REDD+ SCHEME IN TANZANIA: IDENTIFYING POTENTIAL TYPES OF FOREST IN TANZANIA THAT PROVIDE COST EFFECTIVE IN REDUCING GREENHOUSE GAS EMISSION THROUGH REDD+ SCHEME.

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Abstract

While deforestation and forest degradation contributes nearly 20% of the global greenhouse gas emissions, still forests are being argued as the potential and relatively cost effective options for climate change mitigations. However through REDD+ scheme, which provides financial incentives to the local communities, will enhance sustainable forest management, and improve forest carbon stocks as well as reducing the level of poverty to the local communities in developing countries.

Using Tanzania mainland as a case study and through literature review, the study identified which types of forest in which region of Tanzania are likely to provide cost effective of reducing greenhouse gas emissions through REDD+ scheme. The study identified two types of forests namely miombo woodlands and mangrove forests. Miombo woodlands occupying about 96 % of the total forest in the country whereby out of that 57% are follow in village and general lands under open access management regime, which is the main focus of REDD+ policy. Miombo woodlands have a thick and close canopy cover that provides a potential feature with regard to carbon stock capacity hence being key forest type in climate change mitigation through REDD+ scheme.

The second forest type identified is mangrove forest, which cover about 108,000 hectare that is about 0.3% proportional of total forests in Tanzania. Mangrove forests have the highest carbon

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rich and have the largest carbon storage capacity than other tropical forest. Despite that mangrove occupy a small area in the country, are most cost effective forests in climate change mitigation. Finally the study concluded that, because mangrove forests are full managed by the government through Joint forest Management program, it is supposed to be reviewed so that its ownership to be handled to the communities. This will help to match into the current REDD+ scheme policy and will help to improve its management status compared to the ongoing current of overexploitation and the conflict between the government and the communities.

Keyword: Tanzania, REDD+ scheme, carbon emission, miombo woodland, mangrove forest, deforestation

Introduction

Tropical forests has been argued as the best tool for sequestering carbon in the atmosphere due to having lowest cost and high rate of storing carbon (Putz et al. 1993). However while there is a great relationship between deforestation and agricultural development in developing countries, the rapid human population growth, increase food demand and the rapid growth per capita has been fueling deforestation and forest degradation in developing countries (Phalan et al. 2011 and Foley et al. 2011). Furthermore while many industrial developed countries are the major contributor of greenhouse gas emission from burning of fossil fuels, developing countries also have a potential contribution of global anthropogenic greenhouse gas emissions (Venter et al.2012 & Donato et al. 2011). Moreover it is estimated that emissions from deforestation and forest degradation is the second to the fossil fuels and contributes about 17% to 20% of the entire global emissions of greenhouse gases (Agrawal et al. 2011).

Tanzania currently is well recognized in its effort of managing forest through involving local community and its advancement in community forest jurisdictions in Africa (Kajembe et al.2003). Participatory Forest Management (PFM) in Tanzania is the main forest management approach adopted since 2008 and it has produced several successfully pilot forest management projects (UTR 2013). According to the national forest Act No.14 of 2002 (URT, 2002), Participatory Forest Management is categorized into two forms namely Community Based Forest Management (CBFM) and Joint Forest Management (JFM). The first forms acknowledge that

the local communities are the main stakeholders in managing the village land forest reserves while second approach involve two stakeholders, the government forest managers and the local community living adjacent the national forest reserves. Moreover participatory forest management contributes a potential role in poverty alleviation of the local communities.

The government solely owns all land in Tanzania; it is a public good (URT, 2002). However the ownership tenure of forest under Joint forest Management is owned by the government where as under community based forest management the local communities have full ownership of village forest reserves (Blomley and Ramadhani, 2006). The local communities have a right to access any authorized forest products and services from the reserves such as timber and firewood (Kajembe et al. 2003). Tanzania currently is well recognized in its effort of managing forest through involving local community and its advancement in community forest jurisdictions in Africa (Kajembe et al.2003). Participatory Forest Management (PFM) in Tanzania is the main forest management approach adopted since 2008 and it has produced several successfully pilot forest management projects (UTR, 2001)

Research material and methods

This section presents description of the case of study and method used for collecting information that addresses the study.

Case study area description

Geographical location

The case study was conducted in Tanzania mainland that is located in the eastern part of Africa with a total area of about 947,300 square kilometers lying between the geographical coordinates of $6^0$00'S and $35^0$00'E. The country is bordering the Indian Ocean on the east side where as in the north bordering Kenya and Uganda, western part bordering Burundi, Rwanda and Democratic republic of Congo whereby in south part bordering Mozambique, Malawi and Zambia. With regard to the environmental issues the country is been challenged by soil degradation, deforestation, desertification and destruction of coral reefs that threatening marine organisms. Moreover the increasing of drought is affecting agriculture activities, wildlife and forest ecosystem.

Tanzania occupy about 33.55 million hectares of forest which make an approximately of 37.7% both natural and planted forests (Abdallah and Monela, 2007, FAO, 2002, Brendan et al. 2011 and URT, 2013). However out of the total forest area of Tanzania, 1.6 million hectares are classified under water catchment areas (MNRT, 1998).

Based on the definition above, forests in Tanzania are divided into three main types (miombo woodland, mangrove and other including plantations) whereby moimbo woodlands are the dominant forest type occupying more than 90 percent of the total national forest base as shown in table 2 (MNRT, 1998 and Burgess et al. 2010 and URT, 2013).

Research questions

Based on the general research topic, several questions were developed for addressing the main research topic. These are,

1. What types of forest are found in Tanzania?
2. What type of forest can provide cost effective avoided emissions through REDD+ scheme?
3. What is the management status of the selected forest type?
4. Can REDD+ scheme improve the conservation status as well as sustainable development of the local communities?

Method

Literature review

The method used to collect data during the study was through literature review. Literature review was undertaken through the uses of standard research skills of searching library catalogues and online journals. Literature review was done from different journals such as climate change, Journal of world forest resources management, environmental and resources, global change biology and geographical research letters journal.

Moreover annual reports from the Tanzania forest department and the national forest policy document were used in searching information for answering the research questions. However

searches of literature review was limited only to journal that relates to climate change, forest of Tanzania, carbon sequestration, forest degradation, greenhouse gas emissions from deforestation and forest degradation as well as REDD and REDD+ journals, reports and official websites such as United Nations- Reducing Emissions from Deforestation and forest Degradation (UN-REDD+), United Nations Framework Convention on Climate Change (UNFCCC) and Intergovernmental Panel for Climate Change (IPCC).

Limitation of the study

The study was limited by several factors. The major factor was lack of current information with regards to the;

- Status of forest cover in Tanzania
- The amount of carbon mean stock of forests
- The rate of deforestation

  This is due to the fact that all the information used are from the research undertaken from 1990 to 2013 only.

Literature review

This section presents an overview of literature with regard to the status of forest in Tanzania, management regime of forest, the role of REDD+ scheme in forest management and poverty alleviation and REDD+ scheme in Tanzania.

Status of forest in Tanzania

Tanzania is among of countries being rich in forest biodiversity and endemism (Burgess et al, 2010). However according to the statistics from FAO (2002) shows that the survival of forest reserves is being threatened due to high population growth, high demand of fuel wood, shifting cultivation, market, policy and institutional failure in managing forests. According to the human population census of 2012, Tanzania is supporting about 46million people having a population growth rate of 3% annually (PRB, 2012). Through shifting cultivation, settlement and demand of fuel wood as source of energy increases loss of national forest resources (Burgess et al, 2010,

FAO, 2010 and Msuya et al, 2011). Statistics from FAO (2002) and URT (2013) shows that from 1990 to 2010 the country has lost an average of 403,350 ha equivalent to the rate of 1.16% annually.

Management regime of forest resources in Tanzania

Different authorities manage forests in Tanzania due to the fact that they fall under different management categories such as National forest reserves, National parks, game reserves, nature reserves and village land (MNRT, 1998). However all forest within the national forest reserves, game reserves and nature reserves are managed by the central government through the Ministry of Natural Resource and Tourism (Department of forest and beekeeping and wildlife) whereby forest within the national parks are managed by Tanzania National Park Authority (TANAPA) and forest within the general village land are managed by local councils through the district council (department of natural resources (Burgess et al, 2010). Moreover whether they are managed under different regimes forest in Tanzania (except forest plantations) are100 percent owned by the government whereby about 13 million hectares are gazetted as forest national reserves having high biodiversity and endemism values (MNRT, 1998, Brendan et al, 2011 and Msuya et al, 2011). Tanzania being the poor country with high population growth rate, agriculture is the main economic activity contributing about half of the national GDP by providing about 85% of total export and employing about 80% of Tanzanian (Abdallah and Monela, 2007 and FAO, 2002).

Carbon emissions from deforestation

While burning of fossil fuels being the major contributor of greenhouse gases emissions to the atmosphere, it is followed by the greenhouse gases emissions from deforestation and forest degradation (Harris et al, 2012 and Scott et al. 2009). Harris et al, (2012) argued that during 2000 to 2005 carbon emissions from deforestation and forest degradation, Latin America countries were the top emitters contributed about 54 % of the entire global emissions followed by south and Southeast Asia countries which contributed about 32% and last are sub Saharan countries contributed about 14 percent of the total emission. Moreover the breakdown for each country shows that Brazil were the most emitter followed by Indonesia which both contributed about

55% of the entire greenhouse gases emission from deforestation while Tanzania was the least country.

Normally carbon emissions from deforestation are determined with the consideration of the total area of forest being removed, rate of the carbon cleared and the total biomass of the forests (Ramankutty et al, 2007). Daniel (2012) and Houghton (2005) have pointed out that tracing deforestation emission from the source is very challenging unlike to burning of fossil fuels where their sources are easy to identify and to measure. There is an increasing rate of greenhouse gases emissions from Land Use, Land Use change of Forest (LULUCF) due to increases in clearing of forest cover in most of developing countries which supports large amount of tropical forests (Harris et al, 2012). Furthermore according to the baseline map for carbon emissions from tropical forests from 2000 to 2005 the estimation of emitted carbon to the atmosphere was about 0.81 pentagrams annually.

The role of REDD+ scheme in forest management and poverty alleviation

Agrawal et al, (2011) argued that the main scope of REDD+ scheme is to minimize the emissions resulted from all activities of deforestation and forest degradation, improve conservation, sustainable management of forests and reduce poverty level in developing countries. Miles and Kapos (2008) and Esteve et al, (2010) both have argued that through the implementation of REDD+ landowners and the communities will be able to receive financial incentives through "Payments of Ecosystem Services that will motivate them in sustainable forest management hence help to reduce the greenhouse gases emissions.

Venter et al, (2012) added that REDD+ scheme is the most cost effective way of reducing greenhouse gasses emissions compared to other abatement methods like Carbon Capture Storage. Developed countries find cheaper to meet the greenhouse gas reduction target through funding carbon offset projects in developing countries through Clean Development Mechanism (CDM) (Esteve et al, 2010). In regards to minimizing cost of an organization in carbon-offset project and rising efficiency, forests are the best option (Miles & Kapos 2008).

Furthermore the achievement of climate change mitigations will be faced with several challenges in most of developing countries. Knoke et al, (2012) pointed out that it is estimated that by 2050 there will be an addition of global human population of about 2.2 billion people whereby the

great increase will occur in developing countries. Therefore the increase of human population will results into high demand of food and energy supplies (Phalan et al, 2011). Foley et al, (2011) pointed that in poor countries agricultural system is mainly based on subsistence and shifting cultivation through clearing the forestland. Meanwhile one of the strategies used to mitigate food shortage is through conversion of more forestland into cropland that will maximize the yield production (Knoke et al, 2012). Additionally currently there is an increase of non-food products production such as biofuels and animal feeds that also motivates deforestation and forest degradation (FAO, 2010 and Miles & Kapos, 2008).

Furthermore research data from Burney et al, (2010) and FAO (2012) shows that agricultural expansion and intensification has been the major threats into the survival of the tropical forests. Also the statistics shows that from 1961 to 2005 crop production has increased by 162% and land agricultural expansion of about +27%. Also Angelsen (2010) argued that in developing countries that support a lot of tropical forests the agricultural production has rise up by 3.3-3.4% every year that has resulted clearing forests due to shifting cultivation. Moreover Foley et al, (2011) added that the rise of agricultural expansion has resulted into forest deforestation and degradation hence increasing the amount of greenhouse gasses emission into atmosphere. Therefore the best achievement of REDD+ scheme in developing countries will depend on the level of consideration between population growth, agriculture and forest sectors due to having a close relationship (FAO, 2009).

REDD+ scheme in Tanzania

Tanzania is among of the nine pilot countries worldwide under the United Nations Reducing Emissions from deforestation and forest Degradation (UN-REDD+) scheme in developing countries (Burgess et al, 2011). Despite the fact that the UN-REDD was initiated in 2008, its implementation started in 2012 and Tanzania has already submitted the national REDD+ strategy plan on April 2013 (URT, 2013). The decision to include Tanzania in the pilot projects is due to being advanced in participatory forest management and having potential forests resources among sub Saharan countries that will provides lowest cost in reducing greenhouse gas emissions under REDD+ mechanism (URT, 2013). Therefore REDD+ will help to improve the conservation

status of forests together with enhancing both social and economic conditions of the local communities in Tanzania (Mukama, 2010).

Reducing Emissions from Deforestation and forest Degradation (REDD+) policy focuses on the management of forests that are managed by the local communities (Burgess et al, 2010 & Ramankutty et al, 2007). Whereby Tanzania has about 15.4 millions hectares which is about 57% of the total forest are under open access follow under village and general land which all these will be included by REDD+ scheme (URT, 2013). Furthermore out of 15.4 million hectares, about 4.12 million hectares of forest in 2,323 villages are being managed under Participatory Forest Management (MNRT, 2008). This include successful village forest reserves that are very potential cost effective avoided greenhouse gas emissions example of Angai village land forest reserve, which have an area of approximately 139,420 hectares, located in Lindi region and Suledo village land forest reserve covers an area of about 150,000hectares located in Arusha region (Mustalahti et al, 2012). Participatory Forest Management seems to be achieved a great success especially on delegating the power of managing forest in Tanzania to the local communities that resulted into setting aside several village forest reserves. However Kajembe et al, (2003) and Campbell (2003) argued that despite of this success, local communities lack sufficient financial incentives to enhance management of forest hence converting forest for agriculture activities.

REDD+ scheme as a financial based mechanism under the United Nations Framework Convention on Climate Change (UNFCCC) will help to provide financial incentives to the local communities through selling of carbon credits. Therefore the financial incentives from selling of carbon credits will help to improve sustainable management of forest. Apart from financial benefits, REDD+ program aiming to enhance the capacity building to the national and districts forest officers and the local communities in measuring, reporting and monitoring forest pilot projects in selected villages (Burgess et al, 2011).

Results and discussion

Two main types of forest were identified during the study namely miombo woodlands and mangrove forests. These types were selected based on its distribution, management regime and physical features as far as carbon rich and carbon storage capacity is concerned, that will provide

lowest cost in reducing greenhouse gases emission through REDD+ scheme. Refer table 1 below that shows all three main types of forest in Tanzania but the study identified only two types (miombo and mangrove forests).

Main forest types found in Tanzania

Forest type	Area (000,ha)	% Proportional
Miombo woodlands	32,299	96.3
Mangrove	108	0.3
Other forest type +plantation	1,141	3.4
Total	33,555	100.0

Table 1: Types of forest found in Tanzania

Source: Wang et al, (2003)

Another finding during the study was the carbon mean stock value of forest. The study shows that carbon mean stock of the forest is directly proportional to the physical features of the tree particularly percentage of canopy cover above, size of forest area and the height of the tree below or above the ground (Saatchi, 2011). Tree with canopy cover of 30% or more showed to have more carbon mean stock than trees with 10% and 25% canopy cover. The carbon mean stock estimation undertaken in 2010 showed that forest of Tanzania contain about 2,715 millions metric tons of carbon in living forest biomass refer the table 2 below.

Forest definition Canopy cover %	**10% tree cover**	**25% tree cover**	**30%tree cover**
Forest area (Mha)	34	17	11
Aboveground forest carbon (MtC)	1,073	585	418
Belowground forest carbon (MtC)	332	179	418
Total forest carbon (MtC)	1,406	764	545
Average carbon density (tC/ha)	42	45	48

M=Million, t= metric tons

Source: www.rainforest.mongabay.com/Tanzania. Viewed on 15th May, 15

Table 2: Tanzania forest categories and carbon mean stock values

Tanzania supports a total forest of about 33.55 million hectares whereby about 16 millions hectares are within the forest reserves and 2 millions are within national parks under full

protection by the central government and the remaining of about 15.4 million hectares are within village and general land characterized with open access property regime (URT 2013). Moreover Burgess et al, (2010), Msuya et al, (2011) and URT (2013) both have pointed that 57% of the entire forest resources are under open access whereby 43% are under protection and the open access property regime of forests mainly its conservation initiatives are faced by lack of land tenure, shifting cultivation, wildfire, over extraction for timber, poles or fuel wood, overgrazing and being converted into other land uses.

Miombo woodland in Tanzania

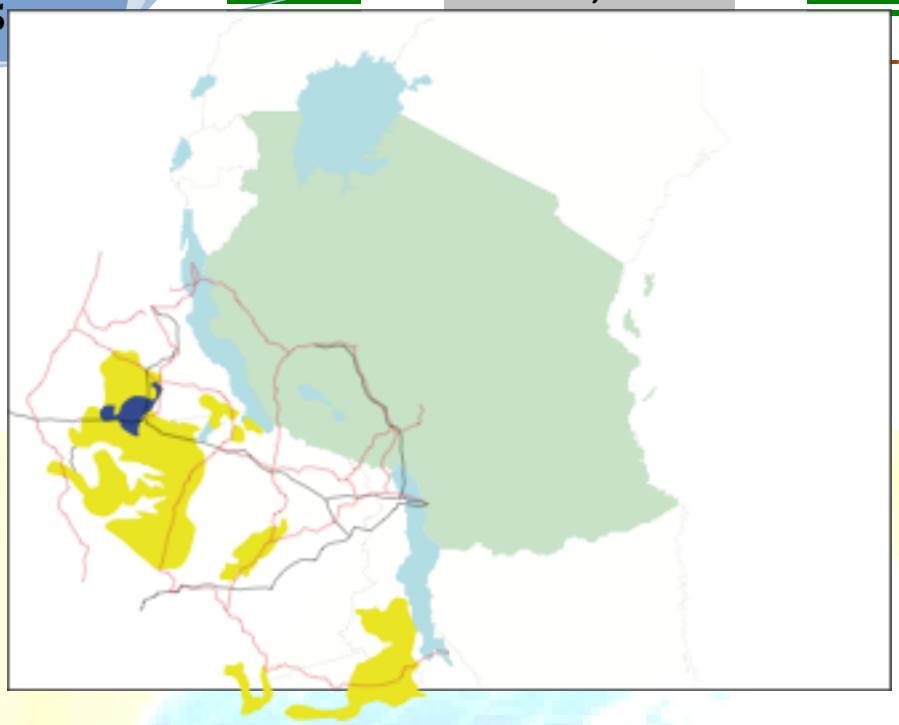
Backeus et al, (2006) argued that miombo is derived from a vernacular language (Swahili language word) adopted by ecologists during characterization of woodland ecosystem covered by trees belong to genera *Brachystegia, Julbarnardia* and *Isoberlinia* (Leguminosae, sub family *Caesalpinioideae*). Forest of Tanzania is mainly dominated by miombo woodland which cover about 96% of the total forest type that is equivalent to about 44.6 million hectares out of which 54% are found in the village and general land with open access (URT, 2013, Mukama, 2010, Burgess et al, 2011, Kajembe et al, 2003, Burgess et al, 2007, Mgeni and Price, 1993 and Mwampamba & Schwartz, 2011). The major miombo species found in Tanzania are *Brachystegia* and *Jubernardia* whereby the other species are *Ptreocarpus angolensis*, *Albizia sp* and *Afzelia quanzesis*. Makundi and Okiting'ati (1995) argued that miombo woodland is considered to be the most effective type of forest in storing large amount of carbon hence reducing greenhouse gas emission from the atmosphere. Moreover its significant to REDD+ scheme has been contributed by its physical features of having height more than 5m (Mustalahti et al, 2012).

Dondeyne et al, (2004) argued that most of miombo woodlands have thick canopy cover more than 25%, closed, with large and broad leaves and deciduous moist which help to store large amount of carbon. Furthermore its understory and herbaceous shrubs and grass also improve to maintain the soil hence increasing storage capacity of soil carbon. The miombo has high species composition and richness that also provide a potential characteristic of miombo woodland to have lowest cost avoided emissions outcomes through REDD+ scheme (Mukama, 2010).

Distribution of miombo woodland in Tanzania

Sedano et al, (2005) argued that the distribution of miombo woodland in Tanzania is highly influenced with the climate condition of different parts of the country that also dictates the type of miombo woodlands. The classification of miombo woodland is been classified into several categories namely tropical, subtropical, grasslands, savannah and shrubs (White, 1983). However the woodlands can be grouped into two major groups according to where they are found. White (1983) and Eye (1985) described the two types of miombo woodlands, wet miombo woodlands that occur in the areas with maximum rainfall of more then 1000mm per year. The vegetation is floristically rich with large, broad and evergreen leaves with thick canopy of more than 15m high. As described above having large evergreen leaves makes miombo woodlands to be one of the forest types that provide lowest cost avoided emissions through REDD+ scheme. The second type is dry miombo woodland that occurs in areas that receive a rainfall less than 1000mm per year, having canopy less than 15m high and the vegetation are floristically impoverished.

The concentration of miombo woodlands in Tanzania differs from one part to another. However because most part of the country is wet, therefore large part of Tanzania is dominated by wet miombo woodlands than dry miombo woodlands (Backeus et al, 2006). Sauer and Abdallah (2007) described that the major concentration of miombo woodlands in Tanzania are found in three main parts, these are Western zone of Tanzania covering the regions of Kigoma, Tabora and Rukwa which are dominated by wet miombo woodlands, Southern part of the country covering the regions of Iringa, Lindi, Mtwara and Ruvuma also dominated by wet miombo woodlands and the last part is central covering the regions of Dodoma, Singida and Shinyanga dominated by dry miombo woodlands (URT, 2013 and URT, 2001) refer the map 1 below



Map1: Map of Tanzania showing the distribution of miombo woodlands.

N.B; **Yellow color**- indicates miombo woodlands.

Source: Abdallah and Monela, 2007

Example of expected pilot REDD+ scheme project of miombo woodland in Tanzania

As described earlier that currently there are several successful forests management under participatory forest management in Tanzania that it is obvious that these projects will be adopted by REDD+ scheme. One example is the Angai Village Land Forest Reserve (AVLFR) in Lindi region.

Angai Village Land Forest Reserve (AVLFR)

Angai Village Land Forest Reserve (AVLFR) located in Liwale district, Lindi region, comprises of 13 villages and covering an area of about 139,420 hectares of forests dominated by miombo woodland species (Mustalahti et al, 2012). These villages were formulated in 1970s during the period of villagization (Ujamaa). Moreover the 13 villages form an association known as "Muungano wa Hifadhi ya Msitu wa Angai" – (MUHIMA), in other word is the Association of Angai Forest Reserve which was established legally in 2001. Lindi region is located in

southeastern part of Tanzania and is among of the poorest region with low and dispersed human population but very rich in natural resources (FAO, 2010). The natural resources include wildlife, ocean and high diversity of forest from miombo woodland, shrubs to mangrove forests.

AVLFR is very rich in vegetation as pointed above that the main forest species is miombo woodland, which are compressed, locked forest and found along the rivers and in dry places. Dondeyne et al, (2004) argued that the reserve comprises different forest species whereby about 133 tree species are already identified and well known. However due to richness in forest biodiversity, make Angalia Village Land Forest reserve to be very successfully under participatory forest management and also it is expected to be more successful under the coming REDD+ program (Mustalahti et al, 2012).

Carbon stock in Angai Village Land Forest Reserve

The carbon stock within the forest in AVLFR is highly influenced by two major factors namely the size of the reserve and the level of protection of the forest (Burgess et al, 2011 and Mustalahti et al, 2012). AVLFR is among the largest reserve under the Tanzanian Group on Earth Observation forest Carbon Tracking National Demonstration Project (Mustalahti et al, 2011 and Mukama, 2010). Moreover according to the results carried out by Mukama (2010) during measuring the carbon sock of the forests in only three villages within AVLFR in 2010, the reserve has a potential carbon stock of about 332.81 – 266.4 MgC, 163.42 – 139.01 MgC and 120.23 – 102.56 MgC in Mihumo, Ngongowele and Ngunja village respectively. The total area covered during carbon stock measurement was; Mihumo 11,792 hectares, Ngongowele 8,285 hectares and Ngunja 6,626 hectares summing up a total area of 26,703 hectares only out of 139,420hectares of the entire reserve. Despite the results shows low carbon stock per hectare, however when it is compared with the total area of the reserve it has a potential carbon stock potentially for carbon trading.

Mangrove forest in Tanzania

The second forest type identified that can provide lowest cost of reducing greenhouse gas emission under REDD+ scheme was Mangrove forest. In Tanzania mangrove forests occupy an area of about 108,000 hectares out of 33.555 million hectares of total forests in the country (Wang et al, 2003). Mangrove forests are located along the entire coastline of Indian Ocean from

northeast part in Tanga region up to the southeast in Mtwara region. Whereby about 50% of the mangroves are found in Rufiji delta, which contain the largest continuous block of mangrove forest in Africa (Mangora, 2011 and Beymer-Farris & Bassett, 2012). Moreover for many decades mangrove has been playing a potential role in maintaining the coast ecosystem as well as contributing to social and economic importance to local communities. Mangrove forests provide shelter, food and breeding area for many marine organisms including fishes, shrimps, crabs and oysters. Moreover local communities depend on mangrove for timber, medicinal, poles, fodder, honey and fuel wood. In this regard, mangrove forest improves the standard of living of the local communities living along the coast.

Management status of mangrove in Tanzania

Tanzania was the first country in Africa to undertake inventory of mangrove forests and preparing mangrove forest management plan in 1991 (Semsi, 1992). Unlike to the terrestrial forests, the management of all mangrove forest is full protected by the central government under total protection only (Beymer-Ferris & Bassett, 2012). The conservation status goes back since 1957 during the colonial period when the owner right from the communities was transferred to the central government. Furthermore the formulation of the National Forest Act in 2002 improved the restriction of any uses of mangrove forest together with prohibiting the expansion of rice plantations along the coast that affect its conservation status.

As noted earlier on the type of participatory forest management in Tanzania, the management of mangrove is through Joint Forest Management (JFM). Through this approach the government managing jointly with the villagers especially on employing village forest guards for law enforcement (Mangora, 2011).

Distribution of mangrove forest in Tanzania

There are nine species of mangrove in Tanzania mainland that belong to six families of Rhizophoracea, Sonneratiaceae, Avicenniaceae, Combretaceae, Sterculiaceae and Meliaceae. However mangrove from the species of *Rhizophora mucronata* and *Avicennia marina* are dominant in Tanzania (Wang et al, 2003 and Semsi, 1992). Mangrove forests are distributed in four coast regions namely Tanga, Pwani, Dar es Salaam, Lindi and Mtwara (Table 3 below). Wang et al, (2003) argued that there is an increasing pressure in overexploitation of mangrove

forests due to the fact that the Joint management approach seems to be not involving local communities directly than community based forest management approach. Therefore because mangrove forest worldwide known to be potential in terms of having lowest cost in avoided greenhouse gas emission through REDD+), there is a need for the government to handle the ownership to the local communities which will fit into REDD+ policy (Beymer & Shurcliff, 1997). However for the purpose of management there are ten regions as shown in the table below.

Region/District covered with mangrove forests	**Area (ha) covered with mangrove forest**
Muheza and Tanga	9,403.3
Pangani	1,755.6
Bagamoyo	5,635.8
Dar es salaam	2,168.2
Kisarawe	3,858.3
Rufiji	53,254.8
Mafia	3,438.7
Kilwa	22,438.7
Lindi	4,546.5
Mtwara	8,941.5
Total	**115,475.6**

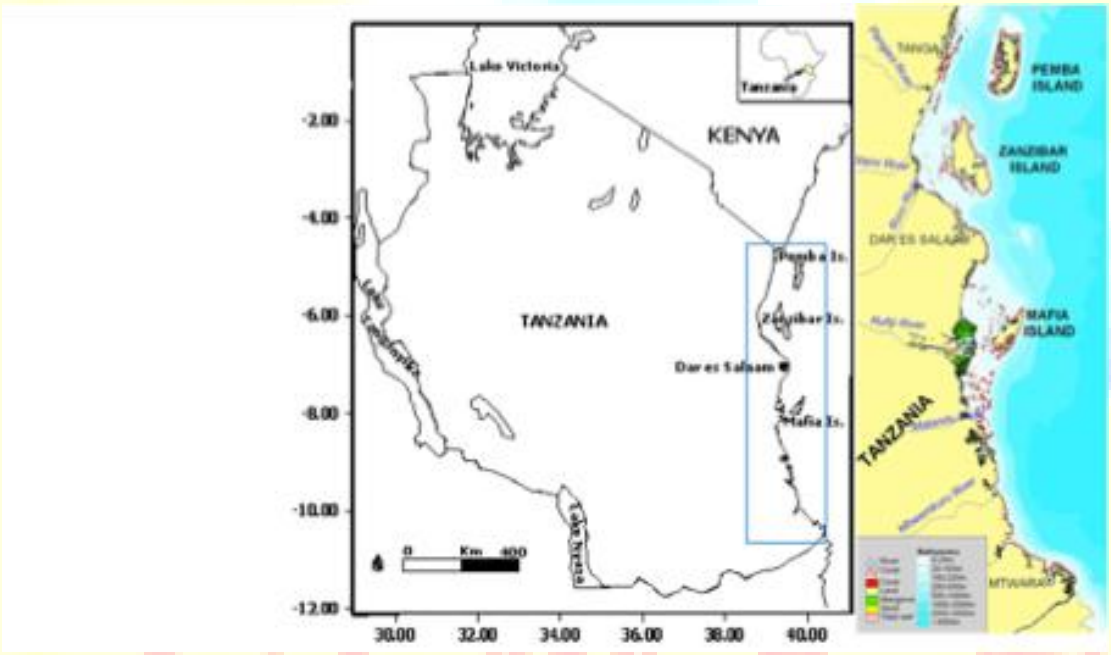
Table 3: Areas/region covered by mangrove forest in Tanzania

Source: Semsi, 1992.

The role of mangrove forest in providing lowest cost avoided emissions through REDD+ scheme in Tanzania

The scientific studies conducted by Donato et al, (2011) argued that mangrove forest in Tanzania have the highest carbon rich and have largest carbon storage capacity than other tropical forests, which is supported by its physical features and its ecology. They argued that mangrove contain carbon mean stock of 1,023MgCha-^{1} . However above ground contain carbon mean stock of about 159MgCha-^{1}, with a maximum of 435MgCha-^{1} and below ground carbon stored in soil contain 71 – 98% and 49 – 90%. However while coastline areas are already experiencing climate

changes consequences such as rising of sea level, increasing of ocean acidification and increasing of storm that already is affecting marine organisms and the environment, mangrove forest are being argued as the forest that can enhance climate change mitigations along the coastlines (Wang et al, 2003 and Beymer-Farris & Bassett, 2012). Most of the people living along the coastline economically are poor hence it has increased the rate of clearing mangrove forest for rise farming. Therefore through REDD+ scheme local communities will receive financial incentives that will help to improve management status of mangrove forest in Tanzania.



Map 2: Distribution of Mangrove forest along the coastline of Tanzania (blue line square)

Source: Mangora, 2011 and Wang et al, (2003).

Can REDD+ scheme promote deforestation in Tanzania?

The study also identified that the initiation of REDD+ scheme in Tanzania in one way or another will promote deforestation.

First the findings show that for the selected pilot project before entering into contract between REDD+ and the local communities, people might cut down trees for timber and other uses

because they will know that after signing the contract they will no longer be allowed. This is because under community based forest management, forests are been used by local communities on sustainable bases for timber and other uses like collecting fuel wood.

Secondly, REDD+ scheme will motivate more deforestation in government forest reserves. Because local communities will be signed contract with REDD+ then the village forest reserve will be under total protection. Therefore the only source of forests for timber and other uses will be the national forest reserve. Therefore there is a need to reverse the REDD+ policy start financing the government forest reserve management this is because in most developing countries there is a deficit of money for law enforcement and management activities (Kajembe et al, 2003)

Conclusion

The study findings identified that miombo woodlands and mangrove forests can provide a cost effective way of reducing greenhouse gas emissions through REDD+ scheme in Tanzania. While miombo woodlands are concentrated much in western and Southern part, mangrove are just concentrated along the coastline of Tanzania. Moreover while about 57% of miombo are under open access in the village general lands this makes them to benefit with REDD+ scheme policy. Furthermore all 108.000 hectares of mangrove forests are under full management by the government through Joint Forest Management approach that does not involve fully the communities. This is the major contributor of deforestation and ongoing conflicts between the government and the communities. Therefore the study suggest that in order to improve the management status of mangrove forest in Tanzania, the government must handle the ownership right to the community whereby it will be adopted by REDD+ scheme and improve its management.

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Glossary/Appendices

The following terminologies are defined according to the Tanzania Forest Policy of 1998 and the National Forest Act of 2002.

'Tree" includes palms, bamboos, shrubs, bushes, plants, poles, climbers, seedlings, saplings and the re growth thereof all ages and all kinds any part.

"Forest" – means an area of land with at least 10% tree crown cover, naturally grown or planted, and /or 50% or more shrubs and trees regeneration cover which includes all forest reserves and providing shelter to livestock and wildlife.

"Forest land" means an area of land covered with trees, grass and other vegetation but dominated by trees.

"Forest land lease" means that the forest land or the land that is suitable for afforestation is leased to the private sector. However the lease is renewable and the government earns lease fees.

"Forest products" include all wood and non-wood forest products.

"Forest resources" include all wood and non-wood based resources in the forest.

"Forest reserve" is a forest area, either for production of timber and other forest produce or protective for the protection of forests and important water catchments, controlled under the forest ordinance and declared by the Minister.

"Village forest reserve" is a forest that is owned and managed by village government.

"Joint forest management" means the involvement of local communities and the governmental in the management and conservation of forests and forestland with appropriate user right as incentives.