

Opportunities for Climate Change Mitigation Through Afforestation and Reforestation of Degraded Lands in The Sub-Saharan Africa

Tolulope M. DARAMOLA

CarbonSink Development Initiatives. Lane F5 Ponle Ojo Close Oremeta Ologuneru Ibadan, Nigeria
t.daramola@carbonsink-ng.org

February, 2012.

ABSTRACT

The continuous expansions of degraded lands have been a major concern in the global discussions on Land Use Land-Use Change and Forestry (LULUCF). Land degradation is caused by various factors, including climatic variations and human activities (UNCCD, 2012). The principal causes of land degradation are the unsustainable exploitation of land by pastoral farming, uncontrolled deforestation and extensive farming activities. Other contributing factors to land degradation is deficiency of forest policy formulation and implementation, most especially in the developing tropical countries. Land is central to development in sub-Saharan Africa, as the livelihoods of about 60% of the population are dependent on agriculture (Vlek and Tamene, 2003). With population pressures increasing and the low investments in land conservation, the future health of land is in question. In this study, evidence of land degradation in the sub-Saharan Africa where presented and the opportunities abound in restoration of the degraded lands for a sustainable livelihood, environmental protection and climate change mitigation where analyzed.

Keywords: *Land Degradation; A/Reforestation; Agriculture; Carbon Sink; Climate Change.*

1. Introduction

Land degradation is described as loss in the ability of land to be productive and its ability to provide quantitative or qualitative goods or services because of natural and human-induced changes in physical, chemical and biological processes (Muchena *et al.*, 2003). The study carried out on Global Assessment of Land Degradation and Improvement (Bai *et al.*, 2008), shows that 24 percent of the world's land surface is degraded. FAO (2008) also re-

ported that more than 20 percent of all cultivated areas, 30 percent of forests and 10 percent of grasslands are undergoing degradation, and estimated 1.5 billion people, or a quarter of the world's population, depend directly on land that is being degraded. The region most affected by the degradation is the part of Africa that is south of the equator, this accounts for 18 percent of the global degraded area (Bai *et al.*, 2008). Given that most of the poor people in the Sub-Saharan Africa depend on agriculture for their livelihoods, efforts to address land

degradation are critical to sustainable development in the region (Ephraim *et al.*, 2008). The loss of land would, undoubtedly, have grave effect on food production, water supply, energy security, balance ecosystem and consequently would lead to low quality of life for the people.

Studies have shown that forest degradation is the major cause of land degradation. A measure of forest degradation may be in terms of loss of biodiversity, forest health, productive or protective potential or aesthetic value (FAO, 2011). Forest degradation is one of the major sources of greenhouse gas (GHG) emissions. The forest ecosystem plays very important role in the global carbon cycle. It stores about 80% of all aboveground and 40% of all belowground terrestrial organic carbon (Oke and Olatiilu, 2011). Trumper, *et al* (2009) also reported that terrestrial ecosystems store about 2100 Gt C in living organisms, litter and soil organic matter, which is almost three times of the currently present in the atmosphere. Studies further indicated that tropical and boreal forests represent the largest carbon stores, but the state of tropical forests has continued to deteriorate. The recent study on emissions by Nature Geoscience (Van der Werf *et al.*, 2009), estimated that emissions from forest degradation contribute 12 percent to global green house emissions, of which, tropical deforestation accounts for 10 percent to the current emissions from deforestation and degradation (Redd-Monitor, 2012). However, A Global Challenge Needing Local Response (Simula and Mansur, 2011) highlighted that more than two billion ha worldwide of forestland that has either been completely cleared over the centuries or has been degraded offers opportunities for restoration. Furthermore, the success stories of afforestation and reforestation of degraded lands in the Loess

Plateau China, and Nepal have helped us understand the enormous potentials of forestry projects for economic development and environmental protection.

Forests are essential components of life and provide various goods and services that support human existence. The World Agro-forestry Centre (2009) reported that 65% of the population of sub-Saharan Africa is rural and depends directly or indirectly on forests and woodlands for their various needs such as; food, fuel-wood, building materials, medicines, oils, gums, resins and fodder. Concerted efforts towards restoration and bringing degraded lands under sustainable management would not only help in mitigation and adaptation to climate change, but would also create employment opportunities and income generation for millions of people, which at the long run would consolidate global efforts towards a sustainable development in the sub-Saharan Africa.

This study focus on both forest and land degradation and presents the opportunities abound in restoration of degraded lands including those provided by carbon markets. The outcome unveils the products for restoration of degraded lands, which includes boosting agricultural produces, environmental amelioration, balance ecosystems and the carbon credits revenue from afforestation/reforestation carbon project.

2. Situation Analysis

2.1. Degradation in sub-Saharan Africa

Forest and land degradation is a complex issue and difficult to dovetail general definition because of variation in people's perception to degradation. To some, degraded forest is a source of livelihood (Simula and Mansur, 2011). The expert meeting on harmonizing for-

est-related definitions FAO (2002) came up with common definition for forest degradation as “the reduction of the capacity of a forest to provide goods and services”. On the other hand, the process of forest degradation enacts the deterioration in the quality of land, its top-soil, vegetation, and water resources. In addition, excessive use or inappropriate exploitation of land, either through conversion of forests land to agriculture and other land use activities including overgrazing by livestock are the major causative agents of land degradation.

Land degradation in sub-Saharan Africa is intensifying at alarming rates. Millions of people including children struggle every day to survive in an increasingly deteriorating land condition amidst unpredictable climatic variation. The health of its soils and forests continue to decline, a condition considered to strain the capacity of the region to provide for its growing population. As climate change further influences the situation, the outlook is increasingly grim and predicted to exacerbate the poverty rate in the region. The estimation of the extent of land degradation is a complex issue. The United Nations Environmental Programme (UNEP) project on Global Assessment of Human-induced Soil Degradation (GLASOD), estimated that 8.7 billion hectares of agricultural lands, pastures, forests and woodlands, nearly 2 billion hectares (22.5%) have been degraded since the mid-century. GLASOD further indicated that about half of these vegetated areas are under forests, of which, about 18 percent is degraded; 3.2 billion hectares are under pastures, of which 21 percent are degraded; and nearly 1.5 billion hectares are in croplands, of which 38 percent are degraded. Various sources suggest that 5 to 10 million hectares are being lost annually to severe degradation. If this trend

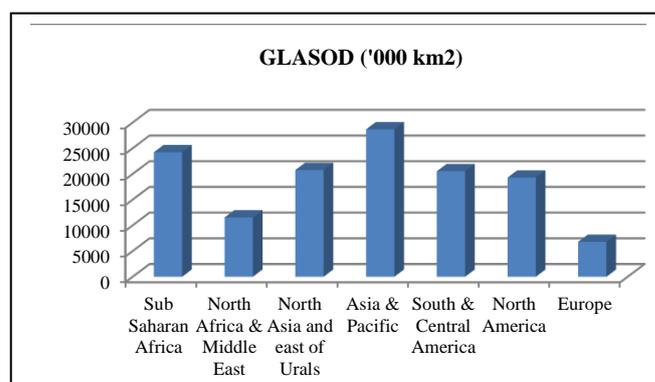
continues, Scherr and Yadav (1996) estimated that 1.4 to 2.8 percent of total agricultural, pasture, and forestland would have been lost by 2020. Furthermore, between 1981 and 2003 alone, the world’s productive land area declined by 12 per cent because of land degradation, and Africa is the continent most severely affected by land degradation, of which, 95 million hectares of land in sub-Saharan Africa are at risk of irreversible land degradation if non-sustainable land-use practices continue (IFAD, 2009).

The study by GLASOD in 2008 (Table 1) shows that 131,842,000 km² have been degraded globally, amongst that, the sub-Saharan Africa have the second highest rate of degraded lands after Asia and Pacific (see table 2). This accrued to 24, 231,000km² total land degradation severity in sub-Saharan Africa.

Table 1. Global Assessment of Human-induced Soil Degradation (GLASOD) datas on land degradation.

Land degradation severity and population distribution		
Regions	GLASOD ('000 km ²)	Total Population
Sub Saharan Africa	24231	646598560
North Africa & Middle East	11543	901589068
North Asia and east of Urals	20759	201869728
Asia & Pacific	28678	3281412480
South & Central America	20538	495124820
North America	19295	303969040
Europe	6799	629090784
Total	131842	6459654480

Table 2. Showing the land degradation by regions



Land degradation in the sub-Saharan Africa will affect major sources of livelihood in the region, most especially those leaving in the rural areas. The unhealthy land will threaten food security and the sustainability of the social and environmental values of the region. Scherr and Yadav (1997) reported that suitable croplands have been lost to soil degradation and the cumulative productivity is on a decline for over 50 years, this amounts to 13 percent, and 4 percent of pasture lands. Furthermore, crop yield losses in Africa from 1970 to 1990 due to water erosion alone are estimated to be 8 percent. The situation is already severe enough to reduce yields on approximately 16 percent of the agricultural land, especially cropland and pastures in Africa (WMO, 2005).

Studies have helped us to predict the magnitude of climate change in Africa, and the sub-Saharan Africa is already witnessing the grave effects of the changing climate including expansion of degrading lands. Nevertheless, the rural communities that depend on the degraded lands can take remedial actions towards restoration of the degraded lands if they are supported with the required technical and financial assistance, and the awareness on the imposing challenges is increased following the model of the Loess Plateau China success story.

2.2. Climate change effect in the sub-Saharan Africa

The IPCC (2007) unveiled Africa as one of the continents that is vulnerable to climate change and climate variability, mainly because of the low capacity of the region to adapt. The World Agro-forestry Centre (2009) further stressed that the sub-Saharan Africa is the region that is most vulnerable to climate change. In addition, developmental challenges, widespread diseases

and endemic poverty, armed conflict, weak policy and lack of strong institutional frameworks, low technical capacity and limited infrastructure, inadequate level of education and access to technology and finance are contributing factors that compound the climate change impacts in the region.

Different models by experts on climate change consent on the spatial pattern of temperature changes in Africa, with the strongest warming in the Sahara region. Studies reveal that Africa will experience stronger warming trend over the 21st century (IPCC, 2007); this includes from +2.0° to +4.5° C by 2100 in sub-Saharan Africa, which is expected to be stronger than the global average (Muller, 2009). Studies further show that climate changes will impact societies and natural systems in various forms. The irony of the situation is that Africa contributes the least to climate change, meanwhile, the continent is projected to suffer the most devastating effects of climate change, evident as the prevailing climate stress such as drought, low precipitation and flooding are on the increase. It is also projected that climate change will affect the supply and quality of water in Africa. Currently, about 25 % of the African populations are witnessing water stress, which means that less than 1000 m³/year/capita accessible and 69 % live under relative water abundance (Vörösmarty *et al.*, 2005 as cited in Muller 2009). Estimation reveals that 300 million people, i.e. more than 40% of sub-Saharan Africa's population, currently lack access to safe drinking water, and by 2020, an additional 75-250 million people accessibility to water supplies are unreliable (DFID, 2009). The frequency and intensity of climate change will increase over the years; as a result, this will exacerbate the degrading condition of the 333

million people that are already in extreme poverty (DFID, 2009).

More than half of the population in sub-Saharan Africa is rural; two out of three rely on agricultural production for their livelihood, this is foreseen to be severely compromised by climate change (DFID, 2009). Furthermore, severe impacts will occur in countries located in the arid and semi-arid regions, especially in West Africa, where projected increased frequency of drought will heavily affect crop productivity (Muller, 2009). As well as frequent floods and drought could reduce agricultural yields and threaten food supplies. Even though only 8 % of the total land area is arable cropland and 34 % is permanent pasture land, agriculture contribute 17% to African GDP (Muller, 2009), and it serves as the major contributor to the economy and livelihoods in the African countries which accounts for a large share of export earnings, and employment in most African countries (IFPRI, 2010).

3. Reforestation as panacea to degraded lands

Restoration of degraded lands through afforestation and reforestation is an important action to mitigating the global climate change. The global leaders have continually express concerns over the increasing challenges around Land Use Land Use Change and Forest (LU-LUCF). However, the Bonn Challenge - a global effort to restore 150 million hectares of lost forests and degraded lands by 2020, was set to augment the REDD+ goal and Target 15 of the Convention on Biological Diversity, as well as the UN framework on food security. Maginnis (2005) of the IUCN made known that restoring 150 million hectares over the next 10 years could potentially close the emissions gap

by 11-17% and inject more than US\$ 80 billion per year into local and national economies. Furthermore, the Great Green Wall for the Sahara and the Sahel initiative project is another landslide towards restoration of degraded lands in Africa. The programme was initiated by some groups of African leaders of states with the aim to tackle the imposing challenges of social, economic and environmental impacts of land degradation and desertification in the region. The initiative tends to contribute to climate change mitigation and adaptation efforts, as well improve the food security and livelihoods of the people in the Sahel and the Sahara. The government of Senegal already begun the implementation of the initiative through planting of two million trees per year, and as at the year 2012 the country have recorded about 50,000 acres of trees in addition to protecting the existing forests.

CO₂ is the most important green house gas acting in climate change. The presence of carbon atom in the soils is the key to soil fertility, which serves as organic matter for increase farm productivity and provision for food security for the world's growing population (Arnalds, 2012). The sub-Saharan Africa as lost huge amount of carbon due to land and ecosystem degradation including soil erosion. Degraded natural resources and reduced biodiversity directly threaten food supplies and income of food insecure people, leading to a vicious circle of poverty, environmental degradation and hunger (DFID EC UNDP WORLD BANK, 2002 as quoted in Millennium Project 2013). Agricultural development play pivotal role in alleviating poverty in the rural communities and various studies have shown that the issue of land degradation have increase the vulnerability of the poor and hungry community in the

sub-Saharan Africa. It is estimated that about half the world's population depend on smallholder farmers for their food supply (Scherr, 2011), and in Africa alone, where majority of farmers are smallholders, agricultural demand is expected to triple by 2050 (Scherr, 2011). Furthermore, the newest projections of the impacts of climate change by various studies, suggest negative impacts on crop yields in most of the developing countries because of high temperature and rainfall changes. Yet even without climate change, agricultural land degradation has reduced productivity on huge areas of land (Scherr, 2011).

However, the restoration of degraded lands through afforestation and reforestation can increase annual carbon storage, increase soil fertility and strengthen food security of the sub Saharan Africa. Additionally, the emerging market on carbon trading has increased the potentials of harnessing carbon finance as a mechanism for restoration of degraded lands through the trapping of atmospheric carbon in the wood biomass and soils (Kelly and Biggs, 2008). Nabuurs *et al.* (2007) summarized studies showing that afforestation, reduced deforestation and forest management can potentially offset between 1.3 to 13.8 Gt of carbon dioxide equivalent (CO₂e)/year through 2030. Montagnini and Nair (2004) also estimate the storage of carbon by the tree component in agro-forestry systems at 9 tC/ha in a semiarid environment, 21 tC/ha in a sub-humid environment, 50 tC/ha in a humid environment and 63 tC/ha in temp regions.

Promoting afforestation and reforestation of degraded lands can generate additional income for the local communities within the carbon credits trading scheme. Considering the scenario of reforesting the degraded lands in the

sub-Saharan Africa; a forest that is growing can remove between 5-11 tons of CO₂ per hectare per year, depending on location and productivity (Sohngen, 2012). The current California Carbon Allowances (CCAs) are trading for about \$15 a ton on the secondary market. Taking GLASOD (2008) estimate for instance, refer to in *table 1*; the land degradation severity in sub-Saharan Africa is 24,231ha. If we calculate the rate of carbon removal of a growing forest between 5-11 tons per hectare, and multiply the cost of tCO₂ at the rate of \$15 by the total estimate of land degradation severity in the sub-Saharan Africa, this means additional income generation between \$1,817,325 - \$3,998,115 for the rural communities in the severity sub-Saharan Africa region.

4. Conclusion

This study shows the current states of Land degradation in the Sub-Saharan Africa and the challenges it poses on humanity, including the enormous impacts on the environment, the climate and the society. Despite concerted efforts by the international community, the issue of land degradation remains unabated mainly in the developing countries. Land degradation in the sub-Saharan Africa is a major challenge, which has undermined the capacities of the local communities to cope with the disasters and adapt to climate variability and change in the long-term. However, the study also reveals the benefits in restoration of the degraded lands, which could serve as catalyst to food security, soil nutrition, fertilization for farmlands and prevention against environmental disasters; including erosion control, carbon sequestration, environmental amelioration and income generation provided by the carbon market. To this end, acting now and acting fast to rehabilitate

degraded lands will serve enormous purposes that would alleviate the vulnerable in the sub-Saharan Africa and avert the more expensive delayed action towards adaptation.

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