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Assessment of changes in provision of forest ecosystem goods and services and benefit sharing mechanisms in the Ugalla-Masito Ecosystem: A case of Ilagala and Karago villages in Kigoma Region, Tanzania

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This paper presents results of the assessment of changes in provision of forest ecosystem goods and services in the Ugalla-Masito Ecosystem, using a case study of Ilagala and Karago villages in Kigoma Region, where REDD is being piloted. Various data collection methods were employed. These included focused group discussions, key informants' interviews, in-depth interviews using structured questionnaires and document analysis. The results indicate that the demand for forestry products in the ward is quite high compared to the level which the surrounding forest can supply. This includes demand for fuelwood, timber and building poles. The ecological footprint accounting techniques revealed that people in Karago need five to six times their available village area per year for fuelwood production, while for Ilagala, the requirement is 8.5 to 9.7 times. This implies that these villages have a very high ecological deficit. Regarding possible compensation for the forgone ecosystem services, the present study reveals that each household in the villages may need to be paid Tshs 1,919,000 – Tshs 2,586,000 ($ 1279-$ 1,724) per year as compensation for foregone fuelwood. The study recommends that there is a high need for conservation schemes such as the REDD project to cooperate with village governments in the farm field tree planting campaign as well as encouraging the use of improved stoves so as to cut down costs of fuelwood access in the foreseeable future.

Key words: Forest ecosystem goods and services, ecological footprint, benefit sharing.

INTRODUCTION

Forest ecosystems provide a wide range of goods and services from which people benefit, and upon which all life depends. Also, forests act as carbon sinks, resulting in an uptake of greenhouse gas - carbon dioxide (CO_2) from atmosphere. In this way, a forest plays important role in climate change mitigation (UN-REDD Programme,

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2009) such that it has now captured international attention (Intergovernmental Panel on Climate Change (IPCC), 2007; Stern, 2006).

Forest loss, primarily tropical deforestation and forest degradation, accounts for approximately 18-20% of global greenhouse gas emissions (IPCC, 2007). By reducing emissions from deforestation and forest degradation (REDD) through forests conservation, practices stabilize the atmospheric concentration of greenhouse gas (GHG) emissions, which, in turn, help avoiding global warming and increase forest goods and services (Angelsen and Wertz-Kanounnikoff, 2009).

The governments of Norway and Tanzania signed a letter of intent in 2008 for establishment of a partnership intended to address climate change challenges through reduction of emission from deforestation and forest degradation (REDD) (United Republic of Tanzania (URT), 2009). The government of Tanzania started by piloting REDD in various locations of the country. These include Mbeya, Sumbawanga, Kigoma, Shinyanga, Kondoa, Kilosa, Lindi, Mtwara and Zanzibar. The programme involves about eight Non-Governmental Organizations, which collaborate with the central and local government. Academic institutions and private sector are currently implementing the projects.

Despite the implementation, it is argued in IRA (2009) that there are some challenges of implementing REDD in Tanzania. These include heavy dependency on the natural resources base for livelihood sustenance and economic development. Some communities utilize forests for cultural and traditional activities. If these forests are put under the REDD programme, the activities will no longer be allowed to take place in the forest areas due to non-existence of known modalities for compensation as well as lack of national model for benefit sharing. In addition, there is no clear documented information on ecological footprint(s), which is the amount of land required for providing goods and services that people do consume in the specific project areas. This determines the extent which the flow of forest ecosystem goods and services might be affected in the forest-dependent communities upon REDD project implementation.

Kigoma Region, Kigoma Rural District in particular, is among the areas in Tanzania where the REDD project is at pilot stage. Communities covered by the REDD project areas have been foregoing forest ecosystem goods and services in favor of REDD project implementation, much as demand for forestry products in the district is quite high compared with what the district or region can supply. People frequently rely on forests for acquiring firewood and charcoal (for selling or using as fuel), timber and building poles (URT, 2008). It is argued in URT 2009 that the implementation of REDD project in Kigoma Region mighty interfere with the cultural and economic values of large number of indigenous people, if the aforementioned challenges are not immediately taken into account.

This paper thus confines itself to assessing changes in provision of forest ecosystem goods and services and benefit sharing mechanisms to local communities in Ugalla-Masito Ecosystem, using the case study of Ilagala and Karago villages. These are located in Kigoma Rural District, where REDD is being piloted. The main objective of the study was to present information on what the villages had foregone or prevented them from using the forest reserves, and, to make an interpretation of the expected plans for using money acquired from the possible compensation that the households may need to be given, as well as making interpretation of ecological footprint; which is the equivalent amount of land required to supply or maintain flow of the foregone forest ecosystem goods and services, based on the current household consumption level, particularly the foregone ones. These interpretations were done in accordance with pillars of ecological management which are preservation, protection and sustainable use of components or elements of Ilagala and Karago forest ecosystems.

MATERIALS AND METHODS

Case study description

Masito-Ugalla is one of the Kigoma Rural District's largest natural forest reserves. Due to high bio-diversity value of Masito-Ugalla forest, the international NGO (Jane Goodall Institute (JGI)) is currently implementing the REDD project with a vision to enable communities to benefit from REDD-based global approaches on climate change mitigation. The Project also focuses on seven villages, which include Karago, Sunuka, Ilagala, Kirando, Sigunga, Mwakizega and Songambele. The villages are located along the Lake Tanganyika shoreline lying within Kigoma Rural District, which protects about 700 sq. km of indigenous forests currently classified as general land. However, the REDD implementation approach in these villages links with participatory forest management (PFM). Assessment of changes in provision of forest ecosystem goods and services, as well as benefit-sharing mechanisms of local communities in the Ugalla- Masito Ecosystem, Ilagala and Karago villages, were taken as case study areas.

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 8703 people (about 1600 households) (2012, census) and a land area of 11,219 ha has reserved five forests with a size of 5646 ha (Figure 1). However, the village has agricultural land of 5138 ha and 432 ha for settlement.

On the other hand, Ilagala village is bordered to the north by Mwakizega village, to the south by Karago and Songambele villages and the east by Masito-Ugalla forest reserve, and to the west by Lake Tanganyika. The village is has 21, 246 people (about 3500 households) (2012, census) with a land area of 23,840 ha. It has reserved three forests whose size is 3402.2ha (Figure 2). However, the village has agricultural land amounting 14880ha, 4905ha for settlement and a 653ha reserved forest for mining activities.

Agriculture is the major source of income for the majority of the people in Karago and Ilagala villages. However, the areas which are under agricultural utilization are very small. If the area under crop cultivation is distributed equally to the total population based

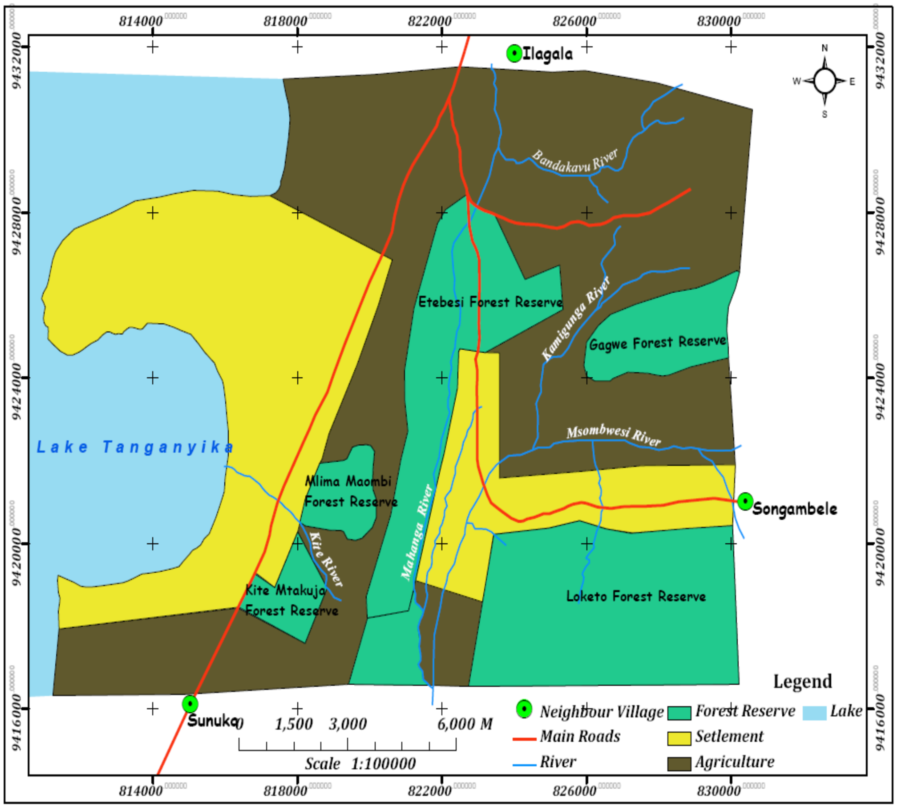

Figure 1. Map showing the land use of Karago Village.

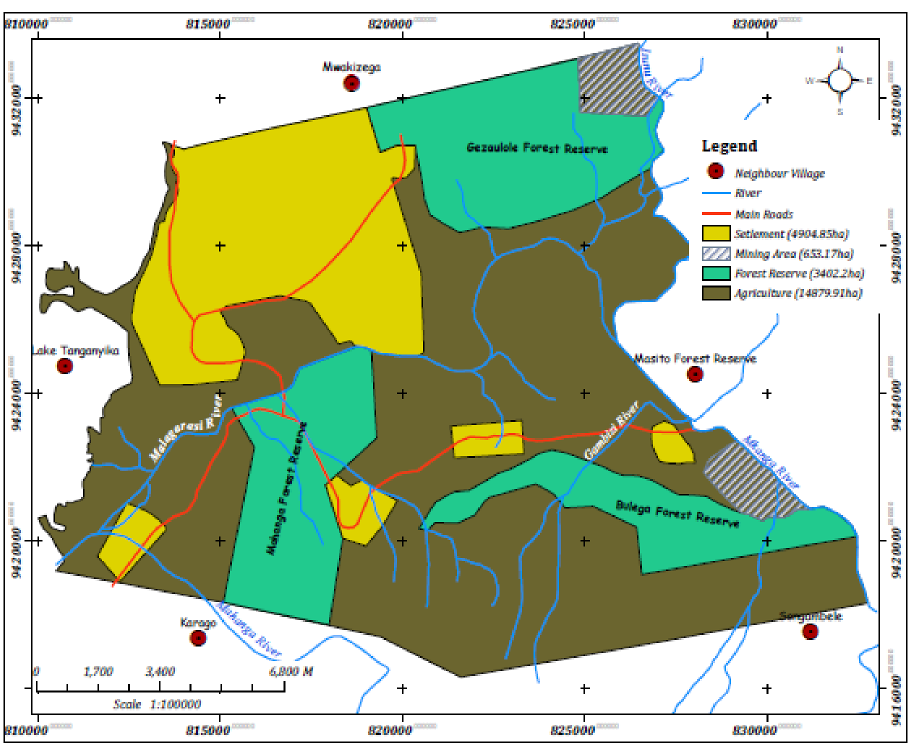

Figure 2. Map showing the land use of Ilagala Village.

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

on 2002 census, every single person in Karago village will be cultivating an area of about 0.6ha while in Ilagala the cultivation area will be 0.7 ha. Agricultural production in Karago and Ilagala villages depends mostly on natural rains for crop growing. The major crops include maize, beans, cassava, bananas, groundnuts and palm oil. Apart from cultivation, other socio economic activities include beekeeping, cattle keeping, carpentry and trading activities.

Data collection methods and analysis

A combined methodology that involved stakeholder meetings (qualitative approach) and household surveys (quantitative approach) was adopted. Consequently, multiple methods and techniques for data collection and analysis were used. Data collection methods included key informants interviews, focus group discussions and in-depth interviews using a standard questionnaire that was structured to obtain information on changes in provision of forest ecosystem goods and services as well as benefit-sharing mechanisms. Through the key informants interviews, various well knowledgeable representatives of actors at Kigoma Rural District level and the respective villages were interviewed. The interviewees also included representatives of the Non-Governmental Organization (NGO), the Jane Goodall Institute (JGI), which is implementing the REDD pilot projects in the respective villages. Other interviewed key informants included ward and village officials, religious leaders and primary school teachers. These were regarded as well knowledgeable people at local level in relation to natural resources issues. They were quite useful in advising on specific communities 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 of selected communities were held to discuss issues related to changes in provision of forest ecosystem goods and services as well as benefit sharing mechanisms in their respective villages. More information was collected through in-depth interviews using a structured questionnaire which contained both open and close ended questions. Under the in-depth interviews, a total of 70 household representatives were interviewed. Table 1 gives the characteristics of the interviewed households. However, during the field study, the following criteria were used in selecting the respondents, especially households:

a) Market access – people living near the roads and far from the roads or people living near or far from the forests.
b) Socio-economic activities of people involved in fishing activities.
c) Deforestation rates - areas with high and low deforestation rates.
d) Access to benefits - people receiving and those not receiving the benefits.

Most of the collected qualitative data was analyzed using content analysis. Content analysis was carried out for data that was collected through focus group discussions. Data collected from the questionnaire was analyzed by SPSS whereby descriptive statistics were determined. These include mean, standard deviation and percentages. Analysis of variance was carried out to determine the significance of variations in ecological footprint (fuelwood consumption) within and between the villages.

Determination of ecological footprint

To find out the ecological footprint for the fuelwood, the footprint accounting formula was used. The following were steps used in determining the ecological footprint for the foregone fuelwood.

1. Collection of data on fuel wood consumption in households during survey.
2. Assembling of ecological footprint table. This was done with the help of the Ecological Footprint conversion factors whereby relevant conversion factors were used.
3. Calculations of ecological footprint (EF) was done using the formula below:

$$EF = \frac{AC}{YF} \times EFEF$$

Sources: Ewing et al., 2009; Ewing et al., 2008).
Whereby:

EFEF = Ecological footprint equivalent factor (gha-year /ha) (translates amount of fuelwood consumed into average universal unit of biologically productive area, a global hectare).
AC = Amount of fuel wood consumed in the area (tonnes or m^3/yearor m^3/year).
YF = Yield factor (tonnes /haor m^3/m^2) = 1 (tonnes /ha or m^3/m^2).

For firewood: AC = Percentage of households using firewood X total number of households in the village X household firewood consumption per week (m^3) X number of weeks per year.
For charcoal: AC = Percentage of households using charcoal x total number of households in the village X household firewood consumption per month (kg) X number of months per year.

Monetary valuation of the foregone forest ecosystem goods and services

The total monetary valuation of the foregone forest ecosystem goods and services, especially fuelwood, was done using the following method(s) of approximation as seen in Table 2.The method was adopted from Chopra (1993).

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 Market price

Table 3. Spatial distribution of benefits derived from forest products to surrounding villages based on value classification.

Value	Goods and services	Local	Regional	Global
Direct use value	Honey	X	X	
	Charcoal	X		
	Firewood	X	X	
	Timber	X		
	Ropes and poles	X	X	
	Medicinal plants	X		
	Fruits, Nuts, Mushroom and Bush meat	X		
Indirect use value	Regulation of local rainfall	X		
	Water yield	X		
Non-use Value	Carbon storage and Sequestration			X
	Future direct and indirect uses of above goods and services	X	X	X
	Traditional/cultural knowledge & traditions	X	X	X

Source: Modified from Jaboury and Diane, 2005

RESULTS AND DISCUSSION

Forest use in Karago and Ilagala villages before and during REDD project

The results indicate that forestry products' demand in villages is quite high compared to the level which the surrounding forest can supply. This includes demand for fuelwood, timber and building poles. Ilagala and Karago villagers have been going short of supply of forest ecosystem goods and services since the REDD project was started. However, forests surrounding the villages have been beneficial not only at village level but also the regional level. This implies that by foregoing forest goods and services due to acceptance of REDD projects, there are both positive and negatives effects not only at village level, but also at regional level. Table 3 shows the spatial distribution of benefits brought by direct and indirect use of forest products acquired from the surrounding forests. Generally speaking, there is no statistical difference in households' dependency on forest reserves for gathering various forest ecosystem goods and services in Karago and Ilagala villages at 95% confidence level. This implies that their livelihoods have been equally connected with forest resources found in their village areas. However, upon acceptance of the REDD project, people have been completely prevented in accessing fuelwood from forest reserves. On the other hand, there are special forest reserves for acquiring some goods and services especially, fuelwood. This has affected people in terms of inadequate supply of construction materials and others who were dependent on these villages to get such products. Some of the people have shifted from the region and moved to other regions like Mwanza in order to seek areas where they can undertake some lumbering activity. The programme of reserving forests under REDD project has changed the pattern of timber and poles access, hence leading to the decrease in their supply.

Table 4. Household Consumption, Time and Frequency of collection of Fuelwood (Mean ± Standard Deviation).

Village	Household consumption of Firewood per week (m^3)	Household consumption of Charcoal per Month (bags)	Time for firewood collection per trip	Frequency of Firewood collection per week
Karago	1±0.5	0.75±0.2	6.2±1.4	2.3± 0.9
Ilagala	1.5±0.8	0.7±0.2	6.0±1.4	2.8±1.3

Table 5. Ratio between household land ownership and Household ecological footprint (mean ± standard deviation).

Village	Household size	Household land ownership (ha)	Household ecological footprint per year (gha)	Ratio of household ecological footprint per year and land ownership
Karago	5±3	7±2	46±30	16±15
Ilagala	8±5	6±4	75±40	20±12

Fuelwood Consumption in the villages and their accessibility during REDD project

An interview conducted at Ilagala and Karago village showed that 77-80 percent of households formally utilized the reserved forests for collecting firewood. However, 5-13% of households used the forest reserves for acquiring charcoal as a source of energy. These percentages of households' utilization of firewood and charcoal for cooking are less when compared with Tanzania- rural areas country fuelwood information for cooking of 2010 (91% use firewood and 8% use charcoal). The percentage of households who use the reserved forest products for fuelwood collection, particularly firewood, is the minimum percentage of people who use fuelwood at the moment in Ilagala and Karago villages.

However, the study reveals that most of charcoal produced was used for business, as it was sold in and outside the villages. Currently, the average household consumption of charcoal in the two villages is 0.75 of a sack per month for Karago village and 0.7 of a sack per month for Ilagala. One sack of charcoal carries 30 kg. Moreover, the current average household consumption of firewood for Karago is 1 m^3 per week and 1.5 m^3 per week for Ilagala and, the frequency of firewood collection is two to three per week. The time taken by household for firewood collection per trip is 5 to 7 h per day (Table 4).

Generally speaking, the supply of fuelwood per household (firewood and charcoal) has decreased since the programme of preserving forests was established. There is only one reserved forest for fuelwood collection. Thus, 45-77% of people are forced to use their agricultural land for the purpose, while some do not own land (3%-10%), hence making them face a hard time. Also, the average agricultural land in the two villages of those who own land is quite small. The individual agricultural land for Karago is 0.6 and 0.7 ha for Ilagala. Under normal circumstance, this land is insufficient to cater for agricultural activities and fuelwood demand. People having inadequate farming land might be contributing to the percentage of those who illegally collect firewood from forest reserve (2-7%) buying (13-43%).

Household ecological footprint

The interpretation of the current household fuelwood consumption behavior into equivalent amount of land required to provide or maintain the flow of fuelwood (ecological footprint of the foregone fuelwood) as well as data on household land ownership show that most of households possess insufficient land for fuelwood supply. Households in Ilagala village require 20 times their available land while Karago village requires 16 times their available land to cater for their fuelwood needs (Table 5). This implies that households in the villages have some very big land deficit per year for their daily fuelwood consumption. The average household land deficit in Ilagala is 69 and 39 ha per year for Karago. This shows that the land required for households fuelwood supply is less by 92% in Ilagala and 84.8% for Karago. Generally speaking, statistical analysis (analysis of variances) shows that there is significant difference in ecological footprint among and within these two villages (Ilagala and Karago) at 95% confidence level. This might be due to differences in type of cooking technologies used, number of people in the households or the easy availability of fuelwood among households.

Ecological footprint of Karago and Ilagala villages based on fuelwood consumption

The current amount of fuelwood consumed by Karago and Ilagala villages per year is mainly obtained from

Table 6. Ecological footprint of Karago and Ilagala Village based on foregone fuelwood.

Fuelwood	Fuelwood Consumption per household per year				Conversion factor (ha-year/gha)	Footprint per fuelwood(gha) per year			
	Karago		Ilagala			Karago		Ilagala	
	Min	Max	Min	Max		Min	Max	Min	Max
Firewood	64,064 m^3/year	75,712 m^3/year	218,400 m^3/year	248,430 m^3/year	0.93	59,579	70,412	203,112	231,040
Charcoal	56.2ton/ year	34.56 ton/year	44.1 ton/year	70.56 ton/year	0.43	14.86	24.20	18.96	30.34
Total footprint of fuelwood per village						59,594	70,436	203,131	231,070
Total available agricultural land per village / biocapacity						5,275.88		14,879.91	
Ecological deficit= Footprint-Biocapacity						54,318	65,160	188,251	216,190
`Total area for the villages						11,218.88		23,840.13	

Minimum value is based on percentage of households at field who used the reserved forest for fuelwood collection while maximum value is based on Tanzania- rural areas country fuelwood information for cooking of 2010 (91% use firewood and 8% use charcoal).

agricultural land. But, it is less compared to the amount they previously used to obtain from the forests, which are now reserved for the REDD project. Table 6 gives the ecological footprint of fuelwood, which shows the picture on the standard amount of space or land required to supply the total foregone fuelwood in the two villages.

The total ecological footprint for fuelwood of Karago village ranges from 59,594 to 70,436 global hectares per year (Table 6). This is an area of fuelwood production that should be solely dedicated to Karago village for its annual consumption of fuelwood. This amount land far exceeds the total area of the village. Due to the fact that the village sits on 11,218.88 ha of land, it means that it needs more than 5 to 6 times the available area for fuelwood production. This implies that Karago village almost has no land for fuelwood supply. The villagers are compelled to find other places to supplement the land deficit in order to maintain fuelwood supply. Based on the 2012 census, the village population was 8703 people, while the fuelwood footprint per capital was about 6.8 to 8.1 global hectares per year. Also, based on the total available land for agriculture from which fuelwood has to be accessed, it implies that some 54,318 to 65,160 ha are needed to cater for fuelwood needs for whole village. This implies that the land deficit for fuelwood supply at Karago village is less by 91 to 92.5%. This village land deficit (91 to 92.5%) is even greater than that of an average household land deficit (84.8%) by 6.2 to 7.7% within the villages.

Likewise, for the case of Ilagala village, the total area required to support fuelwood (ecological footprint) is about 203,131 to 231,070 global hectares per year. As the village sits on 23,840.13 hectares of land, it uses more than 8.5 to 9.7 times the available village area per year for fuelwood. Just as is the case with Karago village, this implies that the fuelwood footprint of Ilagala has also exceeded its biocapacity. People consume more fuelwood more than what is available within their boundaries. Based on the 2012 census, the village population stood was 21,246, thus the fuelwood footprint per capital stands at about 9.6 to 10.9 global hectares per year. Also, based on the available village agricultural land, from which fuelwood has to be harvested; it implies that a land size of about 188,251 to 216,190 hectares is needed to cater for fuelwood in Ilagala village. This implies that in Ilagala village, the land required to supply fuelwood is less by 93 to 94%. This village land deficit (93 to 94%) is even larger than that of average household land deficit (92%) by 1 to 2% within the villages.

In real sense, the extra land required by the two villages is not feasible, even if the reserved forests could be availed to the villages for acquiring fuelwood. Since the village land deficit in both villages is higher than individual land deficit, there is a very small possibility for the people being given sufficient land by village government(s). Thus if there were no efforts for forest conservations, it could have reached a point whereby the whole village land and their forests would be completely exhausted. That might be the reason why there was previously a high environmental degradation in terms of deforestation and forest dilapidation in the villages. However, when compared with the fair earth share which is 2 ha per each person, the Karago village ecological footprint for fuelwood would have to be reduced by 70.6 to 75.3 percent and 76.5 to 79.4 percent for Ilagala in order to be ecologically sustainable. This means that the average household firewood consumption for Karago should not exceed 0.3 m^3 per weekand 0.35 m^3 per week for Ilagala. Also, for the case of charcoal, the average household consumption for Karago should be 7 kg per month only and 3 kg per month for Ilagala.

Monetary value of the foregone fuelwood

Karago and Ilagala villages have accepted the implementation of REDD project and foregone the value

Table 7. A fair compensation for the foregone monetary value of fuelwood for households.

Type of Fuelwood	Cost Code	Nominal Cost (USD / Tsh)	Source	Monetary Value per year (USD / Tsh)	
				Minimum	Maximum
Firewood	Cost of firewood	18, 000 - 20, 000 /=per m^3	UNDP (2011)	1,040,000	1,560,000
	Cost of labor (time in collection)	0.5USD (750/=) per effective hour	UNDP (2011)	819,000	936,000
Subtotal				1,859,000	2,496,000
Charcoal	Cost of charcoal	8,000-10,000 per bag	Village charcoal businessmen	60,000	90,000
Grand total				1,919,000 ($1,279)	2,586,000 ($1,724)

utilization of the forests, especially the harvest of fuelwood. However, due to the high ecological footprint of the villages which does not correlate with the available land, people have almost no land in the village(s) for collecting fuelwood, hence have to go elsewhere and, if it is within the village, then it will be very far away from their residential areas. This has both time and distance implications. Thus, for the project to be fair, people may need to be paid 1,859,000 Tshs – 2,496,000 Tshs ($ 1239-$ 1,664) per household per year as compensation for firewood costs, and 60,000Tshs- 90,000Tshs ($ 40-$ 60) per household per year as compensation for charcoal costs. Therefore, in general, the total amount of money to be paid directly to each household in the villages is supposed to be 1,919,000 Tshs – 2,586,000Tshs ($ 1279-$ 1,724) per year for fuelwood consumption (Table 7). This amount is far bigger by 92-94 percent compared to the sum the project has promised to pay each household per year which is $ 100. Generally speaking, the promised amount of money for the foregone ecosystem goods and services is not sufficient to meet their needs. Household interviews and questionnaires revealed that people can neither use the promised money as the substitute for fuelwood nor for activities related to forest ecosystem management, but rather for doing unrelated activities like business and paying children's school fees. This constituted more than 44% of interviewed households in Ilagala and 30% of households in Karago villages. It implies that people have accepted the REDD project and foregone forest ecosystem goods and services so as to get cash to solve their problems.

Environmental and social implications of ecological footprint and monetary value of the foregone fuelwood in Ilagala and Karago Villages

It is clear that due to people's plans on the use of cash to be paid as a compensation of the foregone fuelwood, no matter how much the households will be paid, deforestation and forest degradation in the villages is likely to be very high, to the extent of nullifying the efforts of REDD project. The ecological footprints for both households in Ilagala and Karago villages and that of their respective villages are quite high, in comparison with global standards of ecological footprint. This is likely to increase even more since the population of these villages increases while the land is fixed and hence, more .ecological footprint. The amount of land available in Karago and Ilagala villages is not enough to meet their fuelwood demand (Table 6). The land required for firewood collection exceeds the available land; a situation of ecological overshoot is likely to occur and may lead to degradation of natural capital and a consequent decrease in economic and social welfare.

Since the majority (70-70.4%) depends on agricultural activities as the main economic activity in all village areas, this has implications on the conservation of the forest resources. This is due to the fact that if the land on which farmers utilize for farming in these areas losses fertility, they (farmers) will always tend to move towards virgin land so as to access fertile soils, which, in this case, is the forest reserves (Shemdoe et al., 2011). However, over exploitation of fuelwood and the unimodal type of rainfall with an overall trend that keeps on decreasing at the rate of 2.9 mm/year could aggravate forest degradation to the extent of exceeding the natural regenerative capacity of biomass.

High environmental footprint of the two villages implies that villages should depend on nearby villages to cater for the supply of fuelwood, thus the high likelihood of inviting social conflicts as people will compete for available land for fuelwood. Field study has revealed that there are already some land conflicts (20-42.5% of households), which, with time, will be transformed into worst case scenario. In addition, if there shall be no strict strategies on protection of forest reserves, people could even be tempted to collect fuelwood in the reserved forests due to long distance that people have to cover in search of firewood. Measures should therefore be taken to reduce household consumption of fuelwood by high percentage so as to avoid ecological overshoot and the associated environmental impacts. This, therefore, necessitates the need for people to use fuelwood at a slower rate than they are regenerated. It goes without saying that if there will be no change in lifestyle while the populations of Karago and Ilagala villages keep on increasing, then the villages will experience even more deforestation and forest degradation in the future to the extent of nullifying the achievements of the REDD project.

Conclusion and recommendation

The study has indicated the most alarming environmental and socio-economic situations in a foreseeable future. The conservation initiatives should thus balance people's needs with sustainable development and consider investing more in their alternative livelihood projects as well as encouraging them to use high energy and efficient cooking technology. In regard to possible payments modalities, these should be done through their village government account in order to facilitate development activities that will benefit the whole village communities as well as protect and preserve the forests, not just some individuals. This study has generated useful information that needs to be taken into consideration especially when developing variable benefit sharing mechanisms in various REDD-based areas. The information could also be useful to agricultural developers, renewable energy investors, natural resources managers, hydrologists and environmental planners. The study recommends a high need for conservation projects such as the REDD project to cooperate with village government in tree planting campaign in the farm fields and encouraging the use of improved stoves so as to cut down costs of fuelwood access in the foreseeable future.

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