International Scholars Journals

Advances in Food Science and Technology ISSN: 6732-4215 Vol. 13 (5), pp. 001-010, May, 2025. Available online at www.internationalscholarsjournals.org © International Scholars Journals

Full Length Research Paper

REDD Project in Ugalla-Masito Ecosystem: Exploring Carbon Credit Potential and Community Perspectives in Kigoma, Tanzania

Nicholaus Fabian Mwageni*, Riziki Silas Shemdoe and Robert Kiunsi

Ardhi University, P.O. Box 35176, Dar esSalaam, Tanzania.

Received 4 August, 2024; Accepted 23 February, 2025

The paper presents results of the potential carbon credit and community expectations towards viability of REDD+ projects in Ugalla- Masito ecosystem using a case of Ilagala and Karago villages whereby REDD+ is being piloted. Various data collection methods were employed and these included focused group discussion, interview, structured questionnaires and document analysis. Results of the study indicate that, there are two suggested payment sharing approaches associated with different preferences at both household and village government levels. These include cash payments to households for compensating the opportunity costs incurred and the second is that funds should be given to village government for community developmental projects. Analysis of the opportunity costs, marginal (incremental) revenues from forest carbon stock as well as the conceptual trend of forest biomass indicates that, there is probability for the project to flop in a very short time. Therefore, in order to ensure the future viability of REDD+ and its associated projects as well as ensuring sustainability of people's livelihoods, any REDD+ associated activities should harmonize community preferences and balance them with project goals by supporting communities in their alternative livelihood activities.

Key words: Carbon stock payments, community preferences and REDD+ project viability.

INTRODUCTION

Carbon exists on the earth's atmosphere primarily as the gas-carbon dioxide (Vashum and Jayakumar, 2012). In the recent past, it has gained a lot of attention as a chief among the greenhouse gases, as it has potential to influence the climate pattern of the world. Why carbon emission drew much attention is because carbon dioxide has long residence time in the atmosphere compared to other greenhouse gases (Brown, 1993).

Forest's ecosystem is one of the most important carbon sinks of the terrestrial ecosystem. It removes the carbon dioxide from the atmosphere during photosynthesis and stores the carbon in the plant tissues, forest litter and soils. This process is more prolific in a relatively new forest where the growth of the trees is still rapid and it

*Corresponding author. E-mail: nicholausmwageni2012@gmail.com. Tel: +255712790905.

decreases as the forest gets old. The carbon stored on the forest trees are mostly referred to as the biomass of the tree or forest, and the carbon concentration of the different parts of a tree is assumed to be 50% (Brown, 1986) or 45% of the dry biomass (Whittaker, 1973). Nevertheless, according to a study conducted by Lugo and Brown (1992), it was revealed that half of the so called matured forests could also sequester carbon in a rate that could be further increased if human pressures like deforestation and forest degradation activities are reduced or removed from the forests.

These activities have tremendous impacts on biodiversity and carbon emissions and hence on the world's climate. IPCC (2007) highlighted that, tropical deforestation and forest degradation accounts for approximately 18-20 % of global greenhouse gas emissions. As a result, current approaches to address climate change include strategies to reduce emissions from deforestation and forest degradation (REDD) through forests conservation practices of which has captured international attention (Stern, 2006; IPCC, 2007). The United Nations Framework Convention for Climate Change (UNFCCC) of 2010 introduced REDD strategy as the financial mechanism compensating countries for the prevention of deforestation and forest degradation that would otherwise occur.

The 2009 Copenhagen accord of the UNFCCC recognized REDD as a valid mitigation strategy and has increased interest in and funding it. Alongside effective greenhouse gas mitigation, the international accord emphasized that REDD may offer other co-benefits like ecosystem restoration, improved land tenure and socioeconomic development due to carbon market that will increase the income of forest communities which has been referred to as REDD+.

Carbon market mechanisms convert emissions reductions from REDD initiatives into carbon credits that industries and countries can use to comply with emissions commitments. The basis for carbon market community-based forestry initiatives, from a business perspective, is a legal contract between the buyer of the carbon credits and the seller (the communities). In many instances intermediaries will pay a key role moving the credits from the level of production (the community forest) to the marketable place (TNRF, 2008). Several payment mechanisms under REDD initiatives do exists. One of them is based on a national level carbon fund that would be the recipient of financial flow for avoided deforestation, carbon credit sales and so on.

In Tanzania, the fund-based approach has been argued to fit with the realities of communal land and forest tenure under village governance and participatory forest management (Burges et al., 2010). The first is an effort-based payment, which rewards communities for improved forest management activities. The second is an output-based payment, which rewards forest managers for empirically verified outputs such as improved forest condition and reduced deforestation (TFWG, 2010). The effort-based approach would reward villages equally even when their ownership of forest resources and utilization of village differs. The output-based approach would benefit more communities who have increased their carbon stocks and are able to demonstrate it by carbon baseline, monitoring and calculation (Bolin et al., 2012).

Kigoma region is one among the areas in Tanzania where REDD project has been piloted. Communities have accepted REDD project implementation with anticipation that the project will be compatible with their local poverty reduction strategies and development goals. In this regard, communities in REDD project areas have been foregoing forestry products despite the fact that their demand is very high compared with what the district or region can supply. These include firewood and charcoal (frequently used for sale or fuel) and timber and building poles (URT, 2009). Thus, there is opportunity cost behind acceptance of REDD project implementation since local communities have been losing income they used to accrue from forestry products. This paper, therefore, confines itself at implication of the potential carbon credit and community expectations towards viability of REDD projects using a case of Ilagala and Karago villages located in Kigoma whereby REDD+ has been piloted. This paper therefore presents the results of the study on the adequacy of potential carbon credit in meeting local priorities and needs as far as the viability of REDD project is concerned using the case of the two above mentioned villages in Kigoma Tanzania.

MATERIALS AND METHODS

Study area

Presence of REDD pilot project and low income communities depending on the forest ecosystem goods and services, were used as the basis for selecting Ilagala ward where Ilagala and Karago villages are situated (Figure 1). The villages are among the seven villages forming Masito-Ugalla Ecosystem where the international Non-Governmental Organization (NGO) (Jane Goodall Institute (JGI)) has been implementing REDD+ pilot project. The villages are located along Lake Tanganyika shoreline within Kigoma rural District. The REDD implementation approach in these villages link with participatory forest management (PFM).

Karago village is bordered to the north by the Ilagala village, to the south by Sunuka village, to the east by Masito-Ugalla forest reserve and southeast by Songambele, and to the west by Lake Tanganyika. It has 8,703 people (about 1600 households) (2012, census) and a land area of 11,218.88 ha has reserved five forests with a size of 5646.49 ha (Figure 2). However, the village has agricultural land of 5137.88 ha and 432 ha for settlement.

On the other hand, the Ilagala village is bordered to the north by Mwakizega village, to the south by Karago and Songambele villages and east by Masito-Ugalla forest reserve, and to the west by Lake Tanganyika. The village has 21, 246 people (about 3500 households) (2012, census) with a land area of 23,840.13 ha and has reserved three forests with a size of 3402.2 ha (Figure 3). However, the village has agricultural land of 14879.91 ha, 4904.85 ha for settlement and a reserved forest for mining activities of 653.17 ha.

Agriculture is the major source of income in Karago and Ilagala villages. If the area under crop cultivation is distributed equally to

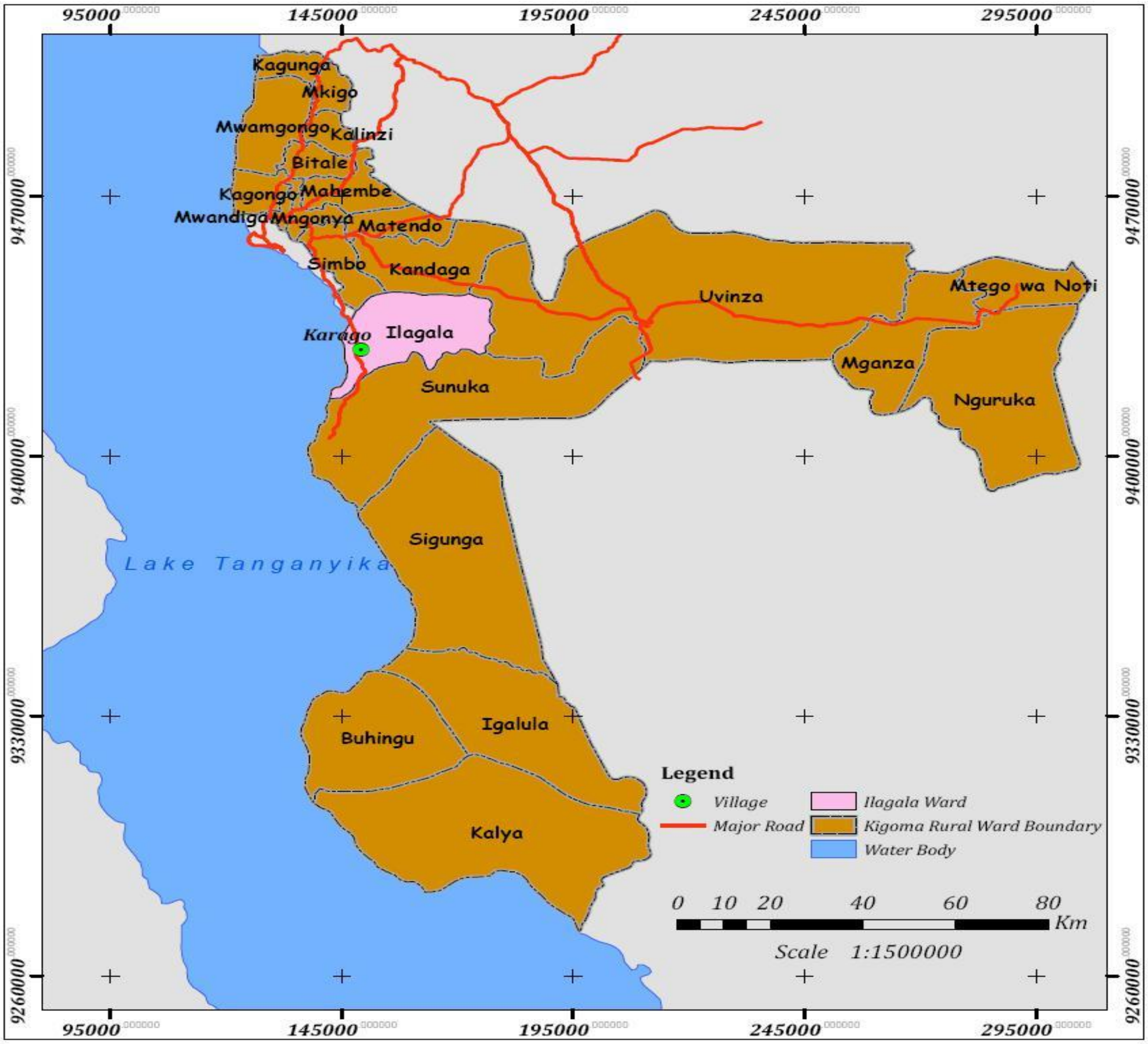

Figure 1. Selected case study villages in Ilagala ward, Kigoma Tanzania.

the total population based on 2012 census every single person in Karago village will be cultivating an area of about 0.6 ha while in Ilagala it will be 0.7 ha.Agricultural production in Karago and Ilagala villages depend mostly on rains for crop growing. Major crops grown include maize, beans, cassava, bananas, groundnuts and oil palm. However, despite of cultivation, there are other socio economic activities like beekeeping, cattle keeping, carpentry and petty business.

Data collection methods and analysis

A combined methodology that involved qualitative and quantitative approaches was adopted. Consequently, multiple methods and techniques for data collection and analysis were used. Data collection methods which were applied included key informants interviews, focus group discussions and in-depth interviews using a standard questionnaire that was structured to obtain the information on potential carbon credit and community expectations towards viability of REDD project. Under the key informants' interviews, different well knowledgeable representatives of the actors at Kigoma rural district level and in the respective villages were interviewed. The interviewee also included the representatives of the NGO which was Jane Goodall Institute (JGI) that is implementing the REDD pilot projects in the respective villages. Other key informants interviewed included ward and village officials, religious leaders and primary school teachers who were regarded as well knowledgeable people at the local level regarding the natural resources issues and again they were useful in advising on the specific community to be interviewed during the in-depth interviews that were carried out in their respective areas. Under the focus group discussions, meetings with village representatives in the selected communities were held to discuss issues related potential carbon credit and community expectations towards viability of REDD project in their respective villages. More information was collected through in-depth interviews using a structured questionnaire which had both open and close ended questions. Under the in-depth interviews, a total of 70 household

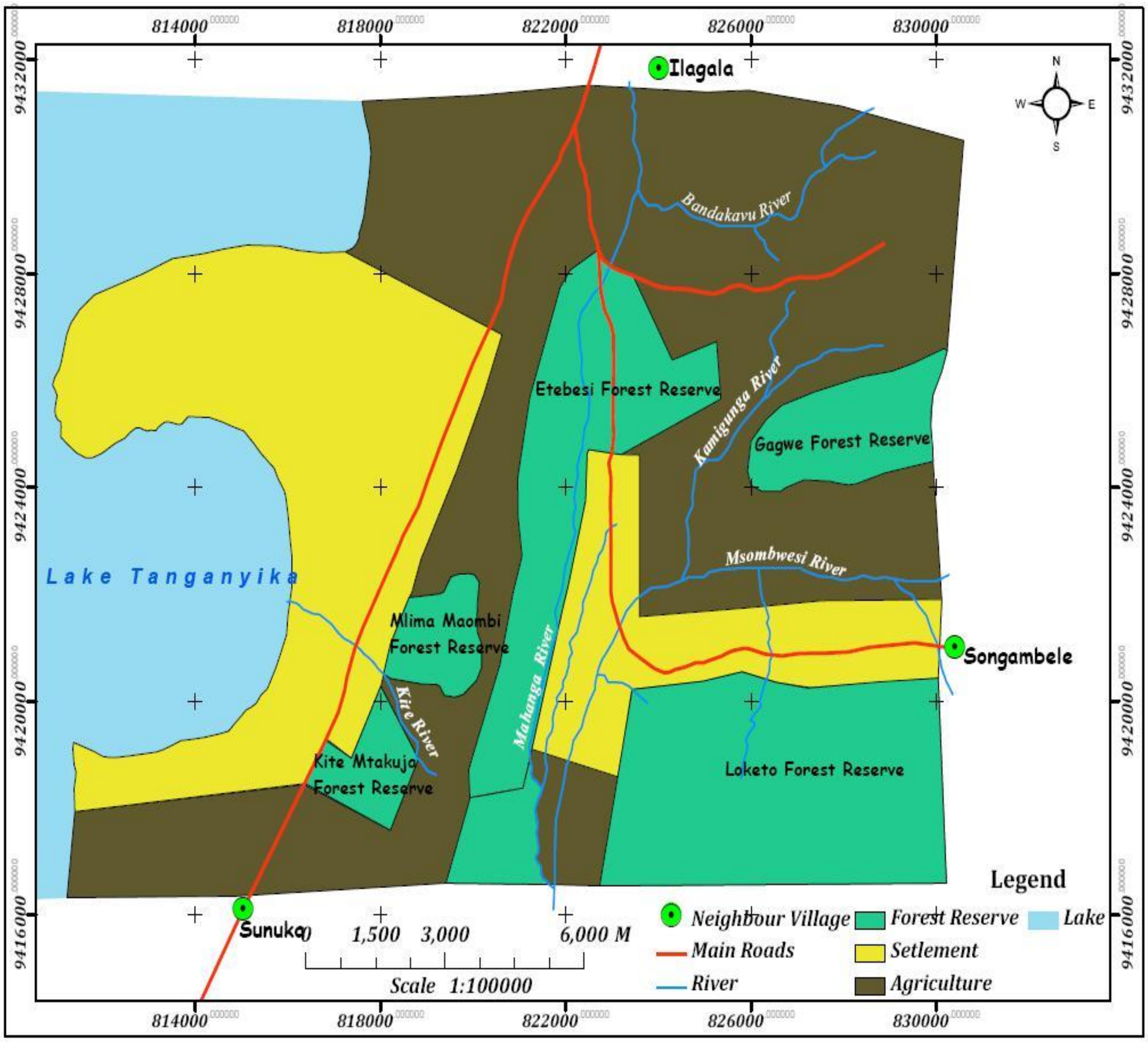

Figure 2. Map showing the land use of Karago Village.

Table 1. Characteristics of the interviewed households.

Village	Households interviewed	Sex		Age (%)			Education level (%)			Residence history (%)	
		%Male	%Female	18-35	36-60	>60	Illiterate	Primary	Secondary	Born in the Village	Born in other village
Karago	30	80	20	30	70	0	3.3	86.7	10	86.7	13.3
Ilagala	40	65	35	25	72.5	2.5	2.5	97.5	0	72.5	27.5

representatives were interviewed. Table 1 gives the characteristics of the interviewed households. However, during the field study, the following criteria were used in selecting respondents especially households: 1) market access – people living near the roads andfar from the roads or people living near or far from the forests; 2) Socio-economic activities for example people who are involved with fishing activities; deforestation rates - areas with high and low deforestation rates.

Most of the qualitative data collected were analyzed using content analysis. Content analysis was carried out for the data that were collected through focus group discussions. Data collected from the questionnaire were analyzed by SPSS whereby descriptive statistics such as mean, standard deviation and percentages were determined.

Opportunity cost estimation for fuel wood accessibility

In order to estimate the opportunity costs for fuel wood accessibility per household in the case study villages, the monetary valuation was done by using the method(s) adopted from Chopra, (1993) as presented in Table 2.

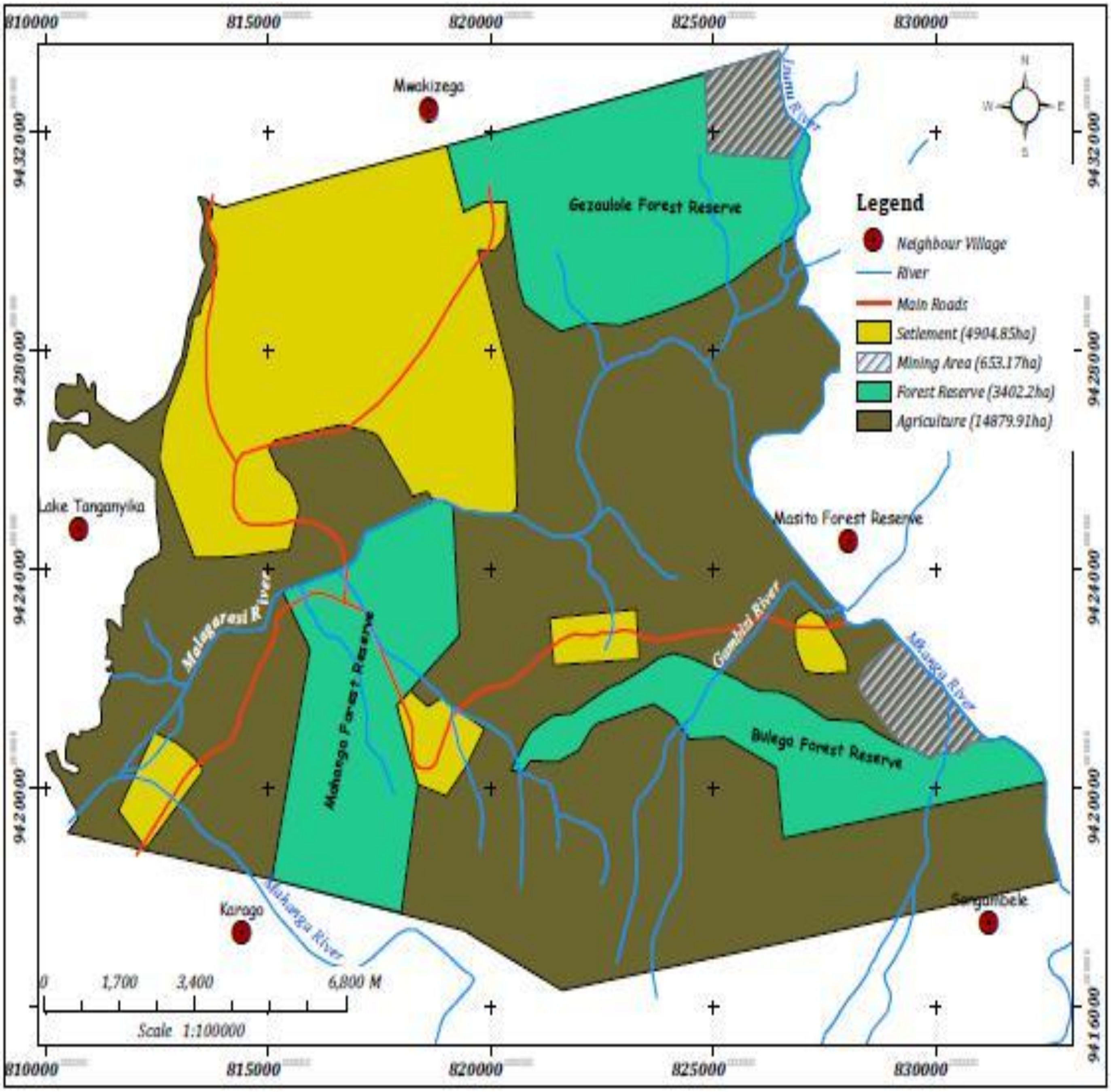

Figure 3. Map showing the land use of Ilagala village.

Table 2. Total Monetary Valuation of foregone fuelwood per household.

Type of Fuelwood	Cost code	Method of Approximation
Firewood	Cost of firewood (PF)	PF= Household consumption per week X UNDP nominal price per m^3 X Number of weeks per year
	Cost of Labor (Time in collection) (CL)	CL=Time taken for firewood collection per day X Firewood Collection Frequency per week X UNDP nominal cost per effective hour X number of weeks per year
Charcoal	Cost of charcoal (MP)	Village current market price

RESULTS AND DISCUSSION

Forests and community livelihoods before and during REDD project

As is the case in many parts of Tanzania, forests have a significant role of securing livelihoods to the surrounding communities. Forest plays three roles to the communities. These include safety netting, supporting consumption, and being an out of poverty pathway (Kajembe et al., 2012). Communities in Karago and Ilagala villages where this study was conducted use surrounding forests for collecting fuel wood, construction materials and non-timber products.

Community representatives interviewed in this study mentioned that during the implementation period of the REDD+ project in the case study area, construction materials and non-timber products have been exploited in sustainable manner but there has been a big concern on fuel wood accessibility. During this implementation period, although forest conservation was highly encouraged to the selected forest reserve, there are no clear identified forests for fuel wood collection and instead, majority (45% -77%) of community members in the case study villages used their agricultural fields for fuel wood collection. This has affected accessibility of fuel wood to residents in terms of space, time and quantity. People who were close to the forest reserves are now obliged to walk a long distance in search of firewood. The average time taken by household for firewood collection per trip was reported to have increased from 5 to 7 h per day and they do that twice a week. Changes in fuel wood accessibility has compelled 43 and 13% of the respondents to buy fuel wood in Ilagala and Karago villages respectively which implied the need for more money to support energy availability for the respective households.

The study has further revealed that, REDD+ project has reduced fuel wood consumption at household level of which is essential for forest ecosystem restoration in the case study villages. The current household consumption of firewood is 1 m^3 per week for Karago and 1.5 m^3per week for Ilagala while for charcoal is 0.75 of a sack (22.5 kg) and 0.7 of a sack (21 kg) per month for Karago and Ilagala villages respectively. The acceptance of REDD+ project has therefore been associated with opportunity costs of which the respondents were willing to take with anticipation that the project will be compatible with their local priorities and needs.

Potential carbon credit and community expectations

Carbon stock estimated in the village forest reserves indicated that Karago and Ilagala villages were required to receive a total $15,625 and$ 11,250 respectively for the first year of the project (phase one). Payments may vary for the next years with respect to amount of the estimated incremental carbon stock of the forest reserves. In these villages, two different payment sharing approaches associated with different preferences at both household and village government level were suggested; these are cash payments to individuals for compensating the incurred opportunity costs which include labour and procurement costs. This was suggested by 20% of the respondents. The second modality was suggested by 80% of respondents. The interviewed community representatives further indicated that funds should be given to village government for development projects and protecting forest reserves (Figure 4).The differences in payment modalities imply that there is need for a harmonized payment mechanism.

Potential carbon credit at household level

Due to spatial and temporal changes of fuel wood accessibility brought by the implementation of the conservation project through REDD+ in the area, some households needed the potential carbon credit for compensating the incurred opportunity cost. People use more time than before the start of the implementation of the REDD+ project. The increased time is used in search of firewood due to the increase in distance. Results revealed that 3% of interviewed households in Karago buy fuel wood while 43% in Ilagala buy fuel wood. In this regard, people may need to be paid $ 1239-$ 1,664 per household per year as compensation for firewood, and $ 40-$ 60 per household per year as compensation for charcoal.

Therefore, in general, the total amount of money to be paid directly to each household in the villages is supposed to be $ 1279-$ 1,724 per year for fuel wood consumption. This amount is far by 92-94 percent compared to the amount that the potential carbon credit which could be divided to households. The amount of money to be given to each household as compensation could not be compared in any case by the forgone opportunity costs.

Potential carbon credit at village government level

In the key informant interviews with the village leaders, it was reported that amount of money to be given to each village government was reported not to be enough to complete even one development project. For instance the amount of money required to complete a water project for the people of more than 1500 households was not less than 200 million (Carlevaro and Gonzalez, 2008). This amount of money is higher by 86 - 88% than the amount of money expected to be given to the households and village government put together. On top of that, the money will be decreasing due to the fact that the incremental carbon stock present in the forests will keep on decreasing too. The achievement of such water

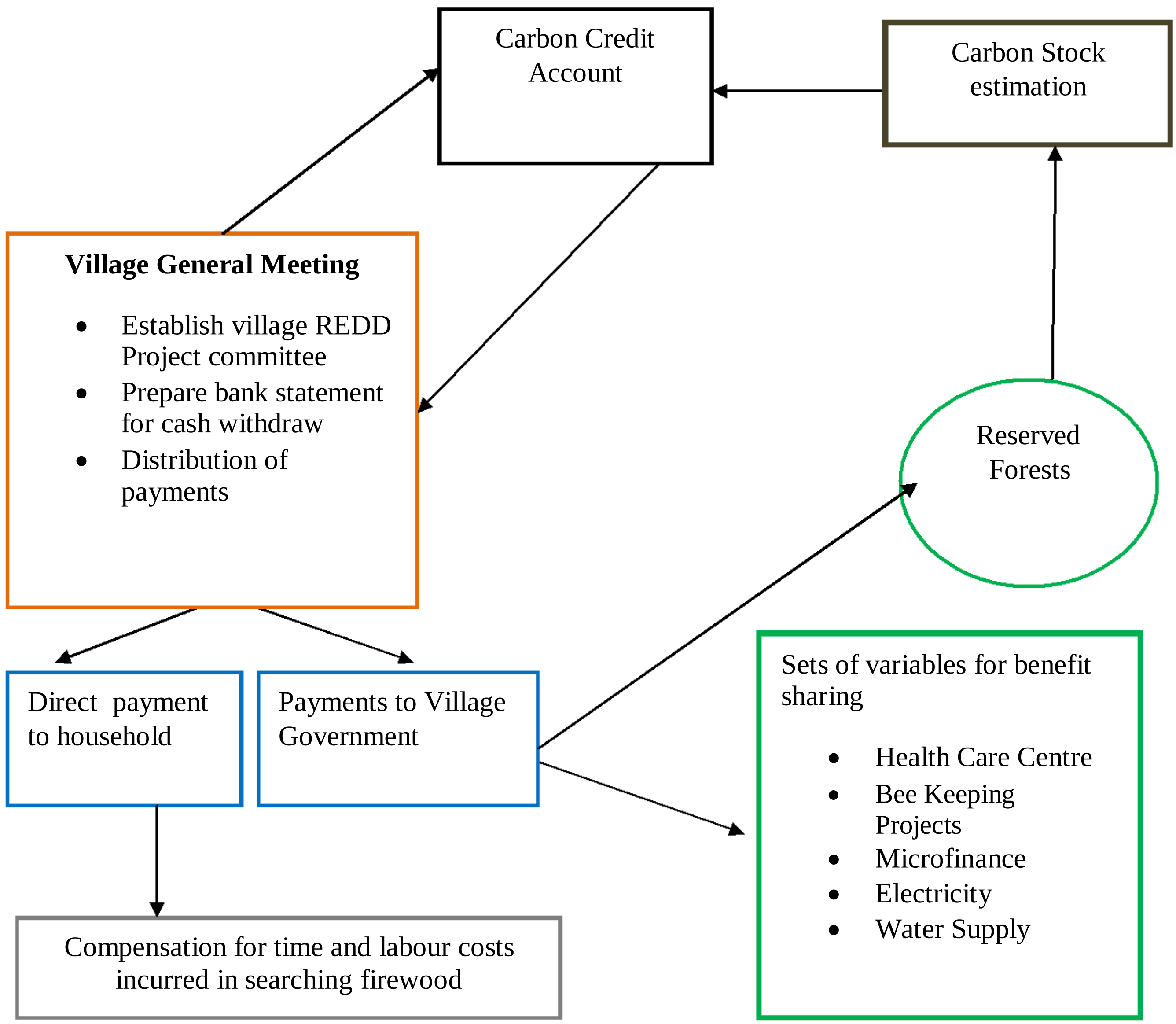

Figure 4. Model for REDD project revenue benefit sharing and payment mechanism for potential carbon credit.

project for example would need an accumulation of money for more than 8 years consecutively under assumption that the amount of money given will not change ($15,625 for Karago and $11,250 for Ilagala) which will not be the case especially when considering the incremental carbon stock.

According to Kabura et al. (2013), the cost of managing a hectare per year is about $6.5. Translating this cost to the case of Karago forest reserve with an area of 5137.88 ha, about $33, 400 per year while for Ilagala forest reserve with an area of 3402.2 ha, about $22, 114 per year is needed for the management cost. These costs are still higher by 45-50% than the financial payments to be received which was $15,625 and $11,250 for Karago and Ilagala respectively.

Trends of opportunity cost, carbon stock and potential carbon credit over time

Analysis of the opportunity cost, marginal (incremental) revenues/potential carbon credit and carbon stock shows that the project will have four major phases (A, B, C and D), each with different behaviour (Figure 5).

In general, there will be a decrease in incremental revenues in each project phase because; the revenues are the function of incremental carbon stock. The incremental carbon stock is also the function of forest age of which increases as the project lifetime increases. Therefore, the project seems to be helpful during the first phase of the project. The probability for the project to flop in near future is high if there will be no means to reduce

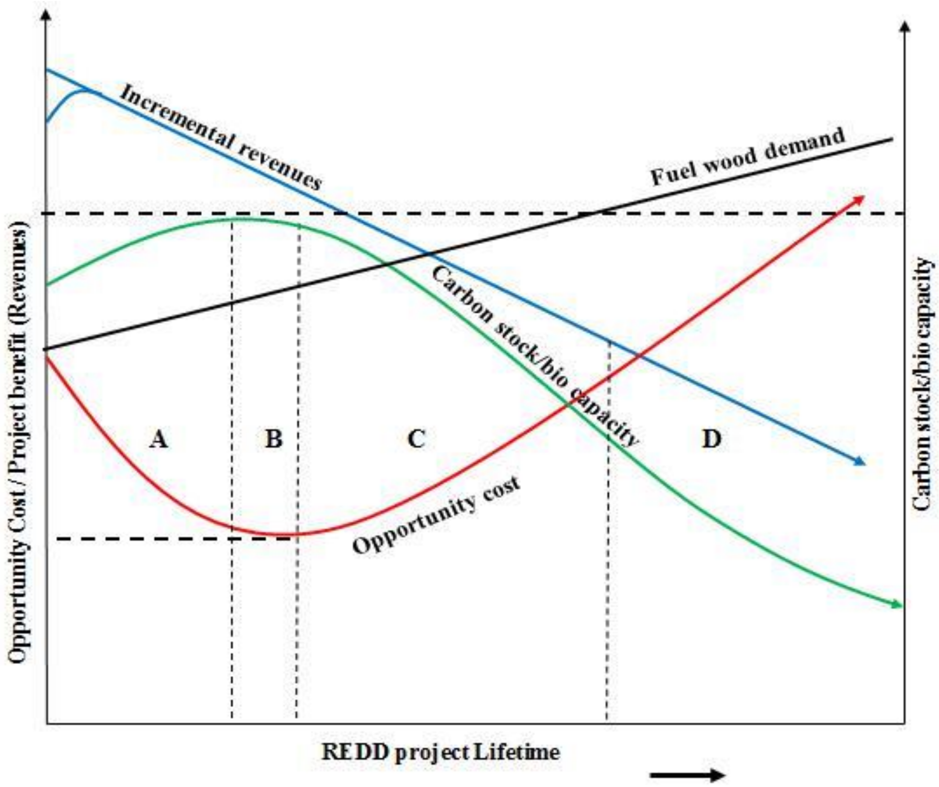

Figure 5. Trends of opportunity cost, carbon stock and potential carbon credit over time.

the opportunity cost and improve forest biomass.

In phase one (A), there will be an increase of carbon credit due to increase of carbon stock in the forest. The bio capacity is slightly higher than the village demand on forest goods. The opportunity cost of forest goods will also have a tendency of decreasing due to the fact that, as the project start operating, there will be additional co-benefits that will lower the opportunity cost. Among the co-benefits from the forest are climate regulation and the increase of food products from the forest such as mushrooms.

Phase two (B) is the positive turning point for the opportunity cost and negative turning point of carbon stock in REDD project forests due to forest age. The opportunity cost will stop decreasing and instead start increasing. The reason is that the forests allocated for fuel wood collection will fail to meet the fuel wood demand and hence raise the labour and procurement costs of fuel wood. It is at this phase when the carbon credit will start decreasing.

Phase three (C) will be associated with high increase of opportunity cost since the revenues from carbon credit will keep on decreasing. On the other hand fuel wood demand will be high if considering no substitute for goods and technologies while bio capacity is low. It is at this time there will be an increase of land degradation and people may start returning to the REDD project forests upon no strict supervision.

Phase four (D) will be associated with unusual increase of opportunity cost which will be far be bigger than the marginal (incremental) revenues from carbon stock increment. This is the time when the ability of forest to sequester carbon will be low due to forest age and hence more less forest revenues to the village. Due to very low bio capacity at constant fuel wood demand, there will be more environmental and social economic problems in the villages. This situation will be worse right from the point (time) when the marginal revenues will have exceeded the opportunity cost. This is the phase when the project will flop.

The role of energy efficient cooking technologies on REDD project viability

The findings from the study indicate that unless energy sources and energy efficient cooking technologies are well addressed, viability of REDD+ initiatives are will still be low. Adoption of high energy efficient cooking techno-logy (HEECT) will reduce pressure in the forests of which is essential for viability of REDD+ project.

According to Tanzania Traditional Energy Development Organization (TaTEDO), the efficient cooking technologies (EECT) include improved charcoal stoves which

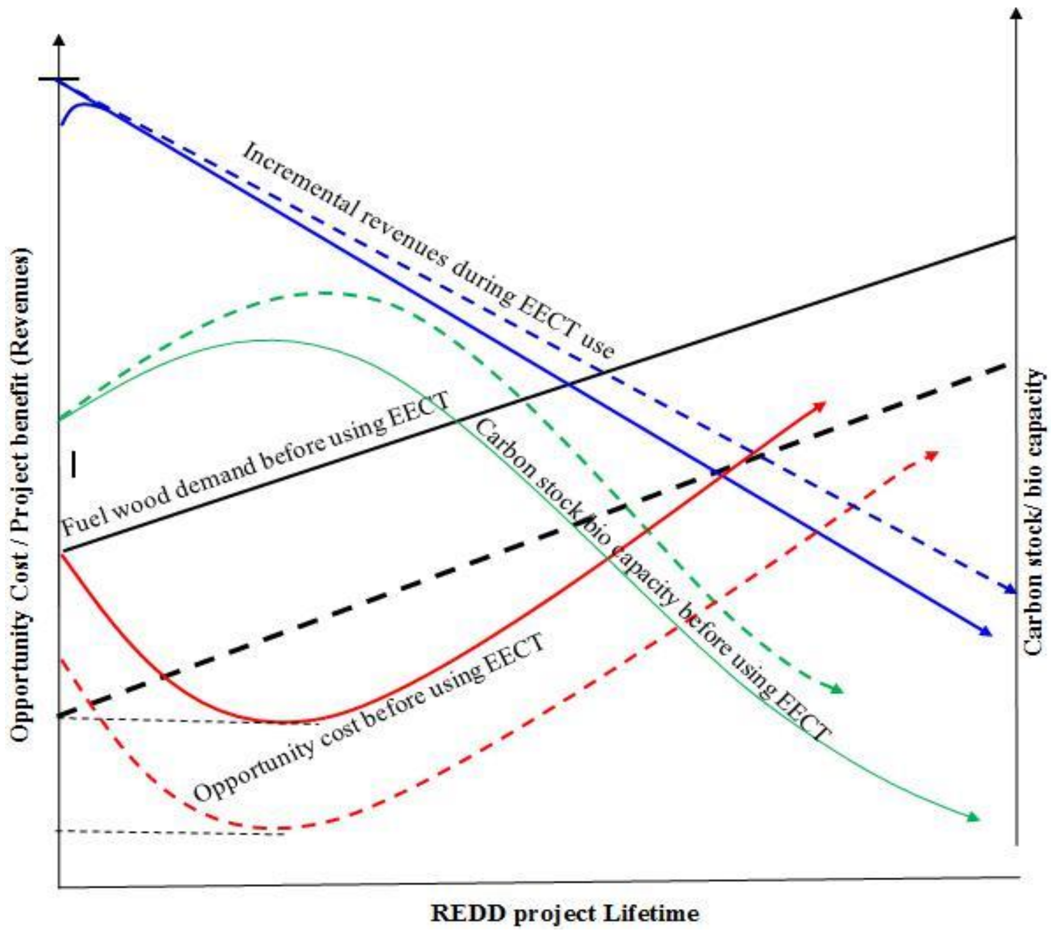

Figure 6. The sketch showing the behaviour of opportunity cost, incremental Carbon stock revenues, fuel wood demand, bio capacity of forest ecosystem before (solid lines)and during EECT application (dashed lines).

have capacity of reducing consumption of charcoal by average of 71% and improved firewood stoves (Improved Okoa Firewood Stove) of which have capacity of reducing consumption by more than 65%. The improved firewood stoves use one or two pieces of firewood. In this regard, by adopting these kinds of technologies, the costs for purchasing firewood will have been reduced significantly for those purchasing firewood as they will consume less fuel wood.

Reduction in fuel wood consumption will in turn reduce further the frequency of fire wood collection. This will help women and children in Karago and Ilagala villages to save around 2,912,000 - 3,328,000 hours per year for collecting firewood with estimated value of $1,456,000 – $1,664,000 per year - at nominal cost of $0.5 per effective hour used for fetching firewood. The time saved can be used for implementing other development activities.

Adoption of EECT will cut down carbon dioxide emissions by 80% since the use of unimproved biomass stove by the 4,000 households in two villages contributes around 1,105,416 tons of carbon dioxide (tCO2) per year at the average of 4tCO2 per cubic meter of firewood but through the use of EECT (improved charcoal technology), the emission could be reduced to 232,137.4 per year.

Moreover, adoption of these technologies may reduce the opportunity costs (labour and procurement costs) for fuel wood accessibility by 67.9 to 70.5%. This is because the opportunity cost for fuel wood accessibility will decrease from $1279-$1724 to $410-$508 per year. The reduction in fuel wood consumption is associated with reduction in frequency of fire wood collection of which has implication on labour costs. Reduction of opportunity cost will increase project viability as there will be a shift of the point at which opportunity cost starts becoming higher than incremental revenues. Also, the decrease in fuel wood demand prompted by the use of EECT will increase project viability in terms of forest biomass as there will be shift of the point at which bio capacity starts becoming lower than the fuel wood demand (Figure 6).The point can be shifted further if communities will be encouraged to have their own woodlots. Thus, application of appropriate measures for opportunity costs reduction and improving forest biomass may make the project more viable in the case villages.

Conclusion and Recommendation

The study reveals that, there is high opportunity cost behind REDD+ project implementation in the case study villages of which 80% of the respondents were willing to take with anticipation that the project will be compatible with their local priorities and needs. The study has further revealed high expectations on the benefits to be gained by the communities in the respective villages. The REDD+ project, local governments and people should therefore, harmonize the community preferences so that project goals become compatible with community priorities and needs. Careful selection of the already proposed alternative livelihood projects like bee keeping project and microfinance must therefore be done in the case villages to ensure sustainability of REDD+ project and people's lives. Notwithstanding the social economic effects, REDD+ project has brought positive changes in the case villages as there is already climate regulation in terms of rainfall, rejuvenation of river water tributaries flowing from the forests and increase of Non wood products in the forest reserves. The study recommends that, in order to maximize the environmental and socio-economic benefits in the case villages, there is a high need for conservation projects such as REDD+ project to cooperate with village government in tree planting campaign in the farm fields and encouraging the use of improved stoves to cut downcosts of fuelwood access and its consumption in the foreseeable future.

Conflict of interest

The authors did not declare any conflict of interest.

ACKNOWLEDGEMENTS

This paper has been prepared as a part of research output of the project on Establishment of Harmonized Modalities and Mechanisms for Community Compensation under Carbon Markets: The Case Study of REDD Pilot Projects in Tanzania funded under the framework of Climate Change Impact Adaptation and Mitigation (CCIAM) programme supported by the Royal Norwegian Government.

REFERENCES

Bolin E, Mustalahti I, Boyd A, Paavola J (2012). Can REDD+ reconcile local prioritiesand needs with global mitigation benefits? Lessons from Angai Forest, Tanzania. Ecol. Soc. 17(1):16.

Brown S (1986). Estimating biomass and biomass change of tropical forests: a primer. Rome: FAO Forestry Paper 134.Food and Agriculture Organization of the United Nations.

Brown S (1993). Tropical forests and the global carbon cycle: The need for sustainable land-use patterns. Agric. Ecosyst. Environ. 46: 31-44. http://dx.doi.org/10.1016/0167-8809(93)90011-D

Burges ND, Bahane B, T Clairs, F Danielsen, S Dalsgaard, M Funder, N Hagelberg, P Harrison, C Haule, K Kabalimu, F Kilahama, E Kilawe, SL Lewis, JC Lovett, G Lyatuu, AR Marshall, C Meschack, L Miles, S AH Milledge, PKT Munishi, E Nashanda, D Shirima, RD Swetnam, S Willcock, A Williams, E Zahabu (2010). Getting ready for REDD+ in Tanzania: a case study of progress and challenges. Oryx 44(3):339-351. http://dx.doi.org/10.1017/S0030605310000554

Carlevaro F, Gonzalez C (2008). Costing Improved Water Supply Systems for Low- income Communities. A Practical Manual. University of Geneva/World Health Organization.

Chomitz KM, P Buys, G De Luca, TS Thomas, S Wertz-Kanounnikoff (2006). At loggerheads? Agricultural expansion, poverty reduction and environment in the tropical forests. World Bank Policy Research, Development Research Group, World Bank, Washington, D.C., USA.

Chopra K (1993). The value of non-timber forest products: an estimation for tropical deciduousForests in india. Economic botany 47(3):251-257 (Institute of Economic Growth, University Enclave, Delhi 110 007, India).

IPCC (Intergovernmental Panel on Climate Change), Aleotti (2007). Assessment of adaptation practices, options, constraints and capacity. In: Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. M.L. Pary, O. F. Canziani, J.P. Palutikof, P.J. van der Linden, and C.E. Hanson, eds. pp 976. Cambridge, Cambridge University Press.

Kabura J, Dos SS, Arild V (2013). The cost of managing forest carbon under REDD+initiative : a case of Kolo hills forest, Kondoa, Dodoma, Tanzania.A paper presented during a CCIAM workshop at Palm Tree Village Resort, Bagamoyo January 2013.

Kajembe GC, Silayo DA, Kitula MM, Lyatura.,Mutabuz K.J. and Massawe F. and Vtn A (2012). REDD Realities:Leasons learned from REDD + Pilot projects in Kondoa and Rungwe Districts, Tanzania.

Lugo AE, Brown S (1992). Tropical forests as sinks of atmospheric carbon. For. Ecol. Manag. 54:239-255. http://dx.doi.org/10.1016/0378-1127(92)90016-3

Stern N (2006).Stern Review: The economics of climate change. Her Majesty's Treasury, London, UK.

Tanzanian Forestry Working Group (TFWG) (2010). Options for REDD in Tanzania: key design issues for the national REDD strategy. Brief 2. Tanzanian Forestry Working Group,Arusha, Tanzania.

TNRF (2008). Tanzania Natural Resource Forum, Carbon, Communities, and Conservation:Developing a Framework for generating socioeconomic and Environmental Benefits using the voluntary Carbon Market in Tanzania: A Roundable workshop hosted by TNRF 14th March, Arusha.

United Nations Framework Convention on Climate Change (UNFCCC) (2010). Decisions adopted by COP 16 and CMP 6. Cancun Climate Change Conference, UNFCCC, Bonn, Germany.

United Republic of Tanzania (URT) (2009). National Framework for Reduced Emissions from Deforestation and Forest Degradation (REDD). Forestry and Beekeeping Division, Ministry of Natural Resources and Tourism, Dar es Salaam, United Republic of Tanzania.

Vashum KT, Jayakumar S (2012). Methods to Estimate Above-Ground Biomass and CarbonStock in Natural Forests - A Review. J Ecosyst. Ecogr. 2:116.

Whittaker RH, Linkens GE (1973). Carbon in the biota. In Woodwell GM, Pecan EV, Carbon in the biosphere, Proceedings of the 24th Brookhaven Symposium in biology. Upton, New York: United States Atomic Energy Commission 281-302.