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FOREST ECOSYSTEM SERVICES AND LIVELIHOOD OF COMMUNITIES AROUND SHUME-MAGAMBA FOREST RESERVE, LUSHOTO, TANZANIA

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Abstract
A study on the potential of forest ecosystem services to the livelihood of communities around Shume-Magamba Forest Reserve in Lushoto District, Tanzania was conducted. Questionnaire survey, focus group discussion and participant's observation were used. Qualitatively and quantitatively data were analysed using the Statistical Package for Social Science. Provisioning services were mostly recognized by local communities as the service provided by forest ecosystem followed by cultural services. Provisioning services played greater role in people's livelihood by generating subsistence income. Income generated (66%) by both men and women were highly used to cater for food, health and education. There was no significant difference between gender and income generated from provisioning services to household livelihood. Men were mainly involved in forest protection and tree planting conservation aspects while women involved in law enforcement thus attaining sustainable forest ecosystem utilization. Fire incidences, planting crops near to water sources and illegal timber harvesting were observed to be the main constraints towards sustainable use of forest ecosystem services. It is concluded that, communities were highly uncertain on the potentials of forest ecosystem services to the livelihood, but in actual fact ecosystem services provide both direct and indirect benefits for household livelihood though the income generated is low.

Key Words: *Forest ecosystem services, Shume-Magamba Forest Reserve, Tanzania*

Introduction

Forest ecosystems provide a wide range of services from which people benefit and upon which all life depends. Ecosystem services are classified into four categories (provisioning, regulating, supporting and cultural). Provisioning services are products obtained from ecosystems including food, fuel, building materials and fresh water; regulatory services are benefits obtained through regulation of ecosystem processes such as climate regulation, flood control and pollination; supporting services are services necessary for production of all other ecosystem services as nutrient cyclic, soil formation and waste management; and cultural services are non material benefits obtained from ecosystem like spiritual area, aesthetic and tourism destination (Bond *et al.,* 2009; MA, 2005). All of these benefits

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depend on the flow of ecosystem services and are non-existent if these services cease to flow. They provide significant economic benefits to surrounding communities and contribute to spiritual, mental and physical well-being, help to fulfill an ethical responsibility to respect nature and provide opportunities to learn about nature and the biodiversity (IUCN, 2000).

Ecosystem services are of enormous value to human society. It was estimated by Costanza *et al.* (1997) that the annual value of these services was $33 trillion, compared to global gross national product total at that time was around $18 trillion per year. Although this figure has proved controversial, there is no doubt that ecosystem services represent a massive contribution to the economic wellbeing of all societies. Furthermore, many of the services are simply irreplaceable. For example, there is no way of providing food to the human population except through the use of natural systems involving soil organisms and crop plants, or of providing drinking water, except through the operation of the water cycle which depends critically on the activities of organisms (Costanza *et al.,* 1997).

The concept of ecosystem services has become important basing on the role of nature for maintaining human livelihoods especially in contributing substantial net gains and economic development. Generally, ecosystem services are little understood and too sophisticated but yet the important roles they play in household livelihood are not being recognized adequately in economic markets and government policies (MA, 2005). Valuing benefits derived from ecosystem services contributes towards better decision-making and highlighting much more clearly the implications for human well-being, while providing policy development with new insights (DEFRA, 2007).

Forest ecosystems and its beneficial services have been rapidly disappearing and becoming scarce, threatening future economic development and human well-being (Barbier, 2007). According to MA (2005) 60% of ecosystem services including forests are being degraded or used unsustainably, often resulting in significant harm to human well-being. A similar situation could be observed in West Usambara Mountain particularly Shume-Magamba Forest. In addition, increasing population, increases people's options for regulating their use of forest resources at sustainable levels are reduced (MA, 2005). Currently, the potential of forest ecosystem services to improve livelihood of communities around this forest reserve in West Usambara has not been adequately documented, despite the threats posed by continued degradation. Therefore, this study was conducted to assess the potential of forest ecosystem services to the livelihood of communities around Shume-Magamba Forest Reserve in Lushoto District, Tanzania.

Methodology

Study Area Description

Shume-Magamba Forest Reserve is located in Lushoto District, West Usambara Mountains. It is one of the thirteen blocks forming the Eastern Arc Mountains of Tanzania and Kenya, along the Albertine Rift. It is comprised of 12000 ha of moist montane forest, which

is a gazetted forest reserve, with 2500 ha under exotic plantation. The area is located at 04° 40' S and 38° 15' E with an altitude of 1,900 m above sea level in the West Usambara Mountains (Lovett, 1996). It receives two rain seasons, September to November and March to April with a mean annual rainfall ranging from 600 mm to 2000 mm. A minor and unreliable rain (Mluwati) occasionally occurs in August and September. The area has annual temperature ranging between 16^{o} - 22^{o}C (Haruyama and Toko, 2005). It has a total population of 75720 people (URT, 2002).

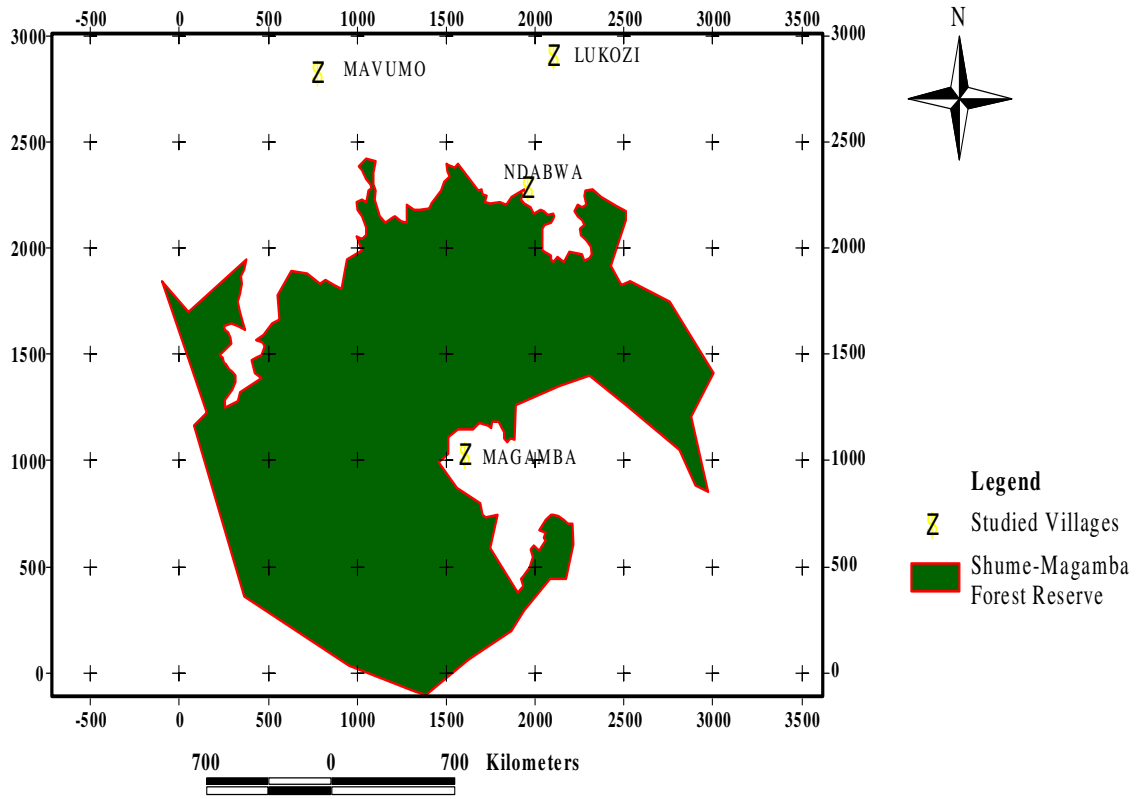

Figure 1: Map of Shume-Magamba Forest Reserve showing the location of study villages

Sampling Design

Multistage sampling strategy was used. In the first stage, a purposive sampling technique was employed in selecting 4 villages out of 21 villages surrounding Shume-Magamba Forest Reserve of which two villages were proximity to the reserve and other two villages were far from the reserve in order to determine the influence of forest ecosystem services to household livelihood. In the second stage, random selection of household within each of the 4 identified villages was done (Table 1). Random sampling aimed at minimizing bias as every individual in household had an equal chance of being selected. The sampling units in this study were households.

Table 1: Demography and distribution of selected households in the study area

Village	Total population	Male	Female	Household Number	Household sample
Magamba	4960	2279	2681	1111	38(29)
Lukozi	6500	3000	3500	1200	32(24)
Mavumo	3659	1447	2212	537	33 (25)
Ndabwa	914	452	462	351	28 (22)
Total	16033	7178	8855	3199	131(100)

Note: Numbers in brackets represents % sample of household

Data Collection Methods

Household questionnaire survey, focus group discussion and participant observation were used in data collection. Both closed and open-ended questionnaires were used to interview heads of households and key informants like village leaders and extension officer in order to gather various information's in relation to the study. In Focus group discussion, a group of 6 – 10 respondents of which men and women were incorporated was done. The meeting addressed general information of household characteristics, types of ecosystem services derived from the forest, potentials of forest ecosystem services to livelihood in terms of income, food, and health; the role of household member in sustainable use of those forest ecosystem resources within gender context and constraints towards their sustainable use in improving livelihood. A checklist was used to guide the discussion which was undertaken with key informants including village government leaders, elders and natural resource committee members.

Data Analysis

Both qualitative and quantitative information's were analysed using Statistical Package for Social Science computer software tools. Qualitative information's collected through verbal discussion and open ended questionnaires were broken down into smaller meaningful themes and analysed to bring statistical meaning. Data were explored for distribution of responses and central tendency (means, percentage and frequencies). Cross tabulation involving Chi-square test were employed to test the relationship between gender and contribution of forest ecosystem services to household livelihood.

Results

Forest Ecosystem Services

Provisioning services mainly water supply, fuel wood, medicinal plants, wild fruits and vegetables, grazing land, food and constructions materials were the most identified ecosystem services by the majority of households (73%). The rest of responses are as shown in Figure 2.

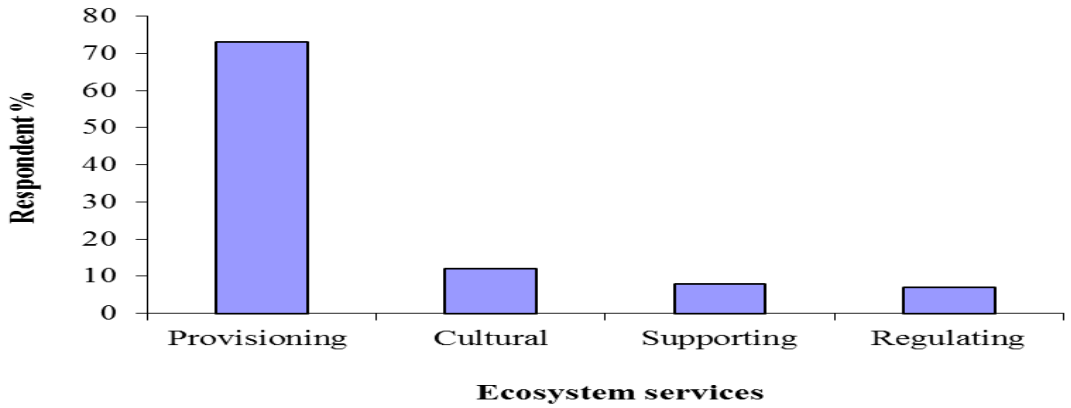

Figure 2: Identified forest ecosystem services by communities around Shume-Magamba Forest Reserve

Potentials of Forest Ecosystem Services to Livelihood

Direct benefits to Livelihood

Firewood Consumption at Household

Sixty-two percent of household in the study area collect fire wood for home consumption outside the reserve (Table 2). Few respondents (37%) of both men and women do use firewood collected direct from the reserve for household consumption. On the other hand, majority of the respondents (88%) were uncertain on the amount of money earned from selling firewood (Table 2) implying that firewood does not have any contribution in terms of income. Few respondents (4%) mentioned firewood to contribute 10,000-30,000 Tshs per month equivalent to 4.8-14.5 (US$) per month at household level.

Table 2: Gender, household firewood consumption and income earned

Quantity of firewood (Bundles)	Male	Female	Total
<5	37(30)	37(18)	37(48)
5-10	1(1)	2(1)	1(2)
None	62(51)	61(30)	62(81)
Total	100(82)	100(49)	100(131)
Income per month (Tshs)			
<10000	2(2)	4(2)	3(4)
10000-30000	4(3)	4(2)	4(5)
30000-50000	1(1)	4(2)	2(3)
>50000	3(2)	2(1)	2(3)
None	90(74)	86(42)	88(116)
Total	100 (82)	100(49)	100(131)

Note: Numbers in brackets are frequencies

Honey Consumption at Household

Results showed 75% of the respondents were uncertain on the quantity of honey being used for home consumption followed by (24%) respondents who indicated to consume 1 – 10 litres annually (Table 3). Women (24%) consume at least large quantity of

honey as compared to male (23%). This implies that women use amount of honey in most of the household as emergency medicine for children's diseases and as diet. However, 90% of the respondents do not generate income from selling honey but few respondents (10%) earned at least little income.

Table 3: Gender, quantity of honey used and income earned from selling honey

Quantity used (litres) annually	Male	Female	Total
1-10	23(19)	25(52)	24(31)
11-20	2(2)	Nr	1(2)
None	75(61)	75(37)	75(98)
Total	100 (82)	100(49)	100(131)
Income earned per month (Tshs)			
<10000	2(2)	4(2)	3(4)
10000-20000	2(2)	Nr	1(2)
21000-50000	2(2)	8(4)	5(6)
>50000	2(2)	Nr	1(2)
None	92(74)	88(43)	90(117)
Total	100 (82)	100(49)	100(131)

Note: Numbers in brackets are frequencies, nr = no response

Medicinal Plants Consumption at Household

Seventy-seven percent of the respondents do not use medicinal plants to cure various diseases followed by 22% who consumed less than 5 bundles per month (Table 4). 24% of men at least have been observed to consume medicinal plants compared to women (18%). In addition, 85% of the respondents do not earn income from sale of medicinal plants implying little potential for livelihood security. However, a few of the respondents (8%) both men and women earn at least small income from sales of medicinal plants with higher number of women response (Table 4).

Table 4: Gender, quantify of medicines and income earned from selling of medicinal plants

Quantity used (bundles) monthly	Male	Female	Total
<5	24(20)	18(9)	22(29)
5-10	Nr	2(1)	1(1)
None	76(62)	80(39)	77(101)
Total	100 (82)	100(49)	100(131)
Income earned per month (Tshs)			
<1000	1(1)	6 (3)	3(4)
1000-1500	5(4)	2(1)	4(5)
1500-10000	6(5)	12(6)	8(11)
None	88(72)	80(39)	85(111)
Total	100 (82)	100(49)	100(131)

Note: Numbers in brackets are frequencies, nr = no response

Water Consumption at Household

Majority of the respondents (61%) of both men and women reported not to consume water from household's tapes rather they depend directly on water from streams from the forest for their household domestic consumption (Table 5). Results further revealed that, 95% of the respondents were uncertain on the amount of money earned from sale of water from household tapes (Table 5)

Table 5: Gender, water used and income earned from selling taped water from tapes

Quantity used (litres)	Male	Female	Total
<100	33(27)	35 (17)	34(44)
100-200	6(5)	2(1)	5(6)
>200	Nr	2(1)	1(1)
None	61(50)	61(30)	61(80)
Total	100 (82)	100(49)	100(131)
Income earned (Tshs)			
1000-10000	1(1)	4(2)	2(3)
>10000	4(3)	2(1)	3(4)
None	95(78)	94(46)	95(124)
Total	100 (82)	100(49)	100(131)

Note: Numbers in brackets are frequencies, nr = no response

Poles for Household Use

Ninety-six percent of the respondents do not earn income from sale of poles (Table 6). Findings showed that communities use mud bricks, burned bricks, timber and hedges around their homesteads for house construction. This probably might be the reason of having a small number of respondents reporting to earn income from sale of poles. Also people were generally reluctant to reveal the extent of cutting poles beyond their domestic use probably because they fear being prosecuted from utilizing the services.

Table 6: Gender and income earned from selling poles in the study area

Income earned per month (Tshs)	Male	Female	Total
<100000	4(3)	Nr	2(3)
>200000	1(1)	2(1)	2(2)
None	95(78)	98(48)	96(126)
Total	100 (82)	100(49)	100(131)

Note: Numbers in brackets are frequencies, nr = no response

Indirect Benefits to Livelihood

Majority of the respondents (66%) both men and women use subsistence income generated from sale of forest ecosystem services for food, health and education with higher number of responses from men (Table 7). This implies that probably men do collect forest ecosystem products for commercial purpose to increase household income which in turn increases diversification of household livelihood.

Table 7: Gender and indirect benefits accrued from forest ecosystem services

Uses	Respondent category		Total
	Male	Female	
Food	10(8)	16(8)	12(16)
Health	1(1)	4(2)	2(3)
Education	2(2)	4(2)	3(3)
Infrastructure	nr	2(1)	1(1)
Food, health and education	70(57)	60(29)	66(86)
Both	11(9)	10(5)	11(14)
Uncertain	6(5)	4(2)	5(7)
Total	100 (82)	100(49)	100(131)

Note: Numbers in brackets are frequencies, nr = no response

User Groups and Conservation of Forest Ecosystem

Results indicated that men (67%) and (24%) are mostly involved in the forest protection and tree planting respectively while women (29%) are involved in law enforcement (formulation and uses of forest by-laws) (Figure 3). Results revealed clear gender division of labour at household level regarding the conservation of forest ecosystem to derive the services sustainably.

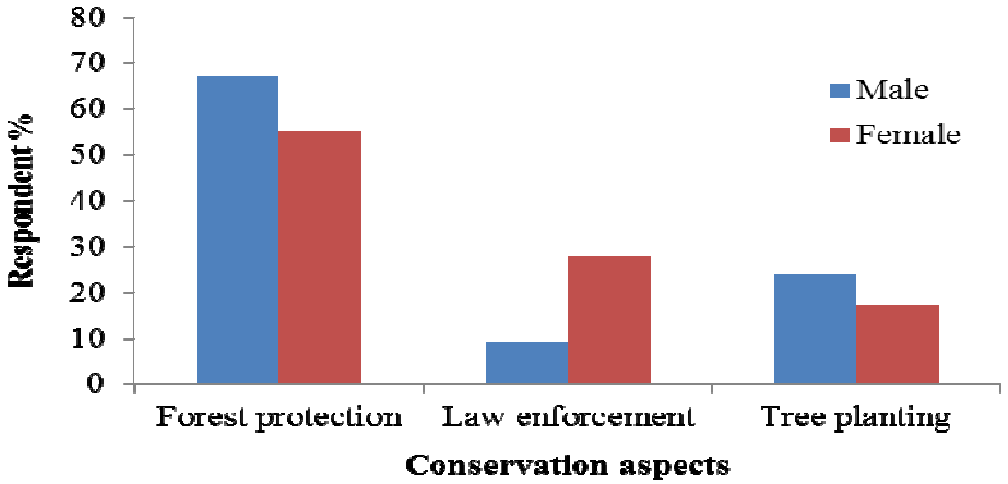

Figure 3: The role played by different user group in the conservation of ecosystem services

Constraints Towards Sustainable Use and Consumption of Forest Ecosystem Services

Forty-five percent of the respondents were uncertain on the constraints towards sustainable use and consumption of forest ecosystem services (Table 8). Fire incidences and planting crops near water sources were the main constraints to the sustainable use and consumption of forest ecosystem services in the study area as revealed by 30% of the respondents with higher number of women responses as compared to men. The rest of the results are indicated in table 8.

Table 8: Gender views on the constrains towards sustainable use of Ecosystem services

Constraints	Respondent category		Total
	Male	Female	
Fire setting and planting crops to water sources	28(23)	35(17)	30(40)
Encroachment, agriculture and fire setting	5(4)	6(3)	5(7)
Illegal timber harvesting and firewood collection	21(17)	16(8)	19(25)
None	46(38)	43(21)	46(59)
Total	100 (82)	100(49)	100(131)

Note: Numbers in brackets are frequencies

Discussion

Forest Ecosystem Services

Forest ecosystems provide a diversity of services vital for human well-being and poverty alleviation. In Shume-Magamba forest, provisioning services mainly water supply, fuel wood, medicinal plants, wild fruits and vegetables, grazing land, food and constructions materials were the most identified ecosystem services by the majority of households. This imply that majority of the respondents are knowledgeable on the types of provisioning services available and their importance to livelihood. Arnold and Perez (1998) noted that large number of rural households in Africa continue to generate some of their income from forest products and services. Similar findings are reported by Antwi (2009) at Bobiri forest area in Ghana where provisioning services were classified as very important forest ecosystem services followed by regulating services. According to Shackleton *et al.* (2008) in arid and semi-arid areas of South Africa, regulating services were not consumed directly or sold to generate income, thus their role in supporting livelihoods and buffering against poverty was less easily demonstrated compared to provisioning services.

Direct Benefits to Livelihood

Communities in the studied villages were found to depend mostly on provisioning services as their direct benefits; however focus group discussion noted the amount of ecosystem products collected per month/season which was taken as indicator to meet the demand for household livelihood in terms of fuel wood etc. Cavendish (2000) reported that forest product and services are critically important to local forest users as a primary, supplementary or emergency source of income. A similar situation could be assumed for communities around the study area.

Firewood consumption was reported to be one of the provisioning services derived from Shume-Magamba forest. Few respondents reported to use firewood collected inside the reserve but majority of the respondents feared to reveal the truth regarding fuel wood consumption from the reserve to avoid being prosecuted from utilizing the services or were ignorant on the quantity they can consume. However, all respondents reported to use firewood for home consumption. The results are similar to the study by Maximillian (1998) in Kibaha District and Lema (2003) in Morogoro Rural District where majority of households used firewood for

home consumption. Elsewhere, results also conform to those reported by IEA (2002) and Williams and Shackleton (2002) where rural households have been reported to use firewood as their primary source of energy in southern Africa. Few respondents (4%) mentioned firewood to contribute 10,000-30,000 Tshs per month at household level. The results are different to those reported by Barany *et al.* (2005) in Mozambique where households are more dependent on income from the sale of forest products (i.e., firewood) and most of the activities requires firewood as an input (i.e., brewing, food vending). Results are also contrary to those reported by Mukul (2007) in Bangladesh where villagers entirely or moderately depend on the surrounding forest reserve for selling of firewood to provide cash income.

Honey was less profitable provisioning service because most of the respondents do not have appropriate beekeeping equipments, knowledge and management the small amount of honey obtained was mainly used as food for home consumption. One litre of honey was sold at 4000 Tshs. The reason for this could probably be the fact that communities in the study area do not have adequate knowledge on modern methods of honey production such as use of modern beehives. The few collectors simply collect honey from dead tree trunks and traditional beehives. These findings are not in line with the study conducted by Monela *et al*. (2000) in miombo woodlands of Tanzania where honey contributed significantly to the cash income of local communities.

In addition, findings revealed that men at least have been observed to consume medicinal plants compared to women. The high percentage of men could probably be due to their access to the forest reserve as most of the medicinal plants are not found close to the forest boundary where women fear to be caught as it was noted through discussion. Communities in the study area are currently relying more on dispensaries and hospitals for their daily treatment. The results are contrary to the study by Kessy (1998); Luoga *et al.* (2000); Dery *et al.* (1999) who reported that rural areas of Tanzania rely more on traditional medicines, than on modern treatment due to scarcity of hospitals, dispensaries, lack of medicines and associated costs. It was noted that, a person can earn 1500-10,000 Tshs per month. Similarly, Lebora (2007) in Lindi Rural District reported that, medicinal plants from forest reserve were generating an average income of Tshs. 3000 per month from a cured patient as a reward.

Findings revealed that, water from tapes does not have any contribution in terms of income. A similar assumption could be made with regards to presence of forest streams which supply plenty water free of charge to the communities in the study area. However few respondents (3%) mentioned water from tapes contribute an average income of >10000 Tshs. per month. Little water from tapes sold was used for home consumption and for making bricks at a cost of 500Tshs/bucket of 20 litres. The observations are different from those reported by Ngwenya and Kgathi (2006) in Botswana who reported that, fresh water for domestic use is the most obvious service that generates income for household livelihood. Furthermore, water from forest streams was used to irrigate agricultural crops and the revenue generated from selling of these crops was

used to cater indirect needs for household livelihood. These observations are similar to FAO (2007) who reported that forest ecosystem services provide sustainable water to various communities and most of this water is used in agricultural irrigation activities.

In addition, most household use poles for their own requirements and not for sale and almost all cutting of poles are done illegally. Similar observations were reported by Masanja (2004) in Coast Region. Contrary, Lebora (2007) reported that, poles are used for immediate household use like construction of houses, making of beds, storage facilities for storing harvested crops and fence around homestead hence generates income for household livelihood. The findings are also contrary to those reported by FAO (2011) that, although house construction styles have changed in some areas, majority of rural people still rely on their surrounding forest resources for the bulk of their house construction needs especially poles. Findings also indicated that a few men (4%) earned a small income from selling poles than their women counterparts. This is probably due to the fact that, men are culturally highly responsible for the collection of poles from the forest as compared to women in the area, hence obtain some small income for the household livelihood.

Indirect Benefits to Livelihood

Majority of the respondents revealed that, income generated from sale of forest ecosystem services for food, health and education with higher number of responses from men. This implies that probably men do collect forest ecosystem products for commercial purpose to increase household income which in turn increases diversification of household livelihood. Findings by Nyingili (2003) observed income from selling forest products and services being used for regular household expenditures. Similarly, Lema (2003) in Morogoro Rural District and Yasin (2011) reported that the income earned from selling forest products was used to buy food during scarcity, hence indirect contribution to household livelihood. According to McSweeny (2004) being able to collect and use forest resources to meet daily needs for energy, shelter, food and medicine, allows the scarce cash resources to be used to secure other household needs and the accumulation of the necessary assets for a more secure livelihood. Moreover, the cost-saving has benefits not only at the household level, but also the national level (Shackleton, 2001).

User Groups and Conservation of Forest Ecosystem

Forest protection, tree planting and law enforcement were introduced by environmental committee in the study area as one of conservation strategies. Both men and women are now able to integrate conservation of forest ecosystem and development activity in their struggle to achieve sustainable development for household livelihood. User groups are currently encouraged by environmental committee on the sustainable utilization of forest ecosystem in the study area by regulating and/or controlling accessibility of different forest products and services in the forest reserve. Similar observations has been reported by NEMC (2006) that, the government has undertaken a number of strategies that are conservation-oriented to enhance natural heritage, so as to meet the needs of the communities whose livelihood is directly linked with the

ecosystems and resource use. The observations are also similar to Mukul (2007) in Bangladesh who reported that, people came to an understanding about the necessity of conserving forest ecosystem for their survival and to secure their future generations, through change mind set and in turn earn revenue in clear and authorized ways.

Constraints towards Sustainable Use and Consumption of Forest Ecosystem Services

Households were not ready to disclose informations on the constraints towards the uses of forest ecosystem services. The reason for this could be fear that the researcher was investigating around the forest reserve. Fire setting and planting crops to water sources, encroachment, expansion for agriculture and illegal logging were the main constraints towards conservation of forest ecosystem services. Similar results have been reported by FAO (2003) that, fire setting, encroachment, illegal logging and agricultural expansion are the main problems causing loss of forest product and services especially in Eastern, Southern and Western Africa. CDRI (2010) in Cambodia reported that, several ecosystem services that contributed to household income gradually decreased over the period 1999-2008 due to illegal timber harvesting and clearing of forests for agriculture. These constraints facing forest ecosystem at Shume-Magamba Forest Reserve need to be overcome so that communities could achieve optimal products sustainably.

Conclusions

Forest ecosystems provide huge direct values to human livelihood besides the indirect benefits and that the indirect values are equally important as the direct values. The potentials of forest ecosystem services to local livelihood was not significant due to the fact that most of these services are undertaken illegally, no formal markets, reliable informations and records currently existing for ecosystem services. However, the contribution of ecosystem services to livelihood were highly uncertain to communities in the study area but in actual fact they provide both direct and indirect benefits for household livelihood though the income earned is too low. The small revenue generated by both men and women from sales were used to cater for food, health and education. There were clear division of labour between men and women regarding conservation of forest ecosystem for the household livelihood. Fire incidences, planting crops near to water sources, illegal timber harvesting and encroachment for agriculture were the main constraints towards the sustainable uses of forest ecosystem services.

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