continent. The proportion of the land area covered by forests in the various sub regions is: Central Africa (43.6%), Southern Africa (31%), East Africa (20.8%), West Africa (14.3%) and North Africa (7.2%). Planted forest area is 14.8 million hectares, and this represents 5% of the global total. Over 70% of the continent's population depends on forest resources for their survival; yet, many African countries continue to give low priority to forestry in their planning.

African forests and trees are seriously threatened by agricultural expansion, commercial harvesting, increased exploitation for wood fuel and other products and increasing urbanization and industrialization. Table 16 shows the areas of deforested lands in hectares for a number of African countries based on data from FAO recorded in 2010. The countries with high rates of deforestation have higher potential to sequester more CO_2 if they apply adequate afforestation programmes.

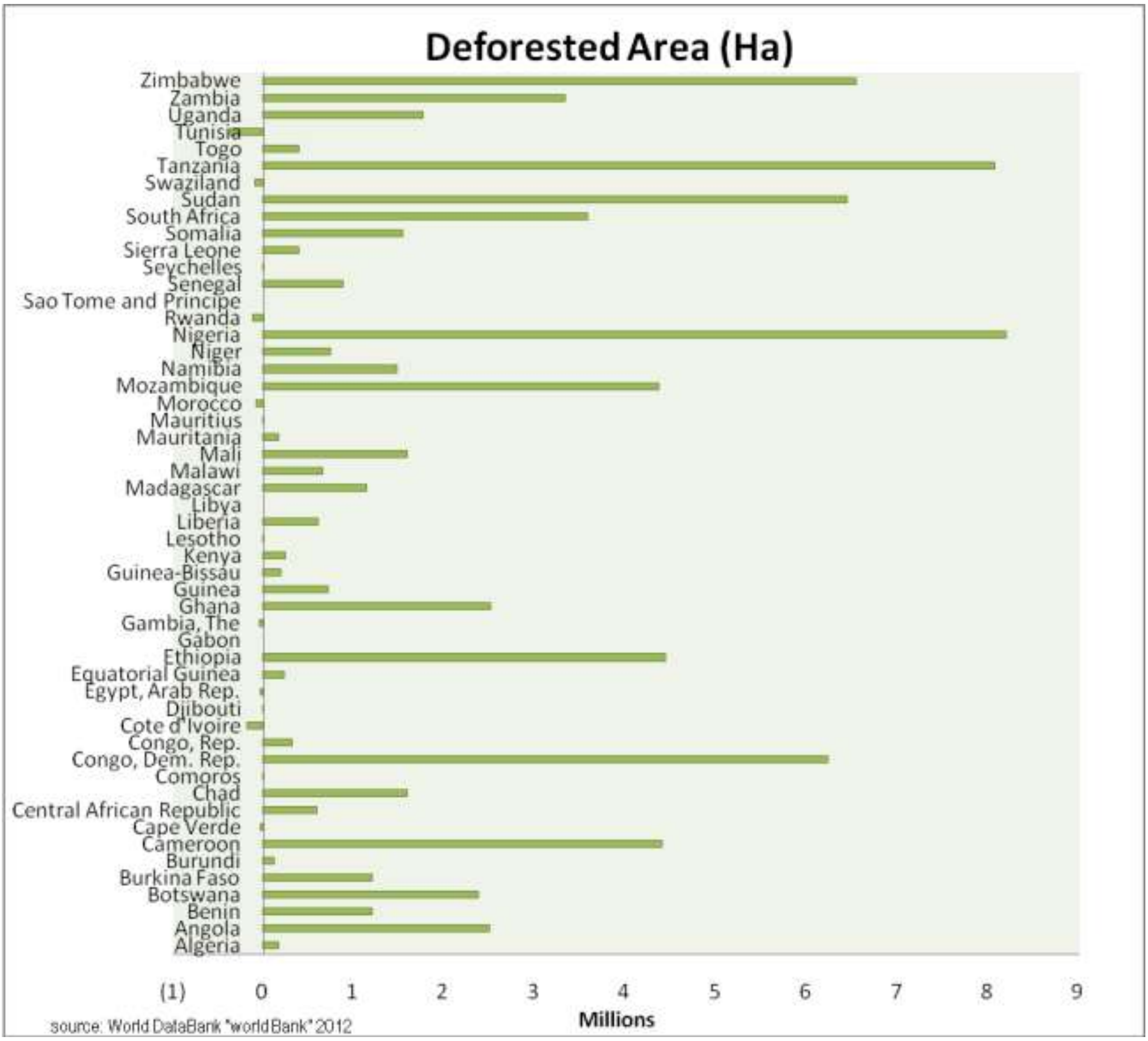


Figure 16: Areas of deforested land by countries from 1990 to 2010
(World Bank: http://data.worldbank.org: Accessed October 2012)

10.1 Need for sustainability

In selectively logged tropical forests, an estimated 20% of the volume of harvestable timber is either lost on the forest floor or abandoned and left to rot because of inefficient and wasteful bucking practices. Typically, less than 50% of the total volume of wood from a tree reaches the mill. In most tropical sawmills, the yield of sawn timber from log is often only 35%. Drying the sawn wood translates into an additional 10% volume loss. Finally, when the dried lumber is processed into furniture or other products, the yield is generally less than 70%.

Figure 17 shows the mitigation potential if the deforested lands in Africa are rehabilitated by restoring forests. Annually Africa can mitigate over 150 million tCO_2 annually through afforestation programmes.

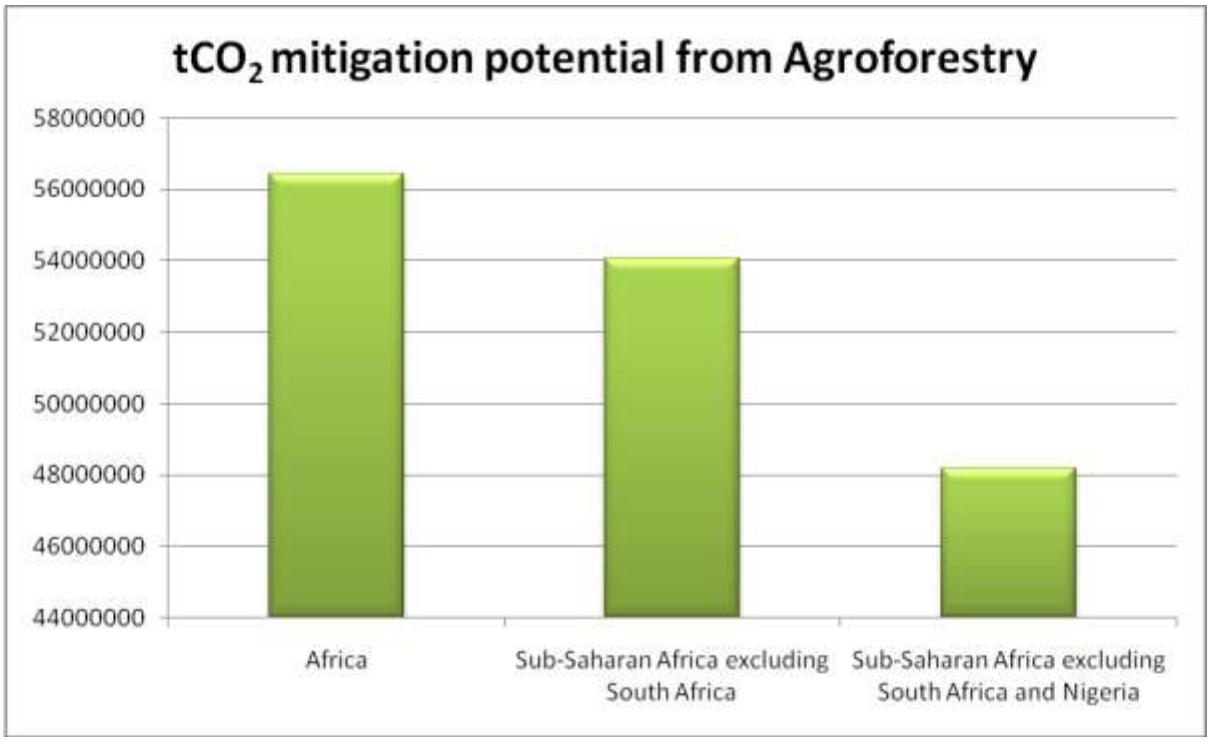


Figure 17: Figure 18: Mitigation Potential if all the deforested lands are put on sustainable agro forestry management

(World Bank: http://data.worldbank.org: Accessed October 2012)

10.2 Eco-labelling standards in the forest sector

Eco-labelling standards in forestry have been practiced in Africa through the Forest Stewardship Council (FSC), which has developed international standards on forest management. From the FSC standards several national standards are put in place all based primarily on the FSC basic principles and through a process of adoption of the FSC principles and endorsement by FSC. The council acts as the certification scheme after being certified that all set principles are followed (Chidumayo, 2011).

The prime principles presented in the eco-labelling forestry standards that have implication on reduction in GHG emissions advocate for the following:

- Maintenance and/or Restoration of Ecosystem Integrity
- Conserving high Conservation Value Forests
- Plantation areas are consistent with landscape level biodiversity objectives
- Plantation area does not exceed 10% of the timber harvesting land base
- Conservation of forest areas that provide basic services of nature in critical situations (e.g. watershed protection, erosion control).

The following are some of the principles contained in the eco-labelling standards on forestry as provided by the Forest Stewardship Council and how they contribute to reductions in CO_2 emissions and climate change adaptations (Chidumayo, 2011):

Forests must be protected from illegal harvesting, settlement and other unauthorized activities.

This principle or rule protects the forest from harvesting that does not comply with the standards. Usually illegal forest harvesters do not consider the age of the tree before they cut it down neither do they consider damages they cause or the wastes they leave behind after they take the timber they are interested in. This has implications on generating waste and reducing biodiversity. The rule therefore contributes in reducing emissions associated with waste decomposition. The rule also contributes to improvements in biodiversity management whose benefit is to provide ecosystem services that are adversely affected by climate change.

The forest management should encourage optimal use and local processing of the forest's diversity of products.

This regulation encourages local processing of forest products like timber thus reducing on the costs of transportation and increase benefits to the local people availing to them non timber forest products. Reducing transportation also reduces on fuel consumption in transportation thus reducing on CO_2 emissions.

Minimizing of waste associated with harvesting and on-site processing operations and avoiding damage to other forest resources.

As stated above about 20% in volume of harvestable timber is lost at the site of harvest due to poor and uncontrolled methods of harvesting. Considering that all wastes associated with unsustainable timber harvesting only about 50% of the timber harvested reaches the saw mill. This amounts to a lot of wastes that eventually result into releasing CO_2 to the atmosphere adding to the GHG emissions. Applying this rule reduces CO_2 emissions from forest wastes decomposition and possible burning during forest fires.

Recognizing, maintaining, and, where appropriate, enhance the value of forest services and resources such as watersheds and fisheries.

Forests provide major ecosystem services including serving as watershed and rainfall catchment areas where rivers originate. The watersheds are also habitats for unique ecosystems with aquatic biodiversity including fish species. They are therefore very important for providing valuable ecosystem services. Wetlands in particular are important carbon sinks where carbon contained in the organic matter deposited beneath the water is removed from the cycle for as long as the wetland remains. This eco-label requirement therefore reduces carbon emissions from the burning of decomposition of organic substances and, thus, reducing GHG emissions.

Conservation of biological diversity and its associated values, water resources, soils, and unique and fragile ecosystems and landscapes, and, by so doing, maintain the ecological functions and the integrity of the forest.

This eco-label requirement contributes mainly in reducing carbon emissions associated with soil degradation and also contributes to climate change adaptations by enhancing biodiversity conservation and increasing the ability of forest ecosystems to provide their services. Climate change is projected to have higher adverse effects on biodiversity both at ecosystem and at species levels. This eco-label requirement helps maintain the ecosystem level of biodiversity in the forest ecosystems, aquatic ecosystems in the forested areas and soil biodiversity.

Maintaining, enhancing and restoring of ecological functions and values, including:
a) Forest regeneration and succession.
b) Genetic, species, and ecosystem diversity.
c) Natural cycles that affect the productivity of the forest ecosystem.

This is a very important regulation as far as mitigating the effects of climate change is considered. Increased temperatures affect the phenological activities of plants thus making them lose the ability to regenerate leading to a loss of the ecological function they provide. Restoration of the ecological functions will enable forest to function through management of the genetic resources, species and ecosystem at risk from climate change. The forest ecosystems will be able to adapt to climate change without or with less degradation.

Harvesting of wood fuel from forests is common in Africa. When the extraction rate is greater than the rate at which the biological system regenerates biomass, forest or woodland becomes degraded. This requirement will therefore serve to make sure that regenerative capacity of the forest is not exceeded by the rate of extraction not only for timber but also for wood fuel.

Controlling the use of exotic species shall be carefully controlled and actively monitored to avoid adverse ecological impacts.

Climate change in association with increased human activities is likely to increase the proliferation of exotic forest species at the expense of indigenous species due to the selective harvesting, introductions by humans and the slow growth of indigenous plant species. If not monitored exotic tree species can replace the indigenous species and altering the ecological functions of the forest. This regulation will play a role in maintaining the ecological integrity of the forest, reduce ecosystem degradation and, thus, contribute to mitigating the effects of climate change. Depending on the type of indigenous species or type of ecosystems originally present and the exotic species that replace the indigenous ones, there could be a net reduction or increase in the soil carbon content (considering the methods of replacement) or a net increase or reduction in the potential to sequester CO_2 from the atmosphere.

Prohibit deforestation to create plantations or non-forest land except in circumstances where conversion:
a) entails a very limited portion of the Forest Management Unit; and
b) does not occur on High Conservation Value Forest areas; and
c) will enable clear, substantial, additional, secure, long term
(d) conservation benefits across the Forest Management Unit.

Studies have indicated that deforestation has a strong effect on rainfall and that the desertification in Africa is due to the declining mean rainfall during the last half of the 20th century that has caused a 25–30 km south-west shift in the Sahel while the Sudan and Guinea vegetation zones in West Africa have shifted at an average rate of 500–600 m per annum.

Deforestation is biggest CO_2 emitter in Africa. Large areas of forest land are annually converted into farmlands and grazing lands effectively converting from a function as a carbon sink to CO_2 emitter. The control of deforestation provided by this eco-label regulation will help to reduce CO_2 emission through deforestation, and maintain forests for long periods of time. The regulation will also conserve forests of high conservation value reducing loss of biodiversity.

Taking measures to prevent and minimize outbreaks of pests, diseases, fire and invasive plant introductions. Promote use of integrated pest management and discourage use of chemicals, pesticides especially in forest plantations and nurseries.

Using integrated pest management as a part of forest management plan, with primary reliance on prevention and biological control methods rather than chemical pesticides and fertilizers will be good for preservation of ecosystem integrity. Plantation managed without chemicals pesticides and fertilizers will have richer and healthier ecosystems and will provide better services to the environment and people. Products harvested from these ecosystems will be less harmful to the users.

10.3 Control wildfires

Protocols for monitoring fires in real time, methods for notifying relevant authorities, and the capacity to deploy motivated, trained and equipped fire fighters need to be implemented. As most of the forest fires that do so much damage in the tropics are slow-moving ground fires, the equipment needs are modest. However, even when information on the location of fires is available, remoteness and difficult access are still major problems to be overcome

The social equity and ancillary benefits of controlling forest fires are significant and diverse. Human health benefits from avoiding high concentrations of particulates and other pollutants released by forest fires; emissions from slow moving or smouldering fires are much worse for human health than those from more intense fires. Preventing large quantities of fire-generated aerosols from reducing regional rainfall also benefits society. From a biodiversity perspective, controlling forest fires has exceptional benefits, except where fires are part of the natural regime (e.g., savannas and woodlands).

11 Fisheries

Fisheries face numerous challenges associated with climate change (Daw, et.al. 2009). Most of these challenges are caused by increased water temperatures, changes in water depths like in the inland lakes and rivers, changes in water currents in the more open waters; and changes in water chemistry (Cochrane; et. al. 2009) Others include changes in the dynamics of aquatic organisms; and degradation of coastal environments (MSC 2010; Huijbregts, et.al. **(**2007).

Despite the challenges facing the sector there is an increasing demand for fish protein worldwide that has contributed to over fishing to meet demand. Overfishing coupled with the challenges brought about by climate change has led to a situation where 52% of the fisheries stocks are being fully exploited with no chance for further expansion (Laurenti, G. 2007)), 19% being over exploited and 18% being completely depleted (MSC 2010)

Eco-labelling is one of the measures to enhance sustainability in the fisheries sector. The eco-labelling standards in use in many parts of the world today are those developed by the Marine Stewardship Council (MSC). At the centre of the MSC is a set of *Principles and Criteria for Sustainable Fishing* which is used as a standard.

These principles reflect recognition of what a sustainable fishery should be based upon (MSC 2010):

- The maintenance and re-establishment of healthy populations of targeted species;
- The maintenance of the integrity of ecosystems;
- The development and maintenance of effective fisheries management systems, taking into account all relevant biological, technological, economic, social, environmental and commercial aspects; and
- Compliance with relevant local and national laws and standards and international understandings and agreements

Fisheries standards that are relevant to climate change adaptations and reductions in GHG emissions are presented in two of the three main principles of the standards. The three principles stated below have similar climate change mitigation potentials (MSC 2010).

1. A fishery must be conducted in a manner that does not lead to over-fishing or depletion of the exploited populations and, for those populations that are depleted, the fishery must be conducted in a manner that demonstrably leads to their recovery
2. Fishing operations should allow for the maintenance of the structure, productivity, function and diversity of the ecosystem (including habitat and associated dependent and ecologically related species) on which the fishery depends.
3. The fishery is subject to an effective management system that respects local, national and international laws and standards and incorporates institutional and operational frameworks that require use of the resource to be responsible and sustainable.

Each of these principles provides a number of management guidelines and criteria to ensure sustainability and adequate environmental considerations in fisheries operations. The section below gives analyses of how these management criteria contribute to reductions in GHG emissions GHG and adaptations to climate change.

Under principle 1 above, the intention is to ensure that the productive capacities of fisheries resources are maintained at high levels and are not destroyed in favour of short term interests. Thus, exploited populations would be maintained at high levels of abundance designed to retain their productivity, provide margins of safety for error and uncertainty, and restore and retain their capacities for yields over the long term. To deliver on this goal three management criteria are as follows:

a. The fishery shall be conducted at catch levels that continually maintain the high productivity of the target population(s) and associated ecological community relative to its potential productivity.

b. Where the exploited populations are depleted, the fishery will be executed such that recovery and rebuilding is allowed to occur to a specified level consistent with the precautionary approach and the ability of the populations to produce long-term potential yields within a specified time frame.

c. Fishing is conducted in a manner that does not alter the age or genetic structure or sex composition to a degree that impairs reproductive capacity.

Climate change relate to the management under these criteria

i. Management of fish productivity of target populations
ii. Restoration of exploited or depleted fisheries
iii. Managing the reproductive capacity through maintenance sex, age and genetic structures.

All these management criteria contribute to reducing susceptibility of the fisheries sector to climatic conditions that will be negatively affecting their reproductive capacity through alterations in habitat characteristics, in addition to the direct effects of changes in water temperatures and other climate stressors on fish populations. Other important ecological gains from this management include maintenance of ecosystem diversity through restoration of depleted fish species.

Principle 2 requires that fishing operations should allow for the maintenance of the structure, productivity, function and diversity of the ecosystem (including habitat and associated dependent and ecologically related species) on which the fishery depends.

The intention of this principle is to encourage the management of fisheries from an ecosystem perspective under a system designed to assess and restrain the impacts of the fishery on the ecosystem.

The criteria associated with this principle are:

1. The fishery is conducted in a way that maintains natural functional relationships among species and should not lead to trophic cascades on the state of ecosystem.

2. The fishery is conducted in a manner that does not threaten biological diversity at the genetic, species or population levels and avoids or minimises mortality of, or injuries to endangered, threatened or protected species.

The climate related benefits under this principle are very similar to those discussed under principle 1.

12 Tourism

Tourism is a major income earner for many countries in Africa. The number of tourist arrivals per country per year is on the increase. The number of tourist facilities are increasing and diversifying in terms of tourist attraction sites, activities and also in terms of inclusiveness of tourist classes ranging from business tourists, and high end class of tourists. Infrastructure to suit both accessibility and comfort to tourist destinations has also improved or is improving fast. Other services like air travel, water sports, motor sports, and cultural events are also increasing and diversifying.

All these developments, as much as they are good for the national economy and beneficial to investors in the industry, they are impacting negatively on environment in many ways both locally and internationally. They are contributing to green house gas emissions in many ways and that these emissions are increasing year after year (Brierton, (1991).

There is a need to put in place measures to ensure that these environmental impacts do not harm the sustainability of environmental processes that are the backbone of human development and economic growth. One of these measures is the use eco-labelling standards.

Some of the benefits for applying eco labelling in the tourism industry include: Curbing tourism's negative environmental impacts by encouraging tourism enterprises to attain high environmental standards;
Exerting pressure on the tourism industry to improve environmental performance by adopting effective and tangible environmental management techniques; Improving tourism practices by fostering environmentally sensitive business operations; Assisting the industry by developing and applying standards for environmentally sensitive tourism services, conforming to the concept of environmentally compatible tourism alongside of natural resource management, environmental conservation and protection, and pollution control policies (Sasidharan et.al. 2002).

In this report we present some of the conditions contained in tourism eco-labelling standards that have implications of the environment especially reductions on CO_2 emissions and adaptations to climate change.

Purchasing Criterion

Purchasing should favour environmentally friendly products for building materials, capital goods, food and consumables.

This criterion further specifies that the tourist business should give priority to local products and services, and use natural, environmentally friendly products / services. The business should also give priority to reusable, returnable and recyclable products

Consumable Goods Criterion

The purchase of disposable and consumable goods is measured, and the business actively seeks ways to reduce their use.

The criterion requires use of disposable goods as a percentage of the total volume of consumable products. The business should measure the proportion of recycling achieved of all consumables.

Energy Consumption Criterion

Energy consumption should be measured, sources indicated, and measures to decrease overall consumption should be adopted, while encouraging the use of renewable energy.

The business should implement, an energy efficiency programme, which is managed by a sustainability manager. It is recommended that the energy efficiency programme is designed with the help of an expert. The business collects and monitors data on overall energy consumption (kWh), energy used for heating (kWh) and consumption by tourist overnight. . The business strives to minimise the use of non-renewable energy sources.

Water Consumption Criterion

Water consumption should be measured, sources indicated, and measures to decrease overall consumption should be adopted.

The business implements, as part of its sustainability policy, a programme for the reduction of water consumption, which is managed by the sustainability manager; collects and monitor data on water consumption; ensure that its water consumption is sustainable and does not significantly impact on the water availability to local communities and ecosystems.

Greenhouse Gas Criterion

Greenhouse gas emissions from all sources controlled by the business are measured, and procedures are implemented to reduce and offset them as a way to achieve climate neutrality.

The business implements, as part of its sustainability policy, a greenhouse gas reduction programme, which is managed by the sustainability manager. The business should use a system to measure and monitor greenhouse gas emissions, and uses carbon offset practices to indirectly reduce greenhouse gas emissions. The business should provide incentives and promote flexible mobility alternatives to its staff, clients and communicates this to the local community.

Wastewater Criterion

Wastewater, including grey water, is treated effectively and reused where possible.

The business implements, as part of its sustainability policy, a wastewater programme, which is managed by the sustainability manager. The business is connected with the local wastewater and sewage plant or has its own wastewater and sewage installation.

Waste Management Plan Criterion

A management plan on solid waste is implemented, with quantitative goals to minimise waste that is not reusable or recyclable.

The business implements, as part of its sustainability policy, a waste reduction programme, which is managed by the sustainability manager. The business should collect and monitor data on the volume of waste produced. Make sure all organic waste is composted according to local authority guidelines. A recycling system should be in place that is implemented by staff and guests.

Harmful Substances Criterion

The use of harmful substances such as pesticides, paints, disinfectants, and cleaning materials is minimised; substituted, when available, by innocuous products; and all chemical use is properly managed.

The business implements, as part of its sustainability policy, a programme for the reduction of use of chemical and harmful substances, which is managed by the sustainability manager. The business collects and monitors data on consumption of chemicals and harmful substances. The green areas are managed without the use of pesticides or according to organic farming principles. Cleaning products must be either natural products (such as vinegar, citric acid, curd soap) or eco-certified.

Other Pollutants Criterion

The business implements practices to reduce pollution from noise, light, runoff, erosion, ozone-depleting compounds, and air and soil contaminants.

The business implements as part of its sustainability policy, a programme for the reduction of air, noise, light, and soil pollution, which is managed by the sustainability manager. Should minimise non-natural noise and implement the requirements of a "Natural Quiet" policy, minimise the use of artificial lighting and implemented the requirements of a "Dark Skies" policy.

Wildlife Species Criterion

Wildlife species are only harvested from the wild, consumed, displayed, sold, or internationally traded, as part of a regulated activity that ensures that their utilisation is sustainable.

The business implements, as part of its sustainability policy, a strict policy regarding wildlife species. The business abstains from any use of rare, endangered or protected wildlife species and reports illegal activities.

Wildlife in Captivity Criterion

No captive wildlife is held, except for properly regulated activities, and living specimens of protected wildlife species are only kept by those authorised and suitably equipped to house and care for them.

The Wildlife Park or Wildlife Sanctuary operates according to national, European and International standards and legislation and keeps native species.

Landscaping Criterion

The business uses native species for landscaping and restoration, and takes measures to avoid the introduction of invasive alien species.

The business uses native species for landscaping and landscape restoration.

Biodiversity Conservation Criterion

The business contributes to the support of biodiversity conservation, including supporting natural protected areas and areas of high biodiversity value.

The business directly contributes and/or support nature conservation either financially or in-kind. Conservation activities are communicated to staff, clients and the local community.

Interactions with Wildlife Criterion

Interactions with wildlife must not produce adverse effects on the viability of populations in the wild; and any disturbance of natural ecosystems is minimized, rehabilitated, and there is a compensatory contribution to conservation management.

The business implements, as part of its sustainability policy, a strict programme regarding hunting, and any other activity that results to loss of wildlife. The policy complies with local/national legislation and is approved by the national Ecotourism Association (if there is one) and respects the views of the local community on the subject. The business respects codes of conduct for every activity that interacts with wildlife, and strictly enforces them.

12.1 Waste management

Waste management is addressed by all the standards in the four sectors discussed in this report. Waste is generated in the agricultural sector in the form of crop residues, livestock products processing wastes, material wastes during the production and marketing processes as well as harvested wastes that are contaminated, pest and parasite infested or damaged. In the forest sector, it is already indicated that about 50% of harvested trees end up in the market as processed timber and that the rest is lost as waste. In the fisheries sector, like in the livestock wastes occur in the processing factories while others become part of domestic wastes. Both the agricultural and fisheries sectors contribute significantly to the volume of wastes generated by homesteads, including those in the urban centres that end up in the municipal dumpsites. In the tourism sector, hotels generate significant wastes during the processing of food.

Waste decomposition poses health risk to people and is also contributes globally about 3% of GHG emissions. All sustainability standards emphasize on separation of wastes at source and follow a stepwise prioritised process of first exercising a waste prevention and minimisation strategy, re-use, recycle, generate energy and finally what ends up still as a waste is put in landfills.

In terms of climate change impact, the benefits of waste prevention generally outweigh benefits derived from any other waste management practice: Not only are net GHG emissions avoided from treatment and disposal of the waste, but there is also a benefit in avoided GHG emissions from less raw resource extraction and manufacturing. Life Cycle Analysis (LCA) has been used to estimate the climate benefit of avoided resource use for a limited number of scenarios.

Waste minimisation refers to waste avoidance, through various mechanisms such as Cleaner Production and material light-weighting and waste reduction. Reduction of waste post generation is achieved through re-use and recycling. Indefinite re-use may be assumed for certain items in the waste stream, and closed-loop recycling may be assumed for certain types of materials (i.e. aluminium, steel, glass, etc.,). Open-loop recycling, 'down-cycling', and industrial symbiosis are additional recycling methods. From a climate perspective, the benefits of both re-use and recycling are realised in avoided GHG emissions from waste treatment and disposal, and a GHG benefit in avoided resource extraction and manufacture of new products.

In the context of this report, waste management sector can save or reduce GHG emissions through several activities:

- Avoiding the use of primary materials for manufacturing through waste avoidance and material recovery (i.e. the GHG emissions associated with the use of primary materials – mostly energy-related – are avoided).

- Producing energy that substitutes or replaces energy derived from fossil fuels (i.e. the emissions arising from the use of waste as a source of energy are generally lower than those produced from fossil fuels).

- Storing carbon in landfills (i.e. carbon-rich materials that are largely recalcitrant in anaerobic landfill conditions, such as plastics and wood) and through application of compost to soils.

The compost output (from facilities that accept source-separated organic wastes) is typically assumed to substitute for the primary production of mineral fertilisers and/or peat – in either case, there is an associated GHG saving from avoided primary production. There are additional GHG benefits from reduced use of irrigation, pesticides, and tillage where compost is regularly applied to agricultural land.

After waste prevention, recycling has been shown to result in the highest climate benefit compared to other waste management approaches. Estimates of GHG savings are generally based on the premise that recycled materials replace an equal – or almost equal – quantity of virgin materials in a closed-loop recycling system (i.e. where material is reprocessed back into the same or a similar product).

13 Economic benefits for mitigating CO2 and adapting to Climate change

Economic benefits on mitigating GHG emissions can be achieved by reducing or avoiding the costs of dealing with impacts created by climate change. These impacts come in reduced agricultural productivity, poor ecosystem goods and services (like the forestry, fisheries and tourism sectors), responding to climate related disasters like droughts and floods, repairing systems damaged by climate change extreme events (e.g. roads, buildings, irrigation schemes and other infrastructure); responding to climate change related disease epidemics on human and livestock. In many cases such damages may also result into loss of human lives, displacement of people, and destruction of livelihoods. All these end up to be major costs to the country's economy and human prosperity. Through climate change mitigation and adaptations substantial amounts of these costs can be avoided. Figure18 gives projections of annual economic costs associated with management of climate change disasters expressed as a percentage of loss in GDP per country for the years 2030 and 2050.

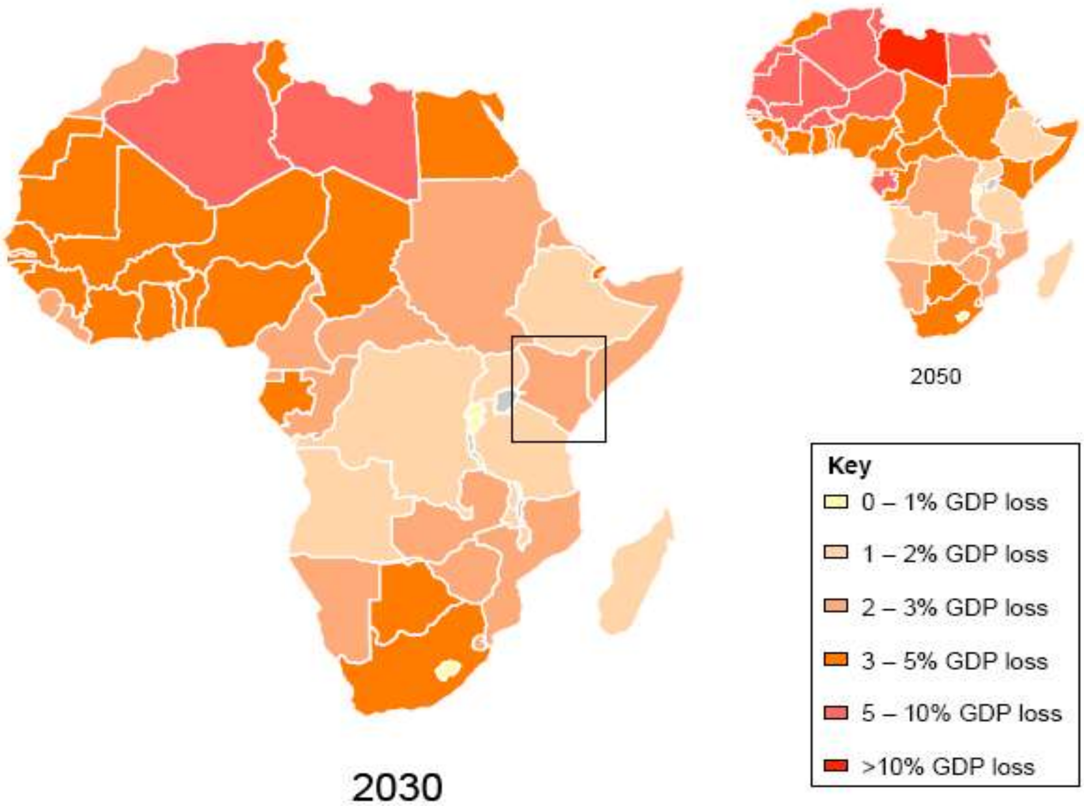


Figure 18: Annual Economic Costs from Climate Change as a function of GDP
(Source: SEI, 2009)

Kenya (inset on 2030 map) for example may spend nearly 3% of its GDP in 2030 due to climate change. This will be expenditures on combating with impacts of climate change especially on dealing with extreme events like floods, droughts, landslides and others.

The figure shows some countries will lose as much as 10% of their GDP due to climate change. As observed most countries in Africa fall in the category of those who might lose 5 to 10% of their GDP due to climate change and that the loss is project to increase with time.

Through climate change mitigation and adaptation strategies much of the losses projected in the above figure can be significantly reduced. The figure below gives estimates of loses that can be reduced through climate change adaptations and mitigation measures and the combined benefits of applying both climate change mitigation and adaptations. Figure 19 shows economic cost of climate change as a Function of GDP in Africa with mitigation and adaptation.

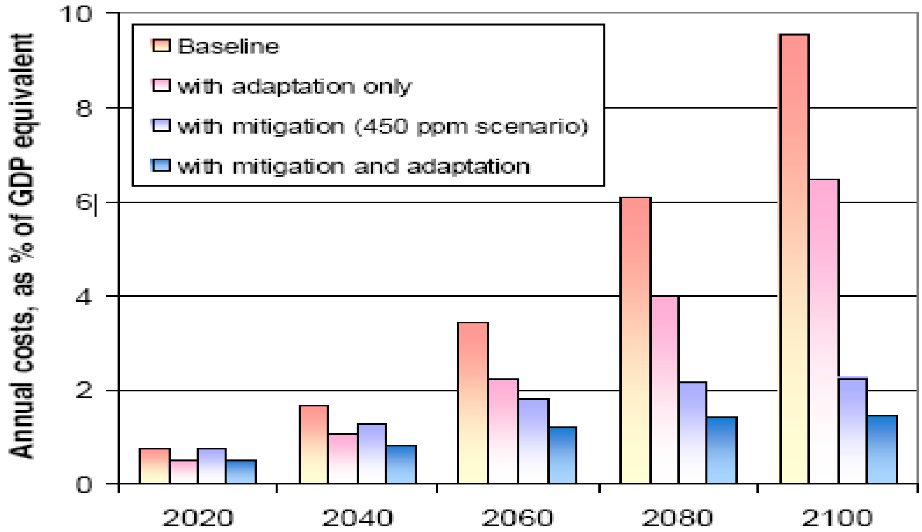


Figure 19: Annual Mean Economic Costs from Climate Change as a Faction of GDP in Africa with mitigation and adaptation.
(Source: SEI 2009)

From the figure presented above, the use of mitigation and adaptation interventions will reduce annual losses from a possible of 10% to well below 2% by 2100, a reduction of more than 8 % while with adaptations only, the reduction in loses will be about 3% of the GDP equivalent.

Table 7: Impacts of sustainable agricultural practices on food production and carbon sequestration (in soils and above ground biomass)*

FAO farm system category	Average increase in crop yields (%)	Carbon sequestered (ton C/ha/year)
Smallholder irrigated	129.8 (±21.5)	0.15 (±0.012)
Wetland rice	22.3 (±2.8)	0.34(±0.035)
Smallholder rainfed humid	102.2 (±9.0)	0.46 (±0.034)
Smallholder rainfed highland	107.3 (±14.7)	0.36 (±0.022)
Smallholder rainfed dry/cold	99.2 (±12.5)	0.26 (±0.035)
Dualistic mixed	76.5 (±12.6)	0.32 (±0.023)
Coastal artisanal	62.0 (±20.0)	0.20 (±0.001)
Urban-based and kitchen garden	146.0 (±32.9)	0.24 (±0.061)
All projects	79.2 (±4.5)	0.35 (±0.016)

*Standard errors in parenthesis
Source: *Pretty et al. (2003, 2006).*

Sustainable agriculture increases food production as well increasing carbon sequestration. Table 7 above gives the gains made per hectare of cultivated land in the increase in percentage of crop yields and the carbon sequestration in tonnes of carbon stored in soils and above ground biomass per hectare per year.

14 Conclusions

The need for sustainable production and consumption is highly appreciated in all sectors of economic growth in Africa (UNEP, 2010). Economic growth in Africa is highly dependent on external trading with on agricultural commodities, natural resource products and provision of services like tourism (ECA, 2010; AGI 2012). African countries and regional commissions that have been able to exploit these trading opportunities have developed faster than those that have not. A case in point is South Africa which dominates on Africa's external and internal trade and is by far more developed than other countries (Daya et. al. 2006) especially among the sub Saharan Africa countries. Many Africa economic communities have been striving to improve trade with member states between the communities and also with countries outside Africa (Bigsten, *et. al*. 2004; UNIDO 2011). Implementation of eco-labelling mechanism will enable countries and their economic blocs to improve their intra Africa and external trade by increasing compliance to standards demanded by the markets (Janisch, Claire. 2007).

While long-term projections suggest that global growth in demand for agricultural products will be weaker than that experienced before the 2008 economic downturn, World Bank forecasts suggest that three quarters of global demand for food between now and 2030 will emanate from developing countries (World Bank 2009). This implies that regional and domestic markets in developing countries, in addition to global markets, will continue to offer growing opportunities for African food and agro-industrial products. Exploiting these opportunities will be crucial if African countries are to meet the growth and poverty reduction targets under CAADP and the MDGs. The African countries that will adapt the AEM standards will be better placed to exploit these trading opportunities. For example trade in horticulture and processed commodities exported from Africa for final use grew faster during 2008 than total agro-industrial exports, at 10.7 per cent and 10.8 per cent, respectively, compared with only 7.2 per cent for total agro-industrial exports and 5.0 per cent for unprocessed commodities exported for processing (UNIDO 2011) .

In addition to trade-reducing policy distortions between countries and regions, the ability of entrepreneurs to expand and diversify exports has been curtailed by binding constraints on the supply side. Some of the key supply-side barriers reported in various studies, and that African eco-labelling mechanism reduce include: the low productivity due to poor agronomic practices, inefficient production and processing technologies, management practices and organizational structures that contribute to low productivity. These constraints can effectively be reduced through application of AEM standards.

Standards and technical regulations that cover health, safety and quality requirements have become important determinants of access to export markets and the lucrative segments of the domestic market (UNEP 2010). Despite this importance, there has been only limited success in developing comprehensive and sustainable standards and quality management capacity in many African countries (Biggs 2007). AEM will increase the ability of governments and the private sector to build and strengthen this limited capacity to develop and export new products or higher quality variants of existing exports.

Implementation of eco-labelling is a demand driven need that motivates producers to participate due to market forces (Janisch, Claire. 2007). Access to the premium markets motivates producers to join eco-labelling schemes (Gulbrandsen, 2006). However, many farmers in Africa produce mainly for their local domestic markets in addition to producing for their own consumption. As many producers are beginning to commercialize their production, it is a matter of time for some of them to start seeking foreign markets for their commodities in order to generate more income and at the same time to adjust to market demands and subscribe to eco-labelling standards especially if they need to attract the premium prices.

African Eco-labelling will contribute to climate change mitigation in many ways through reductions in CO_2 and other green house gas emissions. Adoption to appropriate land management will reduce emissions resulting from burning of the biomass. Better waste management will reduce emissions related to waste decomposition and respiration, and avoided deforestation will reduce emissions related to land use change. Better use of water resources will reduce emissions related to agriculture especially better management of irrigation schemes like in the case of rice irrigation.

Eco-labelling will also increase adaptations to climate change through a number of ways that will help the producers to adjust to the changing climatic conditions that affect their production. Eco-labelling encourages the producers to adapt to several prescribed standards all aimed at reducing environmental costs in production, packaging, transportation and marketing. In return the producer gains access to premium markets where the products fetch higher prices than the products produced without following the prescribed standards. Eco-labelling is therefore a market driven voluntary mechanism through which products are produced in an environmental friendly way.

In Africa the concept of eco-labelling is recent and many producers are still sceptical on whether it is not one of non-tariff barriers to trade. Based on analysis of recent market trends and requirements, Africa has been unable to access prime markets due partly to non compliance with standards of production. Production through eco-labelling helps to meet some of these standards as in the instances where these standards have been applied like in organic agriculture in east Africa, access to markets has been impressive and continues to grow.

In regards to forestry, a review and expert survey (Zagt et al. 2010) draws conclusion that certification has helped reduce biodiversity loss in the tropics. However, the amount of forest or area of certified natural forest in the tropics is relatively small compared to the total area under forests. If more forests in Africa can be managed through AEM, a lot more can be achieved on reducing biodiversity loss. This in return helps to sustain the tourism sector that is highly dependent on the diversity and richness of biodiversity (Becken, and Hay, 2007).

Reducing GHG emissions from Agriculture, forestry and other land uses offers a great opportunity for Africa to contribute to climate change mitigation and help millions of small holder farmers adapt to climate change impacts. Although overall Africa's contribution to GHG emissions is significantly low, emissions from land use changes particularly conversions of forests land to farmlands is quite substantially high. In view of this African negotiators in international agreements should work on a plan that places more recognition and acceptance of CO_2 reductions from land use changes by availing more financial resources for activities that promote reductions in GHG emissions from land use changes (Chidumayo et. al. 2011).

They should also push for a position that international greenhouse gas offset markets should accept carbon credits from emission reductions and carbon stock increases from land use changes from developing countries. Climate change and the international instruments dealing with it have created a scope of new challenges, opportunities and tasks for the forest sector. Meeting them successfully requires fresh perspectives, modified priorities, new knowledge, skills and creativity. Recent initiatives from REDD open up new funding opportunities. Reduction in emissions from deforestation and forest degradation is generally recognized as a relatively low cost greenhouse gas mitigation option.

Production through eco-labelling helps to reduce emissions of CO_2 in all the sectors through enrichment of the soil carbon sinks, increase in the amount of carbon tied in the land and below ground biomass, and the associated CO_2 removal from the atmosphere through increased photosynthesis. Eco-labelling promotes waste management and introduces standards that reduce GHG emissions from wastes in all the four sectors of the African Eco-labelling Mechanism. Gains in reductions of CO_2 and other green house gasses span across all the life cycle stages of production and all means of production including crop production livestock rearing, timber and non timber forest production, fish production and in services like tourism and transportation.

The gains also would include savings on national GDP due to avoidance or reduction in possible looses that may be incurred from damages of climate extreme events. These savings are likely to be in billions of dollars and estimated to be between 3% and 10% depending on the country and the predicted climatic regimes of different regions of the continent (SEI 2009).

African Eco-labelling Mechanism will help countries to reduce their carbon emissions and in turn help to reduce the rate of global warming. In so doing the countries will increase sustainability of their means of production especially the agricultural production. Trends in the current production are characterized by seasons of poor or no harvest due to poor weather, the initiative will at larger scale reduce climate variability through reductions in GHG emissions.

Eco-labelling in tourism will increase profitability to the investors through savings in energy consumption, water use, waste management and above all increase number of high end tourists. Eco-labelling will also increase biodiversity conservation a resource on which tourism is based on. This in return pays back by increasing the diversity of tourist attraction (UNEP 2010).

Greening the world's fisheries will help restore damaged marine ecosystems (Barange, and Perry, 2009; Daw, et. al. 2009). When managed intelligently, fisheries will sustain a greater number of communities and enterprises, generating employment and raising household income, particularly for those engaged in artisanal fishing (De Silva, and Soto, 2009). In order to achieve sustainable levels of fishing from an economic, ecological and social point of view, a serious reduction in current excessive capacity is required. Given the wide difference in the catching power, the job creation potential, and the livelihood implications of large scale versus small-scale fishing vessels, it appears that a reduction effort focused on large-scale vessels could reduce overcapacity at lower socio-economic costs to society (De Silva, and Soto, 2009).

15 Recommendations

This report has put across many advantages that African Eco-Labelling Mechanism will bring to increase sustainability of production and consumption in agriculture, forestry, tourism and ranging from environmental benefits, to trade and business opportunities, and to ways of reducing losses on GDP due to climate change related damages. AEM is working to create a Pan African programme on eco-labelling in four productive sectors that cut across all the countries and RECs in Africa. Due to the high number of countries and production units as well as complexities in trading within the continent, there are challenges in harmonizing production standards across Africa and adapting to a unified structure of marketing. To help overcome these challenges we recommend the following.

1. ***Embracing a Pan Africa approach in the implementation of AEM through the support of AU and other pan African political organizations and development agencies***

   The unique quality of AEM is the pan African approach where the standards are adopted by all the RECs and countries and use the EMA label as a mark of quality above all other regional and national standards that may exist within the continent. For AEM to succeed in this endeavour, there need for a concerted effort among different stakeholders in different parts of the continent. These include a good will of the African Union and through the relevant department of AU pass legislative instruments to enable member states harmonize their policies to allow and encourage countries and regional authorities to facilitate participation in AEM, including trade using EMA label.

2. ***Continued support by national and international organizations to AEM implementation***

   Currently AEM has been successful partially due to the technical and financial support it gets from many national and international institutions and forums which should continue in order to maintain the momentum that already exists. We recommend that UNEP continues to give the technical backstopping to AEM especially on the environmental analysis of AEM implementation. One big objective of eco-labelling is increase environmental sustainability through sustainable production and consumption. If these environmental gains are well quantified and communicated to the consumers, the information can play a big role in creating a demand for the products and, thus, a sustaining a market. GIZ has provided the initial funding to start AEM but funds are still needed in order to consolidate the AEM structures across Africa and make the eco-labelling mechanism fully operational. The support from ARSCP and UNECA are very important for effective operation of AEM. AEM needs the support of national standardisation bureaus and departments especially in spearheading the formulation of policy frameworks at national level.

3. ***Creation of enabling policy frameworks to facilitate uptake of AEM production and consumption standards***

   Policy frameworks that will enable uptake of AEM standards by producers need to be put in place in every country. The policies should not enforce the uptake of standards but rather provide options for those willing to adopt the standards to so and if need be offer incentives for the producers especially for the small scale producers to find it profitable to engage in eco-labelling. This can be done under the expectations of the gains the country or regions can make through trading in the world premium markets, and the non monetary environmental gains that is achievable. For example policies can be put in place to remove taxation on the extra earnings made by EMA producer through premium pricing (the earnings above similar commodities produced conventionally) in order to encourage producers to subscribe to the standards.

Some of the areas where policy interventions can facilitate uptake of AEM are:

a. Support for improved land tenure rights of smallholder farmers
b. Targeting programmes for women smallholder farmers
c. Public procurement of sustainably produced food
d. Targeting small micro enterprises with the four sectors

4. ***Public awareness among the producers and consumers***

There is a need for public awareness on the existence of production standards that lead to the award of EMA the eco-label of EMA. The awareness should focus on the benefits to the producer and those to the country and the environment in general. The awareness should also target on informing the consumers who are expected to spend a little more to pay for producers who have chosen to consider sustainability of the environment in their production. The awareness should also inform consumers on the health benefits one can have by consuming or utilizing commodities produced through eco-labelling.

5. ***Capacity building for standards supervisory personnel and assess***ors

Eco-labelling requires strict adherence to the prescribed production standards. The producers therefore need to undergo training on production procedures; good record keeping of the activities, inputs at all levels of production and above all the benefits for taking the actions recommended by the standards.

There is an urgent need for building a local capacity of assessors who can be accredited to assess compliance with the standards and recommend for certification and issuance of EMA by the relevant authorities.

6. ***The RECs to facilitate uptake of standards among the African producers***

Due to the big number of countries in Africa, it is more feasible for the AEM secretariat to deal with RECs rather than each and every country directly. RECs therefore may be required to facilitate adoption of eco-label standards in their regions. RECs should facilitate trade with EMA products both within and outside the regions.

7. ***Marketing of EMA products both within Africa and outside Africa.***

Eco Mark Africa will need to be known as the mark of quality for African goods and services. EMA needs to be associated with quality in all markets both within Africa and outside Africa. Products bearing EMA should be marketed with an aim to create an appetite for goods from Africa.

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