ROLE OF COMMUNAL AND PRIVATE FORESTLAND TENURE REGIMES IN REGULATING FOREST ECOSYSTEM GOODS AND SERVICES IN

ROMBO DISTRICT, TANZANIA

[1]Kaniki, H.N., [2]Kajembe, G.C., [2]Zahabu, E,. [2]Katani, J.Z. and [3]Eid, T.

[1]Tanzania Forestry Research Institute, P.O Box 1960 Tabora
E-mail: miombowrc@gmail.com
[2]Sokoine University of Agriculture, P.O Box 3013, Morogoro
[3]Norwegian University of Life Sciences, P.O. Box 5003, NO-1432 Aas

ABSTRACT

This study was undertaken to compare provisioning of forest ecosystem goods and services in Manuo Hill Communal Forest and Shirima Private Forest in Rombo District, Tanzania. Fuel wood was a key forest ecosystem good and biodiversity protection was a key forest ecosystem service identified. Manuo Hill communal forest had lower endowments values in terms of number of stems (1376 stems/ha), basal area (2.6 m^2/ha), volume (7.3 m^3/ha) and carbon stock (2.1 tons/ha) compared to the Shirima private forest with 2214 stems/ha, basal area of 3.2 m^2/ha, volume of 11.2 m^3/ha and carbon stock of 3.2 tons/ha. Only volume and carbon stock were significantly different between the forests. Species diversity was more or less similar between the forests. Tree removals were higher in communal (1.5 m^3/ha) than in private (1.0 m^3/ha) but they were not significantly different. Endowments in terms of tenure rights were better in communal forest than in private. More people were entitled to fuel wood from communal forest (78%) than from private (32%). Environmental benefits of biodiversity protection were entitled to everybody in both forests. It was concluded that no single tenure regime can achieve all objectives of forest management. Instead, balancing between different tenures is recommended.

Key words: forest ecosystems, tenure regimes, endowment and entitlement, goods and services.

INTRODUCTION

Forest ecosystem goods and services are natural flows which are of relatively immediate benefit to humans and other organisms (Daily *et al.* 1997; Chivian 2002; Brown *et al.* 2007). The capacity of a forest to provide forest ecosystem goods and services is a function of forestland tenure regime (Zahabu *et al.* 2009). The regime determines who can use what resources, for how long and under what conditions (FAO 2002; Reeb and Romano 2007; Acharya *et al*. 2008). It is the system on how tenure rights in forestland are being entitled to people (Bruce 1989; Haley *et al.* 2008). The meaning of tenure in this paper reflects neither property nor an act of ownership. Tenure simply pertains to rights, relationships, responsibilities and duty.

Tenure rights may be distinguished into operational level and collective choice property rights. Operational level property rights include access rights (i.e. the right to go into a defined physical property e.g. forestland and make non-subtractive uses e.g. enjoying natural beauty of forest) and withdrawal rights which are also called use rights (i.e. the right to obtain the

"products" of a resource). Collective choice property rights include management rights (i.e. rights to transform resource and/or regulate its uses), exclusion rights (which determine who is entitled to access and withdrawal rights and who decides about the transfer of such entitlements) and alienation rights (i.e. rights to sell or lease withdrawal, management or exclusion rights) (Ostrom 2000). Holders of collective choice rights are the ones determining operational rules (Schlager and Ostrom 1992). Depending on distribution of tenure rights, people may be divided into different right holders namely authorized entrants, authorized users, claimants, proprietors and owners (Schlager and Ostrom 1992). Authorized entrants are people having operational rights to enter and enjoy non-subtractive uses e.g. enjoying the natural beauty of the forest. People with both access and withdrawal user rights are termed authorized users. When an authorized user is endowed with management rights, the user is termed as claimant, and when a claimant is given exclusion rights the claimant is termed as proprietor. Owners or the rulers as the last class of users, holds all types of property rights including alienation right (Ostrom 2000).

In Tanzania operational and collective choice rights are effective within these legal paradigms. Basically, forest ecosystems in Tanzania are under either of these forestland tenure regimes: state, village /community/communal and private (URT 1998; URT 2002). These should not be confused with management regimes where open access is also included as a regime. The forestland tenure categories are in line with the Land Act No 4 and the Village Land Act No 5, both of 1999 (URT 1999a; 1999b) which categorize Tanzania's land into three categories namely reserve, village and general land. Among other issues, these two Acts have the overall objective of formalizing and legalizing customary land tenure arrangements.

Differences among forestland tenure regimes create different possibilities for the forest endowment and entitlements, forest conditions and hence different provision of forest ecosystem goods and services to forest adjacent communities. Forest endowments, which are often converted into entitlements, refer to either or both forest goods existing in forests and tenure rights that social actors have (De Jong *et al*. 2006). The rights underline rules that determine who has the right to enjoy benefits streams. In principle, the more rights people have, the more command over the goods they will have. On the other hand, entitlements are alternative sets of utilities derived from environmental goods and services over which social actors have legitimate effective command (Leach *et al*. 1999). However, according to Ribot and Peluso (2003), forest entitlements represent sets of utilities irrespective of whether or not social actors have legitimate command over them.

Management of forests under weak or inappropriate forestland tenure regimes is a root cause of rapid alteration of the composition, structure and function of ecosystems, a situation which threatens their capacity to provide important goods and services (Palmer *et al*. 2004; Shvidenko *et al.* 2005; FAO 2006; Milledge *et al.* 2007; Zahabu *et al*. 2009). Many studies have been done internationally to evaluate the effects of forestland tenure regimes on resource base and or livelihoods (e.g. Campbell *et al*. 1993; Dewees 1995; Zhang and Pearse 1997; Mwase *et al*. 2006; Acharya *et al*. 2008; Owubah *et al*. 2001; Reeb and Romano 2007). Also, in Tanzania there some examples (e.g. Bernardol 2010; Mpanda *et al*. 2011, Mbwambo *et al.* 2012). But the effects of regimes vary with locality, people and time (Riddell 1987).

Thus, communities must have a clear knowledge on the effects so as to find their own balance among tenure rights (Shvidenko *et al.* 2005). The aim of this study was therefore to compare forest endowment (in terms of forest stocking and tenure rights) and entitlement of forest ecosystem goods and services for forest adjacent communities. Communal (Manuo Hill) and private (Shirima) Forests in Rombo District, Tanzania, were selected. The study provides information that may help on the selection of appropriate regimes for a sustainable management of forest ecosystems in similar situations.

METHODOLOGY

Study area

The study was conducted in Rombo District in Kilimanjaro region located between 2° 50' and 3° 25' south and 37° 20' and 37° 45' east specifically in the lowland zone (Figure 1). Mean annual rainfall is about 500 mm in the district. The soil is alluvial and the main economic activities are agriculture, livestock keeping and forestry. The study dealt with Manuo Hill Communal Forest (39 ha) and Shirima Private Forest (35 ha) both located within Holili village. The vegetation in both forests was mixed Acacia bushland.

Both forests are within registered Holili village land. In Tanzania, there are several forests which were informally established and are in most cases not known even to the surrounding foresters (Akida and Blomley 2008). Manuo Hill forest is within the so called communal land set aside as forest as recognized by Land and Village Land Act (1999). It is owned and managed by the village council on behalf of the village residents. Shirima forest is within the so called occupied land – within village land. It is customarily owned by Mr Sebastian Shirima. Both forests are not gazetted and are managed mainly using customary laws, among other laws.

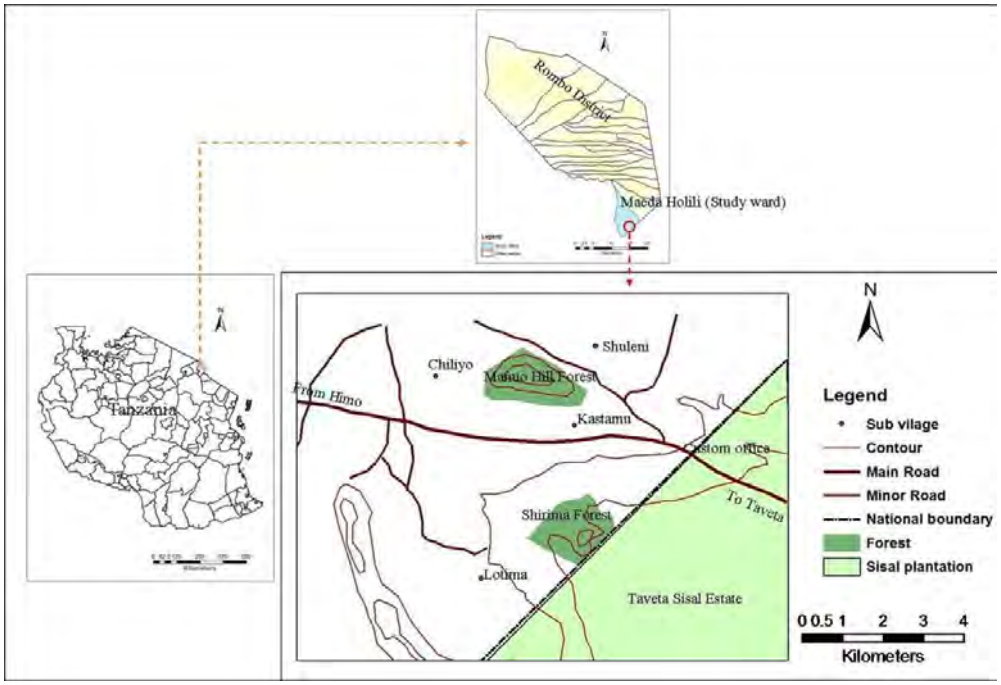

Figure 1: Map of Rombo District showing the study forests in Holili village

Data collection

Key Informant Interviews, Questionnaires and Participatory Rural Appraisal (PRA) were used to collect socio-economic data sets. Pair wise ranking was used to identify, screen and rank forest ecosystem goods and services. Screening of goods was important in order to identify key forest ecosystem goods and services. For the questionnaire survey, the sampling unit was a household randomly sampled from the forest adjacent communities (26 households for the communal Manuo Hill Forest and 25 for the private Shirima forest).

Ecological data were collected using a forest inventory. Number of plots (established based on a reconnaissance survey) was 26 for the Manuo Hill Forest and 25 for the Shirima Forest aiming at a sampling error of 25%. Plots were laid systematically. For the Manuo Hill Forest, three transects were laid at 300 m apart and inter-plot distance was 50 m. For the Shirima Forest, three transects were laid at 200 m apart and inter-plot distance was 70 m. Circular concentric plots were established and measurements were taken within radius of 2 m (identification and counting of all trees less than 1 cm dbh, that is regenerants), 5 m (recording dbh and height of all trees with dbh >1cm), 10 m (recording dbh and height of all trees with dbh > 10 cm) and 15 m (recording dbh and height of all trees with dbh >20 cm). Also, stump diameters were recorded within 15 m plot radius (Chamshama *et al*. 2004; Malimbwi *et al*. 2005).

Data analysis

Socio-economic data were subjected to descriptive statistical analysis using Statistical Package for Social Sciences (SPSS). Content analysis was used to analyse qualitative data. Data obtained through PRA were analysed in collaboration with the PRA members. Forest inventory data were subjected to descriptive statistical analysis where number of stems per hectare (stems ha^{-1}), basal area (m^2 ha^{-1}), volume (m^3 ha^{-1}), carbon stock (tons ha^{-1}) and tree diversity were calculated. Volume of individual trees (*Vi*) was calculated using $Vi = fg_ih_i$ where h_i *was* denoted as the total height of the i^{th} tree (m), g_i was basal area of i^{th} tree (m^2) and f was form factor (0.5). Carbon stock (tons ha^{-1}) was defined by Biomass x 0.5 where biomass was given by Generalized tree density value x Tree volume, and 0.5 was a constant to convert tree biomass to carbon stock (Munishi and Shear 2004). Tree diversity was calculated using the Shannon-Wiener index of diversity (H) (Kent and Coker 1992); and Index of Dominance (ID) (Misra 1989). The equation for Shannon-Wiener index was $H = -\sum_{i=1}^{s} P_i \ln P_i$ where s was denoted as the number of species, P_i was the abundance of species *i* in the sample and "ln" was denoted as the logarithm to base *e*. The equation for Index of Dominance was $ID = \sum\left[\frac{n_i}{N}\right]^2$ where ID was denoted as the index of dominance, n_i was the number of individuals of species *i* in the sample and N was the total number of individuals (all species) in the sample. Stump diameter/dbh function was developed from sample trees to estimate dbh of cut trees. Stump diameter/tree height function was also developed to estimate height of cut trees. The single tree equation described above was again used to estimate the volume of cut trees.

In comparing forest regimes, scoring and content analysis were used to compare endowment in terms of tenure rights and entitlement. Unpaired two tailed t – tests were used to compare endowment in terms of forest stock between regimes (Kothari 2004). Parameters compared for forest

stock were stems ha^{-1}, basal area, volume (for standing trees and cut stumps) and carbon stock for standing trees.

RESULTS AND DISCUSSION

In this study, performance of forestland tenure regime was considered to influence forest status (i.e. endowment in terms of forest stock and tree species diversity) which in turn influences provision of key forest ecosystem goods and services. Fuel wood was a key good and biodiversity protection was a key service identified.

Comparison of forest stocking, fuel wood production, tree species diversity and disturbances

Forest stocking, harvestable fuel wood and tree species diversity

The status of forests in terms of stocking and tree species diversity is given in Table 1.

Table 1: Comparison of the forest status

Parameters	Manuo Hill Communal Forest	Shirima Private Forest	t-test (P-values)
N (stems/ha)	1376 ± 255 (SE)	2214 ± 550 (SE)	0.159
G (m^2/ha)	2.60 ± 0.32 (SE)	3.17 ±0.45 (SE)	0.291
V (m^3/ha)	7.28 ± 0.97 (SE)	11.18 ± 1.56 (SE)	0.034
Carbon stock (tons/ha)	2.11 ± 0.28 (SE)	3.24 ± 0.45 (SE)	0.034
H	2.75	2.31	
ID	0.11	0.15	
Regenerants (stems/ha)	15720	14527	0.860

Shirima private forest had many stems (2214/ha) compared to the Manuo Hill communal forest (1376/ha) but the difference was not significant. The distribution over diameter classes of number of stems in both forests followed the usual expected reversed J-shaped trend more or less (Fig. 2). There were noticeable high numbers of trees and shrubs of below 10 cm diameter at breast height. Dominance of young trees is likely to be due to harvesting of large trees for firewood, withies and poles. The stem numbers observed in this study were high compared with 574 stems ha^{-1} observed by Bernardol (2009) in Acacia bushlands in Shinyanga Region, and low compared with 4253 stems ha^{-1} observed by Monela *et al.* (2005) in Acacia bushlands in Shinyanga Region. Moreover, there was no statistically significant difference in number of regenerants between Manuo Hill and Shirima forests.

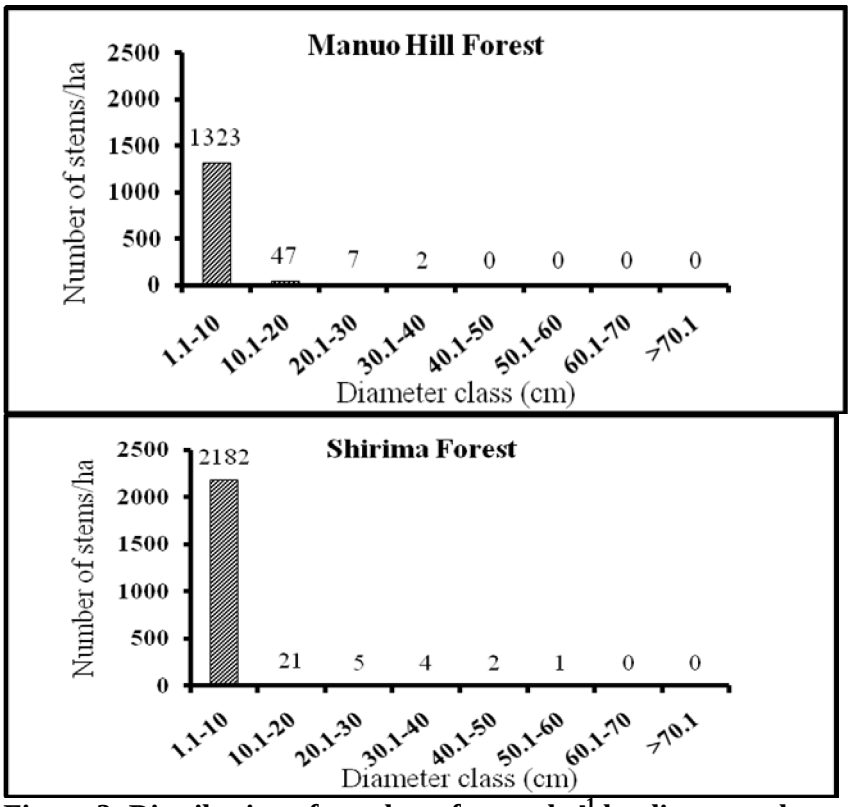

Figure 2: Distribution of number of stems ha^{-1} by diameter classes.

Shirima Private Forest had a larger basal area (3.17 m^2/ha) than Manuo Hill Communal Forest (2.60 m^2/ha) but the difference was not statistically significant. The values of basal area observed in this study are more or less similar to basal area of 3.39 m^2/ha reported by Monela *et al*. (2005) for Shinyanga Acacia vegetation but are lower than basal area of 5.22 m^2/ha reported by Bernardol (2009) in similar vegetation. Mean volume observed in Shirima Forest was larger than that of Manuo Hill Communal Forest and the difference was statistically significant. Mean volumes observed in this study are lower than volume observed by Bernardol (2009) and Monela *et al*. (2005). In Shinyanga Acacia vegetation, Monela *et al*. (2005) reported a mean volume of 6.62 m^3/ha. In the similar vegetation, Bernardol (2009) reported a mean volume of 16.67 m^3/ha. The difference in volume between studied forests in Holili and those in Shinyanga could be due to differences in site conditions such as soil and climate. The distributions over diameter classes for basal area and volume are shown in Fig. 3.

As was expected, the results for carbon followed that of volume. This was due to the methodology used (i.e. tree carbon stock = generalized tree density value x tree volume x 0.5). Manuo Hill Communal Forest had lower above ground carbon stock (2.11 tons/ha) than Shirima Private Forest (3.24 tons/ha) and the difference was statistically significant. The carbon values observed in this study are relatively low compared to miombo forests in Eastern Morogoro and Manyara region, which have carbon stock values ≥ 15.83 tons/ha (Zahabu 2008).

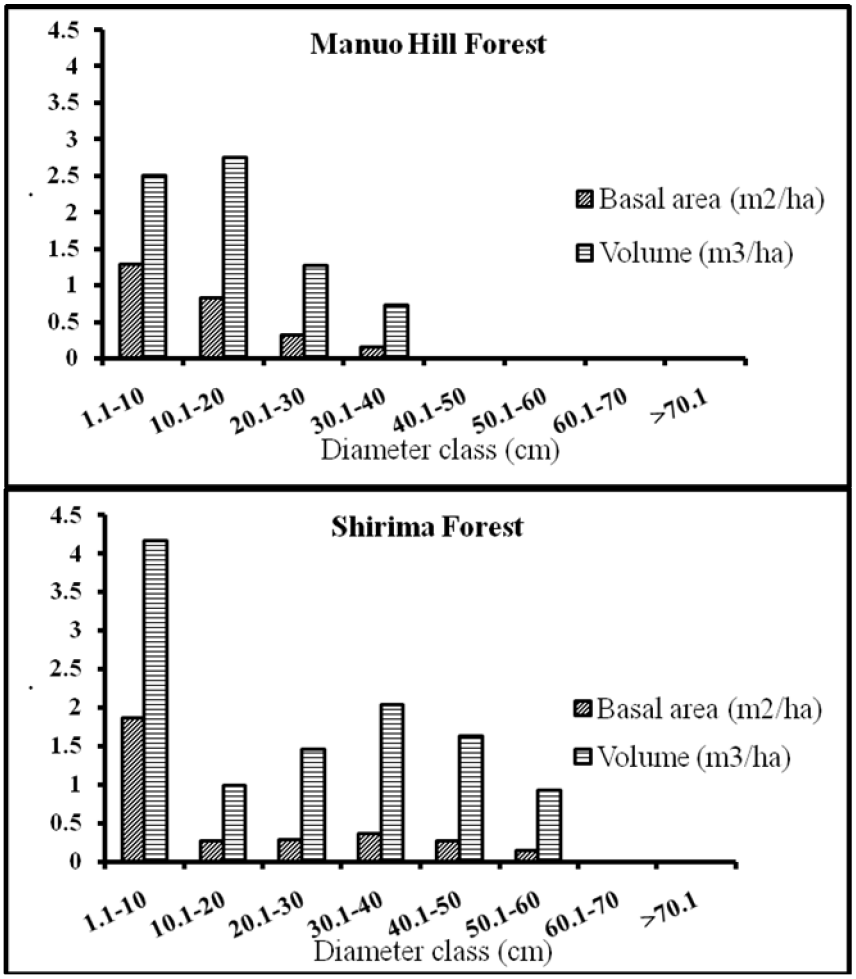

Figure 3: Distribution of basal area and volume in Manuo Hill and Shirima forests.

It was observed in the field that tree harvesting for fuel wood targeted branches and stems of almost all diameter classes, however, trees of dbh class 1 (i.e. trees of dbh = 1 to 10 cm) were the most harvested. According to Abbot and Lowore (1999), collection of fuel wood is normally done on weekly basis targeting branches and stems of 3 – 8 cm diameter. Based on peoples' preferences and harvesting habits, it was assumed that all trees larger than 3 cm were harvestable. According to this, Shirima Private Forest had a larger volume of potentially harvestable fuel wood (11 m^3/ha, N = 1231) than Manuo Hill Communal Forest (7 m^3/ha, N = 1957 stems/ha).

The relatively high stocking level in the private forest could be due to the fact that the owner restricts non-owners to subtractive uses from the forest. Presence of higher stocking in private forest than in communal forest has previously been reported by Hanna *et al*. (1995) and Mwase *et al*. (2006). With private tenure, there exists a clear relationship between investments and benefits. On the other hand, the situation whereby the village government shows minimal interests in forestry issues in Holili village probably also contributed to poor performance of Manuo Hill Forest. PRA findings showed that existence of village environment committee and village by-laws was not known by most of villagers. User's rights

and responsibilities were not certain. Previous experience shows that communal forest can hardly work efficiently if there are no active actors who see fulfilment of their interests (Agrawal and Ostrom 2001). Furthermore, the poor performance shown by the communal forest could be due to the fact that there were no active traditional leaders to enforce customary laws. The situation whereby norms are followed more or less strictly and voluntarily probably disadvantages customarily managed resources, whether in communal or private regimes (see e.g. Acharya *et al.* 2008). Also, in application of customary procedures, non-compliance cannot be treated through legal means. However, social sanctions and cultural believes can help alleviate the problems. Thus, if the system of customary laws is not strong, negligence and misconducts may occur which destroy resources (Acharya *et al*. 2008; Babili and Wiersum 2010; Mwase *et al*. 2006), as observed in Manuo Hill Forest. Lack of institutional and technical support was also observed to be a major reason for the observed low stocking in both forests. During the field visits, Mr. Shirima reported that he has been looking for technical assistance for some years without any success. He has been managing the forest without any technical guidelines and he doubts if the Tanzanian forestry sector is doing enough to favour private ownership in the management of natural forests. Moreover, it was observed that Mr. Shirima was not sure if his forestland will be positively considered by the on-going Holili land use planning process. In reality, although forest trees are forms of banking or security against unexpected events (Subedi *et al.* 1998) this is not yet understood especially by non-foresters.

Considering the contribution of regimes on biodiversity protection, findings in this study indicate that communal and private regimes have more or less similar contribution. Manuo Hill Communal Forest had a total of 63 tree and shrub species and Shirima Private Forest had 45 species. The Shannon-Wiener index (H) values were 2.75 for Manuo Hill Forest and 2.31 for Shirima Forest, while the Index of Dominance (ID) values were 0.11 and 0.15 (see Table 1). In their study in Shinyanga Acacia bushlands, Bernardol (2009) and Monela *et al*. (2005) found "H" and ID values of 0.99 and 0.15, and 2.84 and 0.16, respectively. The values reported from Manuo Hill and Shirima forests are more or less within the range of these studies. However, Shirima forest was dominated by valuable tree species including *Dalbergia. melanoxylon*. During the field work, *D. melanoxylon* was not recorded from communal forest, but evidence indicates that it was there in the past years as reported by the villagers. This may indicate that private tenure regime performs better in protecting important/endangered/threatened species. But land tenure alone does not explain all the differences in species diversity. Variations in tree species diversity may result from even small local differences in elevation, soils and climatic factors (Mwase *et al*. 2006).

Alternatively, the observed difference in stocking and tree species diversity could be attributed to natural ecological differences such as topography. Both forests were located in a hilly and rocky area but the slight difference of altitude and soil might have also contributed to the observed difference.

Forest disturbances

Forest disturbances were severe in both forests (Table 2). They were caused mainly by grazing pressure, murram and stone mining, farming and cutting of trees for fodder, fuel wood and withies/poles. About 1 ha of Manuo Hill Forest was bare due to "murram" mining done by road contractors while about 1.5 ha of Shirima Forest have been converted into farmland.

According to the explanation given by the private forest owner, presence of farming plots within the Shirima Forest was planned by his family during forest establishment. An average of 45 and 88 cut stumps/ha were found in Manuo Hill and Shirima forests respectively but the difference was not significant. The basla area of cut stems and volume were a bit larger in Manuo Hill Communal Forest than in Shirima Private Forest, however, the difference was not significant. About 50% of cut stumps in Manuo Hill Forest were fresh, while only 20% were fresh in Shirima Forest. This means that there was more recent on-going tree cutting in the communal than in the private forest. The most cut trees in terms of volume in the decreasing order were *Terminalia brownii> Euphorbia metabalensis >Commiphora zimmermannii* in Manuo Hill Forest and *Combretum molle >Ozoroa obovata >Grewia fallax >Terminalia brownii* in the Shirima Forest. Trees of stump diameter of between 1 and 10 cm were the most removed. The average stump diameter was 7.5 cm (N=84) and 5.6 cm (N=144) for Manuo Hill and Shirima forests respectively. Shortage of large trees probably contributes to observed cutting of small trees. Large stumps were hardly found indicating that big trees were probably removed long time ago. Cut trees were used mostly for firewood, withies/poles and sometimes for fodder.

Table 2: Comparison of number of stems, basal area and volume of cut stems.

Parameters	Manuo Hill Communal Forest	Shirima Private Forest	t-test (P-values)
N (stems/ha)	45 ± 8 (SE)	88 ± 33 (SE)	0.197
G (m^2/ha)	0.35± 0.1 (SE)	0.31 ±0.1(SE)	0.816
V (m^3/ha)	1.50 ±0.6 (SE)	1.01 ± 0.5 (SE)	0.529

Comparison of provision of tenure rights and entitlements on key forest ecosystem goods and services

Tenure rights considered in this study were access, withdrawal, management, exclusion and alienation (Table 3). There was a higher level of endowment (in terms of tenure rights) on fuel wood in Manuo Hill Communal Forest compared with Shirima Private Forest. In the communal forest the majority of respondents were proprietors (42.3%) and claimant users (38.8%) while in the private forest the majority of respondents were authorized entrant (40%) and some were completely not receiving any right (28%). Twelve percent of respondents in the private forest were claimants and 16% were authorized users. Alienation rights were not prevailing in communal forests, which means that nobody was given the right to sell the forestland. Except for the private owner, nobody was allowed to have alienation right in private forest. Outsiders were excluded from using forests in both regimes because they were not owners and were usually considered to be non-contributors in the management of forest resources. The study further indicates that respondents in the communal forest were endowed with more operational level rights (i.e. rights of being users) than collective choice level rights (i.e. management, exclusion and alienation rights). The collective choice level rights were held mostly by members of the village environmental committees. The

committee failed to make the community responsible. This was a weakness. Experience from elsewhere shows that provision of collective choice rights to the forest adjacent community is important for the management of communal forestland (Agrawal and Ostrom 2001). This is because collective choice rights make people have interest in the resource; hence it establishes strong incentive for the conservation of the forests. Without collective choice rights, local actors may feel that any effort they will make to limit their uses will benefit others who will then assert future rights to harvest (Agrawal and Ostrom 2001).

Considering endowment of benefits of biodiversity protection, the study showed that, like many other services, these benefits were endowed to everybody in both forests. In other words, nobody is excluded from receiving benefits of biodiversity protection e.g. enjoyment of improvement of micro climate, amenity and fresh air. This was of course due to the nature of the service. Biodiversity protection is both a non-rival and non-exclusive service (Brown *et al.* 2007). Moreover, in comparing their perceived performance, the communal regime had relatively higher performance in endowing tenure rights to forest ecosystem goods (mean score = 3.1) compared to private regime (mean score = 2.2) (Table 3). The findings are in keeping with those of Acharya *et al.* (2009) who reported presence of poor endowment in private forests in Nepal.

Table 3: Performance in endowing (tenure rights) on forest ecosystem goods

Tenure rights	Manuo Hill Communal Forest (N=26)		Shirima Private Forest (N=25)	
	Score	Score category	Score	Score category
Access	4.6	Very good	3.1	Good
Withdrawal	3.6	Good	2.2	Satisfactory
Management	2.7	Satisfactory	2.0	Poor
Exclusion	2.7	Satisfactory	1.8	Poor
Alienation	1.8	Poor	1.8	Poor
Mean score	3.1	Good	2.2	Satisfactory

Note: Average score 0-1 = very poor; 1.1-2 = poor; 2.1-3 = satisfactory; 3.1-4 = good; and 4.1-5 = very good.

As previously argued, entitlements represent the amount of key forest ecosystem goods and services benefited/collected (in *de facto*) by the communities and over which people have command. Entitlement of adjacent communities to fuel wood in Manuo Hill communal forest was higher than in Shirima private forest (Table 4). None of the forests had any formal mechanism such as a management plan to monitor resource withdrawal. Each load of fuel wood weighed approximately 10 kg. Interestingly, nobody claimed to collect fuel wood for business purposes in eitherregime. Instead, fuel wood was collected only for subsistence purposes. As expected, benefits of biodiversity protection, which are both non-rival and non-exclusive service (Brown *et al.* 2007) were entitled to everybody.

Table 4: Entitlement of fuel wood per household

Parameters	Manuo Hill Communal Forest (N = 26)	Shirima Private Forest (N = 25)
Fuel wood (loads/week)	3	5
Percentage of household entitled	78	32

CONCLUSION AND RECOMMENDATIONS

Manuo Hill Forest under communal forestland tenure regime and Shirima Forest under private forestland tenure regime have shown some similarities and differences in regulating forest ecosystem goods and services. Customary laws were important in the management of both communal and private forests. Fuel wood and biodiversity protection are key forest ecosystem goods and services provided by both Manuo Hill Communal Forest and Shirima Private Forests. Shirima Private Forest was characterized by relatively better forest condition compared to Manuo Hill Communal Forest. In the private forest, forest stock was relatively larger and forest disturbances were low compared to the communal forest. The difference in shrub and tree species diversity between the two regimes was negligible. Lack of significant control of collective choice relating to formulation of rules, their management and enforcement by the community was a constraint to sustainable management of Manuo Hill communal forest. Shirima private forest plays a more positive role in the provision of key forest ecosystem goods than Manuo Hill communal forest. Provision of tenure rights was higher in communal than in private forest. Entitlement of forest adjacent communities to key forest ecosystem goods i.e. fuel wood in communal forest was high as compared to private forest. Environment benefits of biodiversity protection were entitled to everybody in both communal and private forest. Thus, there is no single regime can to maximize achievement of all objectives of forest management in the study area. Thus, balancing between different tenures is recommended.

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