 J Biodiversity, 2(1): 31-39 (2011)

The Influence of Socio- economic Factors on Deforestation: A Case Study of the Bereku Forest Reserve in Tanzania

Richard A. Giliba[1], Emmanuel K. Boon[2], Canisius J. Kayombo[1], Leonard I. Chirenje[3] and Emmanuel B. Musamba[4]

[1]Forestry Training Institute, Arusha, Tanzania
E-mail: richiea78@yahoo.com
[2]Human Ecology Department, Vrije Universiteit Brussel, Belgium,
[3]African University of Zimbabwe,
[4]Ministry of Natural Resources and Tourism

KEYWORDS Socio-economic Factors. Miombo. Human Disturbance. Deforestation

ABSTRACT Deforestation in forest reserves which is mainly driven by socio-economic factors is considered as one of the key issues of the sustainable use and management of biodiversity. This paper analyses socio-economic factors influencing deforestation in the Bereku forest reserve in Tanzania. Data were collected through questionnaires, interviews, focus group discussions and field observations. Descriptive and inferential methods were used to analyse and explain quantitative data while content analysis was used to analyse qualitative data. The results revealed that livelihood activities, period of residence close to forest and distance from homestead to the forest significantly influence deforestation in the study area. In addition, farm land size, household size, education, awareness of the management of the reserve and its boundaries insignificantly influence deforestation. It was also revealed that the reserve fringe communities are aware of the negative consequences of deforestation and forest degradation. The paper concludes that the causes of deforestation in the Reserve are deeply rooted in the daily livelihood needs of communities and the growing population. Forestry education and extension services should be directed at institutional strengthening catalyzing local communities to actively participate in decision making processes aimed at conserving the forest and improving the livelihoods of rural communities.

1. INTRODUCTION

Miombo woodland is the most extensive tropical seasonal woodland and dry forest formation in Africa, covering an estimated 2.7 million km^2 in regions receiving more than 700 mm mean annual rainfall on nutrient-poor soils (Campbell and Byron 1996; Frost 1996). It covers substantial portions of south and central Africa: Angola, Zimbabwe, Zambia, Malawi, Mozambique and Tanzania, and most of the southern part of the Democratic Republic of Congo (Campbell et al. 1996). In Tanzania, Miombo constitutes the largest single vegetation type in the country (93.2 %), the relatively dry Miombo woodlands cover extensive areas of western, eastern and northern regions (Millington et al. 1994).

Globally, the trend of accelerated environmental degradation in recent times has primarily been driven by land use changes as a consequence of frontier expansion and population growth (Richards 1990). Land use practices and land use significantly impact natural forests, the environment and the whole biosphere. Social, economic and political factors have created incentives for rapid exploitation of forests and intensified pressure on the remaining tropical forests and arid woodlands (Sharma 1992). The forests of Africa are the most depleted of all the tropical regions with only 30 per cent of the historical stands still remaining (Chidumayo and Kwibisa 2003).

Socio-economic factors are contributing to alter or deplete the forest cover and affect forest structure and species composition (Schwartz and Caro 2003). The intensity of disturbances also varies within a given landscape in terms of land-use, accessibility, topography and the type of vegetation present. The increase in dominance of small woody trees in harvested Miombo woodlands suggests that the woodlands may degrade to shrub lands due to anthropogenic pressures (Luoga 2000).

Population growth is undoubtedly one of the most critical socio-economic factors that could alter the pattern of forest resource use. Seventy-five million people inhabit areas covered or formerly covered by Miombo woodland, with an additional 25 million urban dwellers relying on Miombo wood or charcoal as a source of energy (Campbell et al. 1996). The Miombo has some specific biogeographical features that influence

the context for people's use of woodland resources. These resources are central to the livelihood systems of millions of rural and urban dwellers in central and eastern Africa (Campbell et al. 1996). Luoga et al. (2000a) found that in Eastern Tanzania, apart from using Miombo woodlands for farming, local people had eleven types of uses for the trees, including charcoal, firewood, poles, timber, medicine, withies, food, ropes (fibre), live fences, carving and rituals.

Despite the fact that Miombo woodlands offer extensive products and services, there is scanty information on the socio-economic factors driving human disturbances in these woodlands. The impacts of deforestation on tree and shrub species diversity in Miombo woodlands have been studied in Tanzania (Luoga 2000; Zahabu 2001). These studies indicate that, there is a knowledge gap on the anthropogenic factors that are causing deforestation in Miombo woodlands. This paper analyses the factors influencing deforestation in Bereku Forest Reserve. The information presented in this paper is relevant for scientists and decision makers dealing with sustainable management of natural resources and forest reserves in particular.

2 MATERIALS AND METHODS

2.1 The Study Location

Babati district is located at latitude 4°132 South and longitude 35°452 East, 1300-1800 m.a.s.l, Manyara Region, northern part of Tanzania. The district has a total area of 5660 km^2. It is bordered to the north by the Arusha Region, to the south-east by the Simanjiro District, to the south by the Dodoma Region, to the south-west by the Hanang District, and to the north-west by the Mbulu District. The Bereku forest has a total area of about 5,660 ha. The forest is typical dry Miombo woodland located within the Rift valley, about 20 km south of Babati township, accessed by road and surrounded by a total of 9 villages. The forest is dominated by *Brachystegia microphylla (*Hamas.), *B. spiciformis (*Benth.), *Julbernadia globiflora (*Benth.) and other associate tree species. This Miombo woodland contains the majority of commercially exploitable timber species including *Pterocarpus angolensis (*Dc.), *Dalbergia melanoxylon* (Guill. and Perr.), *Burkea africana (*Hook.), *Pterocarpus tinctorius* (Welw).

According to the population census in 2002 the district hosts 303,013 people. Based on this information the population in 2011 is projected to 379,461 people living in Babati district. Bereku forest reserve is surrounded by 9 villages with a total population of about 17,000 people. Most of the villages are linked by paths except for a few that link the main roads. Communities adjacent to Bereku forest reserve are mostly agro-silvopastoralists engaged in livelihood activities like firewood collection and charcoal making. Livestock keeping is mainly extensive though there are some zero grazing and semi-intensive systems. Part of the grazing is done in the natural forest, which is a key contributor to land degradation.

2.2 Data Collection

A socio-economic survey was conducted to gather primary data from people living around Bereku River Forest Reserve. Random sampling was used to select three villages which are adjacent to the reserve. Within these villages, random sampling was further used to select respondents for interview; 120 respondents across the selected villages were interviewed. Purposive sampling was used to select 15 key informants knowledgeable about the forest reserve, including one Regional Forest Officer, two District Forest Officers, three village forest officers, three village leaders and six village elders.

Information was obtained through questionnaires, interviews, focus group discussions and participant observation. Two focus group discussions were held in each village to help evaluate the accuracy of data collected through questionnaires and interviews (Kasemir et al. 2003). Each discussion comprised 6 community members, who were well informed on human factors influencing forest ecosystems. To overcome problems of alienation participant observation was used on entry into each community being studied. The researcher gained the confidence of the respondents without interfering with the natural course of events. This enabled the researchers to obtain honest answers to the questions posed (Kajembe and Luoga 1996).

2.3 Data Analysis

The Statistical Package for Social Sciences (SPSS version 16.0) was used for the quantita-

tive data analysis often sorting and coding of the data. Both descriptive and inferential statistical methods were used to analyse the quantitative data. Descriptive statistics such as frequency counts and percentages were used to explain and illustrate the socio-economic characteristics of the forest reserve fringe communities. Inferential data analysis was done using logistic regression to analyse binary dependent variables. The binary dependent variable of this study was 'deforestation in the forest reserve' which was assigned the value '1' if there is deforestation in the reserve and '0' if it is not the case. The independent variables were livelihood activities, farmland size, period of residence, awareness on general forest reserve management, and awareness of forest reserve boundaries, household size, education and distance. These are the independent variables (socio-economic factors) influencing deforestation in the reserve. Logistic regression model presented in equation (1) was used:

$Yi=1/1+e^{-z}$……..(1)

Where, Y_i = is a binary variable with the value of 1 if socio-economic factors contribute to deforestation in the reserve and 0 if otherwise;

$Z = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + ...+ \beta_n X_n$

β_0, β_1 to β_n = coefficients of independent variables showing marginal effect (positive or negative) of the unit change in the independent variables on the dependent variable; X_1 to X_n = independent variables; e = natural logarithm base (2.718); i = 1, 2 ….n; where n is the total number of variables.

For proper interpretation of the logistic regression results, the following were examined: the Wald statistics to see whether the increase in the independent variable is statistically significant or not; the sign of effect (β) to see whether the increase in the independent variable increase the likelihood of deforestation; magnitude of similarly measured variables to determine which of the independent variables seem to have greater influence on human activities in the reserve. The Exp (β) to see how much a unit increase in the independent variables changes the odds of success (deforestation). To assess the goodness of fit of the regression model to the data, two methods were used, namely the chi-square and the log likelihood ratio-test denoted by –2LL. By using the Chi-square test, the significance level of the model was tested at 0.05 probability level. The magnitude of the –2LL value also determined the goodness of fit of the model to the given data set, the smaller value of –2LL, the goodness of fit of the model.

The qualitative data were analyzed using content analysis. In this case, components of the verbal discussions held with key informants were analyzed in an objective and systematic manner. The recorded dialogue with the respondents was broken down into smallest and meaningful units of information or themes and tendencies (Kajembe 1994) and this helped in ascertaining values and attitudes of the respondents.

3. RESULTS AND DISCUSSION

3. 1 Socio- economic Factors Influencing Deforestation in the Bereku Forest Reserve

To establish the likelihood that the socio-economic factors influence human disturbances in the forest reserve, the factors were entered sequentially in the logistic regression model, checked and the insignificant factors were removed from the prediction model. The logistic regression model was again employed to assess the significant socio-economic factors influencing human disturbances in the forest reserve.

The goodness of fit of the model was found to fit well with the findings of this study (98.8%) (Table 1). A chi-square value of 85.88 with a degree of freedom of 8 was highly significant at 5% probability level (p=0.00), meaning that the independent variables (socio-economic factors) affected very well the dependent variable. Likewise, the – log likelihood (-2LL) value of 36.17 indicated that the model fitted the data well. Table 1 shows that Wald statistics are non-zero values, which implies that there is interaction between the dependent and independent variables. According to Norusis (1990) and Powers and Xie (2000), the non-zero Wald statistic values indicate the presence of relationships between the dependent and explanatory variables. Thus, on the basis of the results of this study the null hypothesis was rejected in favour of the alternative hypothesis that socio-economic factors significantly influence deforestation in the forest reserve at 5% level of significance.

These findings are in line with the study conducted in Uluguru forest in Tanzania by Mtinje et al. (2007) who argued that household size, education and farm land size contribute significantly to the degradation of forest re-

Table 1: Socio-economic factors influencing deforestation in the reserve

Variable	*β*	*S.E.*	*Wald*	*df*	*Sig.*	*(Expβ)*
Livelihood activities	5.737	1.667	11.846	1	0.001 *	3.213
Cultivated land size	-0.031	0.263	0.013	1	0.908 ns	0.970
Period of residence	3.547	1.527	5.394	1	0.020 *	34.726
Awareness on forest boundaries	-1.427	1.307	1.191	1	0.275 ns	0.240
Awareness on forest management	1.836	1.235	2.210	1	0.137 ns	6.271
Household size	0.477	0.318	2.248	1	0.134 ns	0.621
Education	-0.099	0.158	0.393	1	0.531 ns	1.104
Distance	-3.164	1.035	9.345	1	0.002 *	23.670
Constant	-3.256	2.754	1.398	1	0.237 ns	0.039

Number of cases = 120, Model Chi-square= 85.88 (p=0.000), -2LL = 36.17; Overall percentage = 98.8%, Exp (β) = odds ratio (probability of success/probability of failure), SE= standard error of the estimate, *Statistically significant at 0.05 level of significance, ns = statistically non significant at 0.05 level of significance, Sig = significance, β = regression coefficients which stand for the odds ratio of probability of success to the probability of failure and Wald statistics = $\beta/(SE)^2$, d.f = degree of freedom.

sources. Another study conducted in Miombo woodlands in Kenya by Oyugi et al. (2007) suggests that livelihood activities such as livestock keeping and charcoal extraction significantly impact tree abundance and diversity in Miombo woodlands. Livelihood activities, farmland size, period of residence, awareness on general forest reserve management, and awareness on forest reserve boundaries, household size, education and distance from homestead to the forest reserve are the factors influencing deforestation in the reserve (Table 1).

3.1.1 Livelihood Activities

Livelihood activities practised by households in the study area have a positive regression coefficient (β) of 5.737 with odds ratio (Exp β) of 3.213, meaning that a unit increase in livelihood activity will increase the likelihood of deforestation to the forest reserve by a factor 3.213 and vice versa (Table 1). Figure 1 shows the livelihood activities identified in the study area. Like many places in rural areas, farming constitutes 41% of the livelihood activities practised in the study area, livestock keeping (31%), firewood collection (17%), charcoal making (6%) and lumbering (5%) were the livelihood activities which entirely depend on Miombo woodlands resources. The results indicate that livelihood activities are impairing Miombo woodlands of Bereku Forest Reserve. Table 1 shows that the effects of livelihood activities in the Miombo woodlands were statistically significant at probability level of 5% (p = 0.001).

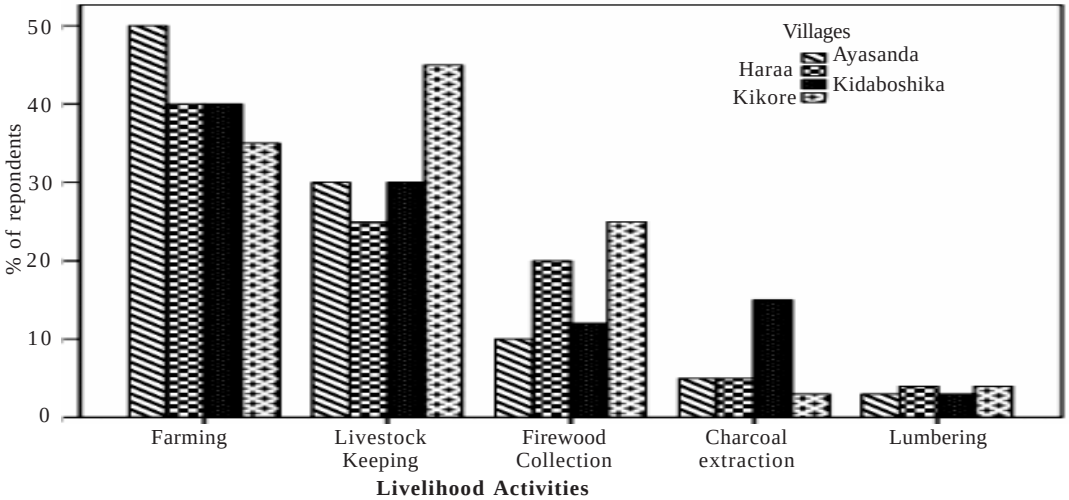

Fig. 1. Livelihood activities in the study area (N = 120)

3.1.2 Cultivated Land Size

Cultivated land size has negative regression coefficient (β) of -0.031 with odds ratio (Exp β) of 0.970 which was statistically insignificant at probability level of 5% (p = 0.908) (Table 1). In other words, increase in one unit of cultivated land size decreases the chance of human activities in the forest reserve by a factor 0.970 and vice versa. This implies that if a household has a large piece of land to cultivate, it will harvest more and will thus become self-sufficient in terms of food security and income. Consequently, reduce pressure the Miombo woodland. All the interviewed households possess land for agriculture (Table 2).

Furthermore, most households' land is acquired through inheritance and buying (74%). However, respondents (26%) mentioned that land is acquired through bush clearing in open land and not in forest reserve (Table 2). This is in line with field observations that no agricultural activities were observed by the researchers during the taking of forest inventories. The mean cultivated land size is 3.5 hectares per household. It was further observed that such land size produces respectively an average of 18 ± 0.5 (SE) and 12 ± 0.5 (SE) bags of maize and pigeon peas annually. Thus, considering the cultivated land size and the level of productivity, the cultivated land size is not adequate but it produces sufficient food to feed a mean household size of 6 individuals. Besides, it was observed that the land is fertile which produces very good harvest annually. The plausible reasons for the small size of cultivated land in the study area include the scarcity of land for farming and rapidly growing population. Shortage of suitable land for farming is placing communities in a relatively vulnerable situation. To combat such vulnerability, some households have developed livelihood strategies such as firewood collection, charcoal making and lumbering through which households earn supplementary income to mitigate their hardships. All these livelihood strategies are supported by the only nearby Miombo woodland of Bereku Forest Reserve.

3.1.3 Period of Residence

Duration of residence in the area has a positive regression coefficient (β) of 3.547 with odds ratio of 34.726 which was statistically significant at probability level of 5% (p=0.02) (Table 1). This means that the chance of human disturbances in the forest reserve increases by a factor of 34.726 for a unit change in this variable. In other words, increase in the number of years of residence of the households in the villages adjacent to the forest reserve increases the likelihood of the perception on forest reserve disturbance. The more people stay in a given place, the more their families grow in size. Thus, more forest products are demanded from the reserve and more land is required to meet the demands of the growing population.

Furthermore, the results indicate that about (75%) of the respondents have stayed in the villages for a period of more than 21 years and only (25%) for less than 21 years (Table 3). The fact that most of the respondents have stayed in the village for many years implies that they have enough knowledge of trends of deforestation activities and associated problems in their respective villages. People who live in a certain area for a longer period of time accumulate ex-

Table 2: Characteristics of respondents on farm-land in the study area

Characteristics	*Villages*				*Overall f (%) N=120*
	Ayasanda f (%) N=30	*Haraa f (%) N=30*	*Kidaboshika f (%) N=30*	*Kikore f (%) N=30*	
Land Holding					
Yes	30 (100)	30 (100)	30 (100)	30 (100)	120 (100)
No	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Total	30 (100)	30 (100)	30 (100)	30 (100)	120 (100)
Land Acquisition					
Inherited and bought	30 (100)	24 (80)	15 (50)	20 (67)	89 (74)
Bush clearing in open land	0 (0)	6 (20)	15 (50)	10 (33)	31 (26)
Clearing forest reserve	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Total	30 (100)	30 (100)	30 (100)	30 (100)	120 (100)

perience, on various problems associated with disturbance as well as the need for restoration of the reserve. Similar observations were reported by Nduwamungu (2001) and Kajembe (1994) which show that people who have stayed longer in an area are likely to provide relatively reliable historical data.

Table 3: Distribution of respondents by duration of residence

Years of residence	*Number*	*Percentage*
5-10 years	11	9
11-20 years	19	16
21-30 years	24	20
Above 30	66	55
Total	120	100

3.1.4 Awareness on Forest Reserve Boundaries

The results in Table 1 further indicate that awareness on the forest reserve boundary has a negative regression coefficient (β) of -0.031 with odds ratio (Exp β) of 0.240. This implies that an increase in awareness on reserve boundary indicate that human activities in the reserve has decreased by a factor of 0.240. The increased clearance and maintenance of reserve boundaries distinguishes it from other areas where the land tenure is consolidated. Clearly, the boundaries tend to frighten the encroachers from entering the reserve thereby reducing the chances of deforestation. When the reserve boundaries are not cleared, people from reserve fringe communities who are short of farmlands and grazing areas may not distinguish the reserve from other lands. Thus, they freely enter the reserve to engage in different socio-economic undertakings. This eventually increases the pressure on the reserve and high impact disturbances.

3.1.5 General Forest Reserve Management Awareness

Awareness of the management of the forest reserve has a positive regression coefficient (β) of 1.836 with odds ratio (Exp β) of 6.271 (Table 1). This indicates that perception on disturbance in the reserve increases by a factor of 4.937 for every unit change in this variable. In other words, the perceived proper management of the forest reserve is statistically insignificant (p=0.137); the perception of disturbances in the reserve by the adjacent communities exhibits a decreasing trend.

Although most of the household respondents (90%) indicated that the forest reserve is generally properly managed (Table 4), the key informants expressed concern about grazing, charcoal making, firewood collection, inadequate staff and expertise to manage the reserve, low priority accorded forestry activities by district authorities and low level of awareness on the importance of the reserve by the surrounding communities. All these factors have contributed towards the increasing disturbances in the forest reserve. Proper management of the reserve will help to increase awareness on the deforestation and reduce the pressure of human activities in the reserve.

3.1.6 Household Size

Household size determines per capita collection and utilization of Miombo woodland products and therefore influences human disturbance. Household size has a positive regression coefficient (β) of 0.477 and the odds ratio (Exp β) of 0.621 (Table 1). This implies that an increase in the household size, which was statistically insignificantly at probability of 5% (p=0.134), increases perception on human disturbances in the reserve by a factor of 0.261. This suggests

Table 4: Awareness on forest reserve management in the study area

Characteristics	*Villages*				*Overall f (%) N=120*
	Ayasanda f (%) N=30	*Haraa f (%) N=30*	*Kidaboshika f (%) N=30*	*Kikore f (%) N=30*	
Forest Management					
Properly managed	30 (55)	30 (100)	30 (100)	18 (60)	108 (90)
Not properly managed	0 (35)	0 (0)	0 (0)	10 (33)	10 (8)
Don't know	0 (10)	0 (0)	0 (0)	2 (7)	2 (2)
Total	30 (100)	30 (100)	30 (100)	30 (100)	120 (100)

that household size in the study area facilitate the contribution of Miombo woodlands to livelihoods of local communities. In other words, given the most household members in the study area are in the working class (30 – 50 years old), the larger the household size, the higher the chances that the members will be involved in various livelihood strategies that depend on reserve's resources. However, the effect of household size on odds of contribution of the Miombo woodland was not statistically significant (Table 1), yet the variable is very important in terms of livelihoods. The mean household size is 6 people. A larger household size will imply an over-exploitation of the reserve's resources to satisfy livelihood needs. Such implications have been confirmed by Nduwamungu (2001) and Madulu (1996) who reported a strong relationship between household size and environment degradation.

3.1.7 Education

Education has a negative regression coefficient (β) of -0.099 with odds ratio (Exp β) of 1.104. This implies that an increase in education, which was statistically insignificantly (p=0.531), decreases human disturbances in the reserve by a factor of 1.104. That is, farmers who can read and write are most likely not to disturb the reserve than those who have not been to school. Education is an important issue in development of livelihood strategies as it determine which livelihood activities a household is involved. In the study area, 94% of the respondents have received at least primary education (Table 5). Therefore, education is an enabling factor that influences households in the study area to engage in various livelihood activities. Similar arguments were put forward by Shali (2003) in the Coastal region of Tanzania. He emphasized that the level of education has a remarkable bearing on sustainable management of natural resources. However, the effect of education on odds of human disturbance was not statistically significant (Table 1), yet the variable is very important in improving livelihoods. It was generally acknowledged that education is perceived as being among the factors that influence an individual's perception on disturbance. According to Mitinje et al. (2007), education is normally considered as the key to improved opportunities for development and accessibility to information and services.

3.1.8 Distance

Distance from homestead to the Miombo woodland has a negative regression coefficient (β) of -3.164 with odds ratio (Exp β) of 23.670. This implies that a unit increase in distance between the homestead and the woodland will limit the likelihood of disturbances by a factor 23.670 and vice versa (Table 1). The factor is statistically significant at probability level of 5% (p = 0.00). The distance between the homestead and Bereku forest reserve ranged from 0.3 to 3 km with a mean of 1.7 km. Njana (2008) reported that an increase in distance between homestead and the Miombo woodland constrains the woodland's contribution to the livelihood of local communities. Similarly, Grundy et al. (1983) recorded the spatial effects of Miombo woodland resource use in Zimbabwe and showed that an increase in distance from homestead to the woodland raised costs of resource collection and vice versa. McGregor (1995) in a study conducted Shirungwi in Zimbabwe, also argued that rising scarcities of woodland resources caused increase in distance to woodland food resources.

Table 5: Education status of communities surrounding Bereku Forest Reserve

Characteristics	*Villages*				*Overall f (%) N=120*
	Ayasanda f (%) N=30	*Haraa f (%) N=30*	*Kidaboshika f (%) N=30*	*Kikore f (%) N=30*	
Education					
No formal	1 (3)	2 (7)	3 (10)	1 (3)	7 (6)
Primary	18 (60)	22 (73)	24 (80)	25 (83)	89 (74)
Secondary	11 (37)	6 (20)	3 (10)	4 (14)	24 (20)
Total	30 (100)	30 (100)	30 (100)	30 (100)	120 (100)

4. CONCLUSION

The findings of this study indicate that livelihood activities, period of residence in the reserve area, and distance from homestead to the forest, farm land size, household size, education, awareness on management of the forest reserve and awareness on reserve boundaries are the principal socio-economic factors impacting the quality of the forest. These factors are deeply rooted in the daily needs of communities in terms of forest products that cater for the growing population rather than awareness of forest resources depletion and its consequences.

5. RECOMMENDATIONS

From the conclusion, it is, therefore, important that effective ways to address the daily needs of the communities are identified and implemented. Emphasis needs to be put on finding alternative sources of energy, sustainable farming practices, diversification of income sources and promoting rural development for the youth and marginalized members of communities. Forestry education and extension should be directed at institutional strengthening at local levels in order to enable communities to actively participate in decision making processes aimed at conserving the forest and improving the livelihoods of rural communities.

ACKNOWLEDGEMENTS

We are grateful to the Flemish Interuniversity Council (VLIR) of Belgium for providing financial support for this study. We are also thankful to all people who assisted in the data collection in the study area as well as village leaders, household heads, key informants and the District forest officers for providing the required information and data for this study.

REFERENCES

Campbell B, Byron N 1996. Miombo woodlands and rural livelihoods: Options and opportunities. In: B Campbell (Ed.): The *Miombo in Transition: Woodlands and Welfare in Africa.* Indonesia: Centre for International Forestry Research, pp. 221-230.

Campbell B, Frost P, Byron N 1996. Miombo woodlands and their use: Overview and key issues. In: B Campbell (Ed.): *The Miombo in Transition: Woodlands and Welfare in Africa.* Indonesia: Centre for International Forestry Research, pp. 1-10.

Chidumayo EN, Kwibisa L 2003. Effects of deforestation on grass biomass and soil nutrient status in miombo woodland, Zambia. *Agriculture, Ecosystems and Environment,* 96: 97–105.

Frost P 1996. The ecology of Miombo woodlands. In: B Campbell (Ed.): *The Miombo in Transition*: *Woodlands and Welfare in Africa*. Indonesia: Centre for International Forestry Research, P. 11.

Grundy IM, Campbell BM, Balebereho S, Cunliffe R, Tafangenyasha C, Fergusson R, Parry D 1983. Availability and use of trees in Mutanda ressettlement area, Zimbabwe. *Journal of Applied Ecology* 56: 243 – 266.

Kajembe GC 1994. Indigenous management systems as a basis for community forestry in Tanzania: A case study of Dodoma Urban and Lushoto Districts. *Tropical Resource Management Paper 6*. The Netherlands: Wageningen Agricultural University.

Kajembe GC, Luoga EJ 1996. Socio-economic Aspects of Tree Farming in Njombe district. *Consultancy Report to the Natural Resource Conservation and Land-use Management Project (HIMA-NJOMBE).* Tanzania: Sokoine University of Agriculture.

Kasemir B, Jaeger CC, Jager J 2003. Citizen participation in sustainability assessment. In: B Kasemir, CC Jaeger, J Jager, TM Gardner (Eds.): *Public Participation and Sustainability Science*. Cambridge: Cambridge University Press, pp. 3-36.

Luoga EJ 2000. *The Effect of Human Disturbances on Diversity and Dynamics of Eastern Tanzania Miombo Arborescent Species*. Ph. D Thesis, Unpublished. Johannesburg: University of Witwaterrand.

Luoga EJ, Witkowisk ETF, Balkwill K 2000. Subsistence use of wood products and shifting cultivation within Miombo woodland of Eastern Tanzania, with some notes on commercial uses. *South Africa Journal of Botany,* 66: 72- 85.

Madulu NF 996. *Environmental Degradation and Marital Fertility Changes in Tanzania*. Ph. D Thesis, Unpublished. Dar es salaam: University of Dar es salaam.

McGregor J 1995. Gathered produce in Zimbabwe's communal areas: Changing resource availability and use. *Ecology of Food and Nutrition,* 33**:** 163 – 193.

Millington AC, Critchley RW, Douglas TD, Ryan P 1994. *Estimating Woody Biomass in Sub-Saharan Africa*. Washington D.C: The World Bank.

Mitinje E, Kessy JF, Mombo F 2007. Socio-economic factors influencing deforestation on the Uluguru Mountains. *Discovery and Innovation*, 19: 139.

Nduwamungu J 2001. *Dynamics of Deforestation in Miombo Woodlands: A Case Study of Kilosa District, Tanzania*. Ph. D Thesis, Unpublished. Morogoro: Sokoine University of Agriculture.

Njana MA 2008. *Arborescent Species Diversity and Stocking in Miombo Woodland of Urumwa Forest Reserve and their Contribution to Livelihoods, Tabora, Tanzania*. M.Sc. Thesis, Unpublished. Morogoro: Sokoine University of Agriculture.

Norouis MJ 1990. *SPSS/PC+ Advanced StatisticsTM* 4.0 for the IBM PC/XT/AT and PS/2. SPSS Inc. USA.

Oyugi OJ, Brown SJ, Whelan JC 2007. Effects of human disturbance on composition and structure of

Brachystegia woodland in Arabuko-Sokoke Forest. *African Journal of Ecology*, 46: 374–383

Powers DA, Xie Y 2000. *Statistical Methods for Categorical Data Analysis*. London: Academic Press.

Richards JF 1990. Land transformations. In: BL Turner, WC Clark, RW Kates, JF Richards, JT Mathew, WB Merey (Eds.): *The Earth as Transformed by Human Action*. Cambridge, Cambridge University Press, pp. 163-178.

Shalli MS 2003. *Contribution of Agroforestry against Rural Household Food Security in Kibaha District, Coast Region*. M.Sc. Thesis, Unpublished. Morogoro: Sokoine University of Agriculture.

Sharma NP 1992. *Managing the Worlds Forests. Looking for Balance Between Conservation and Development*. Iowa: Kendall Hunt Publishing Company.

Schwartz MW, Caro TM 2003. Effect of selective logging on trees and understory regeneration in Miombo woodlands. *African Journal of Ecology*, 41: 75–82

Zahabu E 2001. *Impact of Charcoal Extraction to the Miombo Woodlands: The Case of Kitulangalo Area, Tanzania*. M. Sc. Thesis, Unpublished. Morogoro: Sokoine University of Agriculture.