Carbon Trading Opportunities and Challenges in Africa

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Abstract

Global Carbon markets with international carbon offset have been designed to channel carbon finance for climate change management to poor and developing countries. In the voluntary carbon markets, companies, governments, and individuals voluntarily spent just under $4.5 billion on conservation and clean energy over the past decade by purchasing nearly 1 billion carbon offsets. This review paper has targets of assessing the level of carbon trading, opportunities and challenges in carbon trading in Africa and suggesting possible remedial ideas for problems related to raised issues. The level of carbon emission from African countries is very low as compared with western and some Asian countries. In carbon markets, buyers and sellers trade in 'carbon offsets' or 'carbon credits' which are units of carbon emissions reduced at source. Broadly, these markets consist of two types of transactions called project-based transactions and trade in emission allowance. In Africa, a local carbon emissions trading system could create a system that is more flexible, encourage local investment projects, craft transparency and generate trading volumes. There are challenges in carbon trading in Africa, among these, uncertainty in the flow of benefit potential and high transaction costs are cited as the two major limitations. The revenue collected from the sale of carbon should be shared among countries particularly which have a good courage as well as motives of conserving forest resources. Project implementation capacity of African must be boosted by creating different opportunities of skills development.

Key words: Carbon, trading, challenge, Africa, Climate, opportunity

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Introduction

Global Carbon markets with international carbon offset have been designed to channel carbon finance for climate change management to poor and developing countries. With climate change becoming more of a global economic threat, scientists, economists and policy makers are all in agreement that carbon emissions have to be drastically reduced to avoid the worst impacts of global warming (Somerville, 2012; IPCC, 2014). One of the major issues raised in extenuating the problem of climate change is global carbon markets. In this scenario, setting well defined tradable permit of carbon can sustainably benefit for countries which can have low volume of emission. Carbon markets have become a powerful policy instrument to leverage both public and private capital for green growth, including activities that are key role to Africa's growth such as sustainable agriculture and renewable energy generation. By putting a price on carbon, carbon markets help to stimulate abatement and technology transfer and drive investment in low carbon technologies and services (Labatt and White, 2011; Stern, 2008).

According to Ervine 2014, global carbon trading has rapidly expanded in volume, value and scope within less than a decade. The number of Clean Development Mechanism (CDM) projects, which is meant for developing clean energy projects in developing countries, stands at over 8475 projects across the world. The total volume of Certified Emission Reduction (CER) permits also increased to over $ 1.7 billion (UNEP, 2016). In the voluntary carbon markets, companies, governments, and individuals voluntarily spent just under $ 4.5 billion on conservation and clean energy over the past decade by purchasing nearly 1 billion carbon offsets (Ecosystems Market place, 2016). The voluntary markets have served as the testing ground for

compliance carbon pricing programs all over the globe (Climate Policy Initiative, 2015).

The maximum limit of world ecosystem that the global warming that can protect the globe from disastrous climate change should be 2^0C (IPCC, 2012). In addition, the atmospheric concentration of GHG must not exceed 450 ppm CO_2e (IPCC, 2013). To stay within this 'carbon budget' in a world projected to support 9.2 billion people by 2050, annual average per capita emissions will need to converge at 2.1 to 2.6 tonnes CO_2e. SSA's current per capita emission levels, whilst the lowest in the world, are slightly above this level, at 2.7 or 3.9 tonnes CO_2e, depending on whether land-use change and forestry is taken into account (James *et al.*, 2015).

Development need and sub-Saharan African (SSA) countries are critically linked. These countries are dominantly known by rapid population growth in urban areas, have a young and growing workforce. However, these countries are characterized by high level of economic growth the majority of citizens are not properly addressed on sharing benefits of this growth. The challenges of climate change on these developing countries are increase the intensity and frequency of droughts, floods, and fires; and reverse any gains in development and poverty reduction that the region has achieved or is expected to achieve in the coming decades (IPCC, 2013).

The main valuable services that forest provide for the environment is carbon sequestration. Traditionally, these services are clean air, nutrient cycling and watershed protection which in most cases they do not have payment. Such free-riding often leads to underinvestment in management and protection of environmental and natural resources, resulting in their degradation. Global warming due to unchecked emissions of GHG into the atmosphere is a case

in point. However, the level of understanding about the presence of well-established environment increased to think of market-based valuation of the environment services. Private firms and individuals can now buy and sell some environmental services as they do other goods and services, thereby providing an incentive for their owners to regulate their use (Jenkins *et al.*, 2004). Internationally, exchange of carbon offsets including carbon sequestration through forests represents the most mature example of these new markets for environmental services (Lecoq and Capoor, 2005).

The first large-scale project to yield carbon offsets through forests was established in 1992 in Malaysia stayed for six years. Over its project life, it helped to sequester 15.6 million tons of carbon dioxide. This is equal to 4.25 million tons of carbon (1 ton of carbon being equal to 3.67 tons of carbon dioxide) by regenerating 25,000 hectares of rainforest in the same country (Aukland *et al.*, 2002). Investments in the form of carbon sequestration projects thus represent valuable financial inflows for developing countries. Experience also suggests that, if undertaken with small land holders, carbon sequestration projects can help alleviate rural poverty and improve local livelihoods in developing countries (Tipper, 2002). Carbon sequestration projects may thus provide a win–win situation between environmental conservation and increased opportunities for economic development in poor countries (UNEP, 2002).

Ethiopia's per capita consumption of electricity was 24 kwh in the periods of 20 years back reported by FAO, 2005. It was one of the lowest consumptions in the world. Many households use other forms of energy, such as firewood, dung, gas, and charcoal. Deforestation is a major problem, amounting to some 140,000 hectares a year in 1990–2005(FAO, 2005). This

trend was continued progressively due to high population growth which leads to high demand of forest fuel consumption and fast increment of unemployment both in rural and urban areas. Thus, biomass fuels provide more than 90 per cent of total energy, with 77 per cent being derived from woody biomass, 8.7 per cent from crop residues, and 4.3 per cent from dung. Moreover, the gap between sustainable fuel wood supply and demand is widening, and estimated to have surpassed 58-ton cubic meters in 2005. This review document aimed assessing the level of carbon trade in African countries particularly from East, West & Southern part of the continent; assessing the opportunities of carbon trading in Africa and overviewing the critical challenges which African countries faced in carbon trading.

Literature review

The level of human activities like fossil fuel burning and deforestation are leading to global climate change. Thus, the atmospheric concentration of GHGs has been increasing rapidly. It is also widely accepted that global climate change would have adverse impacts on the socioeconomic development of many nations (Stern, 2007). The Kyoto Protocol was adopted by the international community in 2005 for minimizing the negative impact of this global warming on day-to-day life of world in general and less developed countries in particular. It sets out mandatory targets for industrialized countries to reduce greenhouse gas emissions by an average of 5.2% below their 1990 levels by 2008-12 (UNEP, 2004).

The implementation of Clean Development Mechanism (CDM) project was more preferable (along with Joint Implementation and Emissions Trading) for making climate change mitigation more cost-effective. For instance, while the cost of carbon sequestration projects in tropical countries (mainly

developing countries) could range from $0.10-$20 per ton of carbon, in industrialized countries it could range from $20-$100 per ton of carbon (IPCC, 2001). Clearly, for industrialized countries, investing in carbon sequestration in the developing world is a much cheaper option. In order to encourage reduction in actual carbon emissions at home, the Kyoto Protocol limits the use of carbon sinks from forestry and other land-based activities to only 1% of their base year emissions for each of the five years of the commitment period from 2008-2012 (Stern, N. 2008).

In addition to markets operating under the Kyoto Protocol, there are several other distinct carbon schemes or markets in operation today. Thus, rather than a single carbon market, several carbon markets operate simultaneously, creating linkages among them. These schemes all use market-based mechanisms to allocate and trade carbon credits that represent a reduction of CO_2 emissions (Ervine, 2014). Carbon transactions are defined as purchase contracts in which one party pays another party in return for GHG emission reductions or for the right to release a given amount of emissions that the buyer can use to meet its compliance or corporate citizenship objectives vis-à-vis climate-change mitigation (Landell, *et al., 2002*). Payment is made using one or more of the following forms: cash, equity, debt, convertible debt or warrant, or in-kind contributions such as providing technologies to abate GHG emissions. Carbon transactions can be grouped into two main categories: allowance-based which payment is made a head of any activity related to emission reduction is made and project-based which all payments made under the implementation of related projects on emission reduction. Transactions can also be categorized by whether the transaction is intended to meet emission limits under the Kyoto Protocol (Elizabeth *et al.,* 2008).

In carbon pricing which helps for mitigating climate change includes carbon markets, taxes and emission trading schemes, and technology-based policies. Carbon markets can help to provide the funding and additional financial incentives for the endeavors that provide opportunities to reduce GHG emissions while increasing community income. The overall problems of poverty can be tackled through carbon marketing is carbon offsetting and improved agricultural practices. With "carbon offsetting", poor people receive payments through carbon markets to engage in carbon sequestration. These are essentially cash transfers but carbon payments also have been used to support revolving funds for technical carbon expertise, such as Malawi's Trees of Hope project. "Improved agricultural practices" refers to increased revenue through improve yields of crop varieties as well as boosting the fertility level of soils at local, zonal as well as regional levels (Scherr and Sthapit, 2009).

In carbon trading, there are other ways which can include general livelihood diversification like increasing biodiversity. There is a spectrum between strictly carbon-offsetting projects that can have benefits for poverty reduction and rural livelihood improvement programs that can have carbon benefits. The former is typically long-term, while the latter is more orientated towards short-term livelihood needs (Bass, 2000). Review of several case studies suggests that the most important role for carbon sequestration payments is "facilitating the adoption of land-use systems that have higher returns even without sequestration payments, but which were inaccessible due to financial or social barriers" (Lipper and Cavatassi's, 2004).

The upcoming nature of projects based on agricultural activities on carbon trading relied on voluntary markets. Most of these have involved project-

based transactions, in which the buyer invests directly in emission reductions and get credits in return (Jindal, 2008). Thus far, carbon markets have not worked well for agricultural and terrestrial carbon, as markets have been biased toward industrial emissions and "buyer's short-term compliance needs rather than long-term mitigation potential" (Streck *et al.,* 2010).

In Kyoto protocol, there were three market-based mechanisms offered for carbon trading implemented by different nations to their emission targets. These are emission trading, joint implementation and clean development mechanism. In emission trading, it allows countries to buy carbon credits from other countries. The EU Emission Trading Scheme (EU ETS) is the largest market for GHG emission allowances. In 2008, the EU ETS market traded 3,093MtCO_2e, and the market was valued at $ 91.9 million (Capoor and Ambrosi, 2009). In Joint implementation, it allows big emitters to purchase carbon credits from emission reduction or emission removal projects in another less emitting countries party. In 2008, 20Mt CO2e of ERUs (Emission Reduction Unit) were transacted, valued at US$294 million, which represent a 50% decrease in volume as compared to 2007 (Capoor and Ambrosi, 2009). Similarly in Clean Development Mechanism, it allows project-based transaction those different parties of developed countries to accumulate carbon credits by financing carbon reduction projects in under developed countries (Hamilton *et al*., 2009).

Climate change mitigation is perhaps associated with boosting the carbon storage capacity of the land. However, the provision of adaptation options and keeping the natural resource-based livelihoods are highly associated with the presence of carbon both in biomass and soils. This helps to assess in many ways that are the beneficial for the range of ecosystem functions and services. Simply by being present, soil organic carbon (SOC) improves

soil structural stability and water holding capacity (Holm *et al*., 2003). The decomposition of organic carbon generates further direct benefits through the recycling of nutrients and maintenance of soil fertility (Stursova and Sinsabaugh, 2008; Scholes *et al*., 2009).

Agricultural emissions account for about 14 percent of total greenhouse gas (GHG) emissions. Furthermore, agriculture is the largest source of non-CO_2 GHG emissions, generating 52% and 84% of total methane and nitrous oxide emissions, respectively. Methane (CH_4) emissions come from organic materials decomposing in oxygen-deprived conditions such as irrigated rice fields, while nitrous oxide emissions are a result of excessive nitrogen which exceeds plant requirements (Smith *et al*., 2008). Carbon dioxide comes from microbial decay, burning of plant litter and organic matter. However, the net fluctuation of this gas in agriculture is thought to be small (Figure 1).

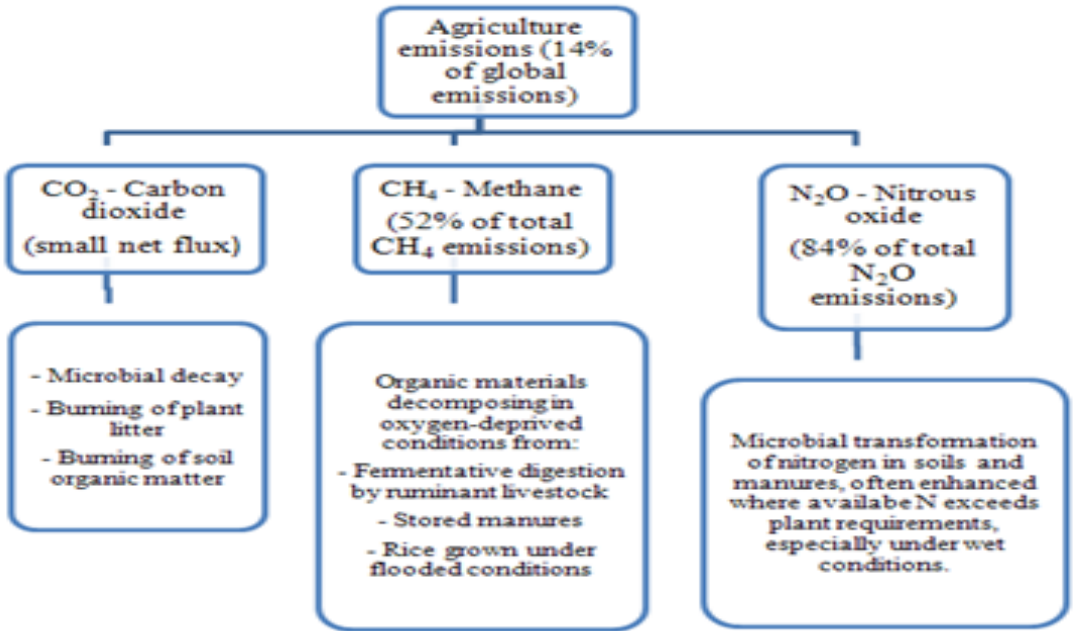

Figure 1. Agricultural GHG emissions

Adapted from: Smith et al. 2008, USEPA (2006b)

A deeper knowledge of the African potential to mitigate climate change through carbon sequestration and reduction of emissions is highly required by the current international climate policy. It is thus important to quantify both carbon stocks and fluxes of African forests and other ecosystems, especially in the context of the UNFCCC (United Nations Framework Convention on Climate Change) mechanisms, such as the Clean Development Mechanisms (CDM) of the Kyoto protocol, and the Reducing Emissions from avoided Deforestation and forest Degradation (REDD) (Bombelli *et al.,* 2009).

In carbon markets, buyers and sellers trade in 'carbon offsets' or 'carbon credits' which are units of carbon emissions reduced at source (for example by reducing consumption of fossil fuels) or units of carbon dioxide that have been absorbed by forests from the atmosphere (Landell-Mills and Porras, 2002). Broadly, these markets consist of two types of transactions (Lecoq and Capoor, 2005):

The first type is Project Based Transactions occur when a buyer invests directly in a carbon emission reduction or carbon sequestration program and gets emission credits in return, e.g. a company pays money to a local community in a developing country to raise forests and then claims carbon sequestration credits in return (Rosa *et al*., 2003; Scherr *et al*., 2001).The second type is Trade in Emission Allowances refers to commercial trading in carbon offsets under various regimes that have emerged in different parts of the world. These systems operate like equity markets with buyers and sellers trading well-defined carbon units at particular prices. Buyers do not invest in any particular project and they simply purchase carbon credits from sellers who may have actually invested in emission reduction or

carbon sequestration projects (Noordwijk *et al*., 2003). Opportunities of Carbon trading in Africa

The great opportunity of carbon trading in the continent of Africa is creating climate mitigating potential. In Africa, there are also potential advantages of establishing a local carbon market. These trading systems of carbon are more flexible, more affordable and better suited to the African environment (Shames & Scherr, 2010). A local emissions trading system could create a system that is more flexible. It also encourages local investment opportunity for African to invest on their respective countries (Bryan *et al*., 2010). An increase in CDM projects would in turn create more jobs, stimulate sustainable development and assist developed as well as emerging economy countries in meeting their respective commitments to climate change mitigation (Reddy, 2011).

The establishment of such a carbon market in Africa has been met with many challenges (UNFCCC, 2007). To unleash the huge potential for mitigation in Africa, carbon markets should be expanded to include projects related to agriculture, forestry and other land uses. A decade ago, the only land use, land-use change and forestry practices accepted by the regulatory market were afforestation and reforestation. Soil carbon sequestration projects and projects that reduce emissions from agricultural soils, such as changes in rice management practices, are excluded (UNFCCC, 2007). Land use and forestry sector are key to increasing emission reductions in the continent, where majority of the population depend on agriculture. There are also many areas where emissions can be avoided through ceasing of current land use activities (Bryan *et al.*, 2010).

In Sub-Saharan Africa (SSA) the role of land use change in controlling CO_2 emissions and annual Carbon budgets at regional and global scale may be more critical than in any other regions (Houghton and Hackler, 2006): with low fossil fuel emissions, Africa's current continental scale carbon fluxes are dominated by uptake and release from terrestrial ecosystems (which in turn are strongly linked to climate fluctuations) as well as forest degradation and deforestation (Williams *et al*., 2017). African forests contain large carbon stocks in biomass, up to 255Mg C ha^{-1} in tropical rainforests that appear to be particularly vulnerable, mainly due to the impact of climate change, land use change, population increase and political instability (IPCC, 2007a). All these changes and instability can lead to a significant decrease in ecosystem carbon stocks in tropical forests and savanna, at least without human countermeasures (Tan *et al*., 2009).

The level of benefits from carbon trading for African countries varies based on the primary objectives of mega projects implemented in respective countries. Scholars Rohit *et al., 2013* evaluated the benefits gained from 27 projects implemented in 14 African countries (Table 1). Accordingly, in Uganda there were 6 projects focusing on maintaining natural forest as well as expanding new forest territory. In these projects' implementation, local community gets the benefits of timber selling as well as utilizing other biomasses. In addition to these, there was an opportunity for selling carbon credits to World Bank who mainly supported the projects financially as well as other logistics. Similarly in Kenya and Tanzania, there were three projects each focusing on rehabilitation of degraded lands with forest and other plantations. In both countries, participating farmers on projects activities were received payments for carbon sequestration to carry out conservation activities which further maintain the forest resources for

prolonged time period. In Tanzania, Participating communities will receive cash and non-cash benefits for carbon sequestration. In countries like South Africa, Madagascar, Senegal and Mali they experienced implementing two projects each targeting similar objectives.

In South Africa, investors get the offsets of carbon and the community members were benefited by getting job opportunity in projects. In Madagascar, farmers involved in forestry projects for earning seedlings for free as well as enjoying other benefits shared with the community. There was a single project implementation in countries like Ethiopia, Mauritania, Sudan, Benin, Burkina Faso, Niger and Mozambique. In each of these countries, community members share the benefits of timber selling, infrastructure constructed and wage gained by serving the projects.

Table 1. Carbon sequestration projects in 14 countries across Africa

No.	Country	No. of carbon sequestration projects	Year	Nature of Benefit Sharing in Carbon trading
1	Ethiopia	1	2006	Biomass benefits will be shared with local communities. Carbon payments to improve local infrastructure and food security.
2	Kenya	3	2005, 2006	✚ Carbon rights transferred to CAAC. All others, viz. timber, NTFPs with Community ✚ Farmers were received payments for carbon sequestration to carry out conservation activities.
3	Uganda	6	1994-2012.	Carbon rights transferred to CAAC. All others, viz. timber, NTFPs with Community. Timber and other biomass (60% of the sale money) benefits goes to farmers. In addition to this, carbon credits with World Bank.
4	Tanzania	3	1999-2013	✚ Carbon rights transferred to CAAC. All others, viz. timber, NTFPs with ✚ Community Commercial plantation, all rights including carbon credits with the company. ✚ Participating communities will receive cash and non-cash benefits for carbon sequestration
5	South Africa	2	2004, 2005	Carbon offsets belong to the investor. Collectives of land owners in Port St. John receive direct payments for labor
6	Madagascar	2	2006	Some benefits including carbon payments will be shared with locals. Local farmers will get free seedlings and all benefits from the projects.
7	Mauritania	1	Since 2000	All benefits belong to community. Carbon credits not claimed.
8	Senegal	2	1999–2003	All benefits with local community. Carbon rights not traded.
9	Sudan	1	1995–2000	All benefits including timber and NTFPs belong to local community.
10	Benin	1	1992	Woodlots with all products belong to community. Information on carbon offsets n.a.
11	Burkina Faso	1	1997–2003	Carbon offsets with World Bank. All other benefits with community.
12	Mali	2	2002–2005,	All benefits with local communities. Gum, firewood etc. to be shared with locals. Deguessi-IER to sell carbon credits. ✚ Gum, firewood etc.to be shared with locals. Deguessi-IERto sell carbon credits.
13	Niger	1	2006	Gum, firewood and timber to be shared with locals. ASI will sell carbon credits.
14	Mozambique	1	Since 2003	Environmental trade buys carbon offsets from farmers by paying them in cash.
Total		27		

Adapted from Rohit *et al., 2013*

Challenges of Carbon trading in Africa

There are many reasons that Africa could fail to be benefited as expected from the huge international market of carbon trading. Despite the continent effort is very high in mitigating activities of evils created due to carbon emission; all earnings from the trade of carbon are not as expected for majority of African countries. Many scholars (Mulugeta, 2012; Pfeifer and Stiles, 2009; Hermwille, 2015) have all blamed this on uncoordinated attempts done by leaders of different African countries on regulatory and policy challenges of carbon emission from majority of western and some Asian countries. The scholars argue that the implementation thereof and global connections can make it a challenge for carbon trading to work. There have also been circumstances under which Baseline-and-credit for Clean Development Mechanism (CDM) schemes have resulted in the maltreatment of indigenous peoples and their environment. Others, such as Capoor & Ambrosi (2009) argue that cases of trade dishonesty and accounting inconsistency have hindered the development of these markets in Africa, with constraints ranging from the structure of the carbon markets themselves to Africa's own unique situation.

Several obstacles prevent African countries from taking full advantage of growing carbon markets. Among others, barriers are of biophysical, economical, social, institutional and political nature. Antle (2000) lists several important issues that need to be considered when designing carbon contracts. Among these are property rights, transaction costs, and uncertainty. Lack of property rights, including uncertain tenure and land ownership and weak legal institutions can limit the possibility to implement carbon contracts or hinder farmers' participation. Second, transaction costs can be very high and can considerably limit the money available for

farmers. Moreover, the quantity of carbon being sequestered is spatially and temporally variable. This generates a relatively high degree of uncertainty at the time the contract is traded.

According to Peskett *et al.* 2006, the major sources of conflicts and disputes in the region on carbon trading under both CDM and voluntary mechanism were uncertainty regarding who owns the carbon emission reductions. Another problem stems from farmers being tied into land use patterns which diverge from local practices known to be effective, which might increase farmers' vulnerability to shocks and economical fluctuations. Lack of modern education for farmers in project areas causes participating members of the community very much reluctant to share the benefits from the success of the projects implemented in their areas. Thus, project implementing actors as well as donors were looking relatively well-informed communities to exercise carbon trading. The level of success which respected projects on carbon trading in Africa can also be depend on the rise of obstacles occurred at specific project implementation areas particularly on local administrative issues, abuses of resources by project implementers as well as local leaders. There are also different types of conflicts rises while sharing the resources during implementation of the projects and benefits sharing.

Other problems relate to infrastructure like road which can serve in all-weather type, telecommunication facilities and electricity both hydro as well as solar energy are clearly observed in majority of African countries which affects carbon trading. Similarly, there are a loose linkage among institutions that have active roles in forest plantation, conservation and timber processing. There is also a problem of sustainable policy framework for natural resource conservation and lack of commitment from political leaders for conserving the resources (Roncoli *et al*., 2007).

Conclusions

The existence of trade in carbon can be taken as blessing for Africa with a certain level of challenges. The level of carbon emission from African countries is very low as compared with western countries like USA and some Asian countries like China and Japan. Even though African contribution is lower, the challenges due to uncontrolled carbon emission particularly attack the continent severely. In order to get out of such suffering, the issue of carbon trading is very much pertinent as well as timely. Thus, creating collaboration among African countries on voicing together about projects that potentially supported by high emitting countries. The supports can be financing conserving of natural resources like forests, setting reasonable price for carbon quota, technology support on modern utilization of energy conserving which can protect the forest resources.

The revenue collected from the sale of carbon should be shared among countries particularly which has a good courage as well as motives of conserving forest resources. This courage can help for countries having relatively weak strategic plan for taking lessons from well experienced countries on revenues sharing from carbon trading. This also more strengthen by offering modern technologies that can have a capacity of reducing carbon emission. The benefits from trading of carbon should fairly distributed for small holder farmers by directly creating job opportunity on forest plantation, conservation, building schools for their children, constructing health centers at different levels, roads can serve on all-weather type, telecommunication facilities and other means of revolving fund for the communities.

Internationally, all rules governing the level of carbon emissions both by developed and under developed countries are not implemented properly by different reasons. In developed countries, the big industries owned by private or state run for maximizing profits as much as possible. This act makes them to give less attention for conserving the environment. In less developed countries the level of production particularly agriculture follows relatively old technologies which lead more carbon emission to the environment. Thus, all developed countries should come onboard with strong rules and regulations that can limit the level of carbon which their respective companies emitted to the environment. Similarly, less developed countries should work hard for adapting improved agricultural technologies in respected field of specialization which can help less level of carbon emission to the environment. Issues related to carbon trading by quota agreement between western countries with the rest of the world should also not to be ignored. The amount of money budgeted for quota buying from less developed countries is increased with time frame and depending on the amount of quota bought. Companies should enjoy by buying more volume and be encouraged to buy more. The less developed countries should utilize the revenue earned from carbon trading by prioritizing the project implementing sites as well as making aware of the communities for sustainable utilization of resources.

The project implementation capacity of carbon trading on majority African countries is very poor due to many reasons. Among these, lack of skilled manpower particularly on project implementation, knowledge gap on local leaders about conserving natural resource, lower level of sense of ownership feeling on local people about forest, conflict of interest within the community members for conserving forest resources as well as problems of

maintaining trust on project leaders to bringing technologies that can conserve forest for a long period of time.

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