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Assessment of biodiversity in cropland agroforestry and its role in livelihood development in dryland areas: A case study from Tigray region, Ethiopia

Etefa Guyassa and Antony Joseph Raj*

Department of Land Resource Management and Environmental Protection, Mekelle University, P.O. Box 231, Mekelle, Tigray, Ethiopia.

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Abstract The assessment of species diversity is crucial since it represents a fundamental property of ecological communities and provides a tool to compare assemblages in time and space, independently from species identities. This research investigation was carried out to assess biodiversity of woody plants in agroecosystem and their significance in dryland agroforestry for livelihood development in Abreha we Atsebeha, Tigray region, Ethiopia. The biodiversity was assessed in three types of agro-ecosystems (homegarden, cropland and grazing land) and adjacent forest land (exclosure). The following biodiversity indices were used for comparison between different land uses: Shannon diversity index (H), species richness (S), species evenness or equitability index (E), Sorensen coefficient of similarity (Ss) and importance value index (IVI). The results revealed high woody species richness in agricultural landscapes than exclosure which indicates that human-managed agricultural landscapes can play a vital role in preserving woody species diversity. In the present study, 39 woody species were recorded in the different agro-ecosystems as only 23 woody species were recorded in exclosures indicating highest species richness on agricultural lands than exclosures. A focused questionnaire survey indicated that about 98% of the respondents have maintained different woody species in their homegardens, croplands and grazing lands. Although the number and type of species retained differed, *Faidherbia albida* and *Acacia etbaica* were more frequently retained than others and were also ranked the top preference of the local people. Farmers retain or plant trees intentionally to derive different socio-economic benefits as a source of their livelihood. The major benefits obtained from trees in the order of their applications were fuelwood, conservation, shade, fencing, construction, farm tools, fodder, fruit and medicine.

Key words: biodiversity, cropland agroforestry, Shannon diversity index, species richness, equitability index, Sorensen coefficient of similarity, importance value index.

* **Corresponding author:** Antony Joseph Raj; **e-mail:** drajr_tn@yahoo.com

Introduction

Due to the ever-growing impact of human activities, the biodiversity of natural habitats is rapidly being eroded at an alarming rate. The major challenge is to achieve a significant reduction of the current rate of biodiversity loss at the global, regional and national level. Agroforestry has great potential for reducing deforestation and forest degradation, providing rural livelihoods and habitats for perennial woody species outside the forests and alleviating resource-use pressure on conservation areas. There is increasing evidence that as natural forest retreats or become degraded, farmers in many situations have historically taken up the planting and management of trees on their lands to provide the needed outputs (Arnold, 1990). In Nepal for instance, there was a four-fold increase in the density of trees in farms in crop-growing areas (Gilmour, 1995). In Africa, parkland agroforestry (scattered on-farm tree system) is one of the most conspicuous traditional practices. The parklands investigated so far in sub-Saharan Africa are proven to compose high species diversity, often 40-50 woody species (Bofa, 1999).

A wide variety of agroforestry systems are found in developing countries and their occurrence is often site-specific (Long and Nair, 1999; Nair, 1993). The promotion of agroforestry practice is among the strategies proposed by Government of Ethiopia to reverse the natural resource degradation and to increase productivity. In Ethiopia, agroforestry is an age old practice whereby farmers maintain trees in croplands for their multi-purpose uses and have different forms in which the most common are homegardens (Zemede and Ayele, 1995; Zebene, 2003), hedgerow intercropping (Peter, 1986), riparian zone vegetation, enclosures and natural regeneration of species in woodlands and pasture. In Ethiopia, despite the overall reduction in the extent of biodiversity of the natural forests, traditional planting or retaining trees in farm lands by farmers in the form of agroforestry is getting significance and have given refuges for a considerable number of native woody species (Motuma, 2006; Biruk, 2006). Floristic study made in the Sidama traditional agroforestry system showed the existence of more than 80 native woody species on and/or near farmlands (Tesfaye, 2005). Floristic composition is very important as it is the resource from where several cereals, fruits, vegetables, quality firewood, quality lumber and palatable fodders are collected. In addition, diversified, compatible and desirable species of trees/woody perennials in agroforesty can result to marked improvement in soil fertility by increasing soil organic matter content, enhancing efficient nutrient cycling within the system and controlling soil erosion (Rao *et al*., 1998).

Although agroforesry is practiced in the dry land regions particularly in Tigray region of North Ethiopia, studies on its potential in biodiversity conservation, its impacts on soil fertility and its socio-economic importance are lacking in the region. Assessment and charactering woody vegetation on farmland and investigating their role for soil fertility and socio-economic development help to fully understand the potential of agroforestry practice in contributing to ecological maintenance and food security. The present study will act as a foundation to propose and promote appropriate agroforesry practices and tree management in farms in dry land regions which contribute for sustainable livelihood development. The objective of the present study is to evaluate the potential of dryland agroforestry practices for biodiversity conservation and livelihood improvement of farmers in dryland areas.

Materials and methods

Site description

The study was carried out in the Abreha we Atsebeha watershed in the Eastern part of Tigray region, Ethiopia (Figure 1). Abreha we Atsebeha is located between coordinates of $13^{0}30'$ to $13^{0}31'$ North latitude and $39^{0}57'$ to $39^{0}58'$ East longitude at an altitude of (1940-2160 masl) and is about 64 km North of Mekelle, the capital city of Tigray. The watershed covers a total area of 7444 ha and the basin represents a typical rural area with the whole range of physiographic units present in the northern Ethiopia highlands. The annual rainfall in the area is confined to a short season called 'kiremmt', from the month of June to September. Traditional agriculture is the predominant economic activity in the basin. Most of the population of the area derives their livelihood from agriculture, which is mixed farming, depending mainly on annual rain fall.

Household selection and socio-economic survey

The total number of households existing in the study area were first assessed which was found to be 350. From these households, 10% (35 households) were sampled randomly for data collection. Other data were obtained from Tabia administrative office in the study area. A focused questionnaire survey was administered to the sampled households. The aim of the household interview was to generate and verify quantitative data about the socio-economic and ecological roles of traditional agroforestry practices and to ascertain socio-economic and ecological variability that affect agroforestry practices.

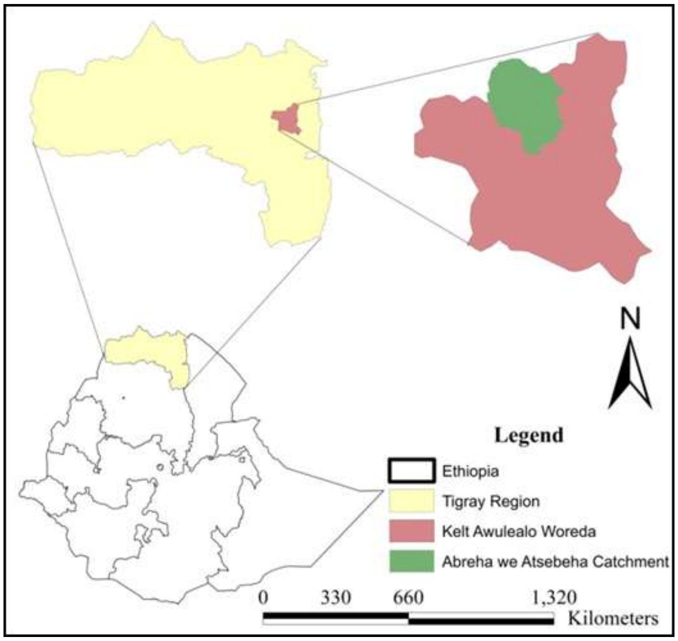

Fig. 1. Study Site

Species-accumulation curve and Trees/shrubs diversity assessment

To assess the diversity of trees and shrubs within the traditional agroforestry systems, the sample households (HH) already selected for the socio-economic survey were employed. The species-accumulation curve method was followed for the selection of number of plots for all land uses. One of the primary goals of field study in biodiversity assessment is to estimate how many species occur in an area. Initially, many species were found as larger areas were sampled and a plot of accumulated number of species against area sampled rose steeply and then more slowly as the increasingly number of rare species are added. The species-accumulation curve may approach an asymptote for data sets of woody species that can be identified easily from the study area where it is possible to obtain a count of all the species present (Colwell and Coddington, 1994).

First, an exact analytical expression for the expectance and variance of the species-accumulation curve in all random subsets of samples from the selected land use was derived. The plot number-species accumulation curve of woody species of the studied landuses flattened before the total number of samples considered were exhausted (Figure 2) showing that sufficient numbers of samples were considered to determine woody species diversity of each system. Using this species-accumulation curve approach, data on species diversity in the homegarden, cropland, and grazing land was collected from 16, 14, and 8 plots with a total area of 22 ha, 4 ha and 8 ha, respectively. In addition to agro-ecosystems, 12 plots of 100 m^2 area (0.1 hectare) of forest land (exclosure) adjacent to agricultural landscape was also inventoried for comparison. Three transects with 100 m apart were systematically laid out in the exclosures.

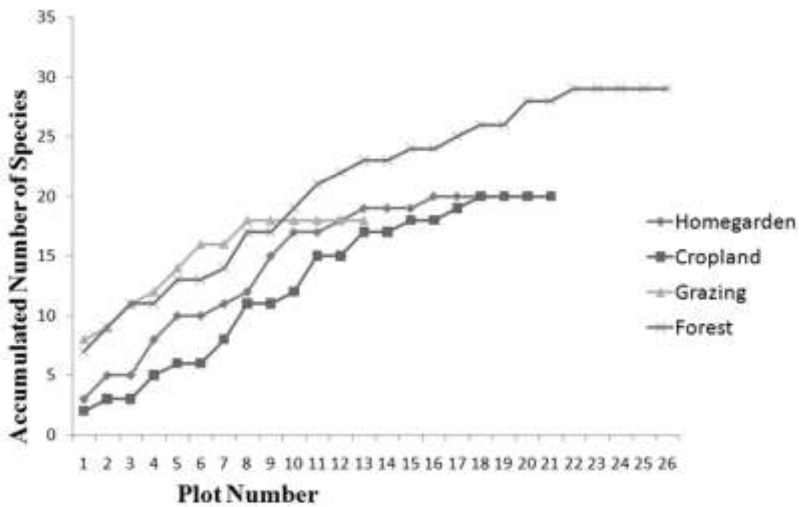

Fig. 2. Species-Accumulation Curve

The species diversity was estimated using different indices: species richness(S), Shannon diversity index (H') and equitability index. The Shannon diversity index was calculated as:

$$\text{Shannon-Wieners Diversity Index (H')} = -\sum_{i=1}^{s}(P_i)(\log Pi)$$

Where, s = number of species; P_i = proportion of species i in the community

Although, as a heterogeneity measure, Shannon diversity indices take into account the evenness of abundance of species, it is possible to calculate a separate additional measure of evenness. The ratio of observed in Shannon index to maximum diversity (H_{max}= log s) can be taken as a measure of evenness (E) (Kent and Coker, 1992).

$$Equitability \text{ or } Eveness\,(J) = \frac{H'}{H'_{max}} = \frac{\sum_{i=1}^{s}(P_i)(\log Pi)}{\log s}$$

The higher the value of J, the more even the species is in their distribution within the sample (Kent and Coker, 1992).

Similarity indices measure the degree to which the species composition of different systems is alike. Sorensen similarity coefficient is applied to qualitative data and is widely used because it gives more weight to the species that are common to the samples rather than to those that only occur in either sample (Kent and Coker, 1992). The Sorensen coefficient of similarity (Ss) is given by the formula:

$$S_s = \frac{2a}{2a + b + c}$$

Where Ss = Sorensen similarity coefficient, a = number of species common to both samples, b = number of species in sample 1, c = number of species in sample 2. The coefficient is multiplied by 100 to give a percentage.

The importance value index (IVI) indicates the importance of species in the system. Importance value for each woody species is the sum of relative abundance, relative dominance and relative frequency. The importance value index was estimated for each system individually to evaluate the importance of woody species found in common to the homegarden, cropland, grazing land and natural forest.

Statistical analysis

Quantitative data from household questionnaire survey were collected, coded, encoded into the computer, and statistically analyzed by using SPSS 15.0 version.

Results

A total of 40 woody species were recorded from home gardens, crop fields, grazing lands and natural forest at the study area representing 24 families. The total number of woody species recorded on agro-ecosystem and forest land of the study sites is presented in Table 1.

Table 1. Species compositions at different land uses

Site	**Land Use**			
	Homegarden	Cropland	Grazing land	Forest land
Abreha we Atsebeha	28	15	18	23

The Shannon diversity index is high in the natural forest and low in the agro-ecosystems, this indicates evenness in the abundance of species in the natural forest as compared to the agro-ecosystems (Table 2). The Sorensen coefficients of similarity showed highest in woody species composition between crop field and grazing land as compared with the other combinations (Table 3).

Table 2. Diversity indices of woody species at different land uses

Land use	Shannon diversity index	Evenness
Homegarden	1.31	0.39
Cropland	1.12	0.41
Grazing land	2.04	0.71
Forest land	2.43	0.77

Table 3. Sorensen similarity percentage in woody species composition

Land use	Cropland	Grazing land	Forest land
Homegarden	41	50	57
Cropland		71	51
Grazing land			70

Faidherbia albida and *Euclea racemosa* are the top two important native woody species among the 5 woody species that were common to homegardens, croplands, grazing lands and natural forest (Table 4). *Eucalyptus camaldulensis* is the most important woody species in home gardens which has registered the IVI value of 87.75 followed by *Faidherbia albida* (70.27), *Euphorbia tirucalli* (50.76) and *Cordia africana* (9.02) (Table 5). *Eucalyptus camaldulensis* and *Faidherbia albida* are the two frequent woody species (n=16).

Table 4. IVI of top woody species common to homegardens, cropland, grazing land and adjacent natural forest at Abreha we Atsebeha

Species	Importance Value Index (IVI)				
	Home garden	Cropland	Grazing land	Forest land	Average
Faidherbia albida	70.27	54.7	97.03	77.88	74.97
Euclea racemosa	4.29	10.01	17.16	41.78	18.31
Acacia etbaica	8.38	12.9	13.62	29.16	16.02
Maytenus senegalensis	8.03	7.11	15.85	25.83	14.21
Acacia abyssinica	5.88	9.02	13.03	13.7	10.41

Table 5. Distribution of woody species in homegarden

Botanical name	Density (ha^{-1})	Relative Frequency %	Relative Abundance %	A/F	IVI
Eucalyptus camaldulensis	960	8.89	46.38	5.2	87.75
Faidherbia albida	120	8.89	5.80	0.7	70.27
Euphorbia tirucalli	800	7.78	38.65	5.0	50.76
Cordia africana	12.5	5.56	0.60	0.1	9.02
Acacia etbaica	24	6.67	1.16	0.2	8.35
Maytenus senegalensis	22.5	6.67	1.09	0.2	8.03
Acacia abyssinica	17.5	4.44	0.85	0.2	5.88
Olea europaea	3.5	3.89	0.17	0.0	5.05
Dodonaea angustifolia	9.5	4.44	0.46	0.1	4.95
Leucaena leucocephala	10	3.89	0.48	0.1	4.46
Euclea racemosa	7	3.89	0.34	0.1	4.29
Psidium guajava	11	3.33	0.53	0.2	4.00
Acacia senegal	7	3.33	0.34	0.1	3.79
Sesbania sesban	6	3.33	0.29	0.1	3.70
Azadirachta indica	12.5	2.78	0.60	0.2	3.59
Euphorbia abyssinica	3	3.33	0.14	0.0	3.53
Carica papaya	9	2.78	0.43	0.2	3.36
Buddleia polystachya	6	2.22	0.29	0.1	2.68
Acacia saligna	4	2.22	0.19	0.1	2.45
Pinus patula	2	2.22	0.10	0.0	2.43
Schinus molle	6	1.67	0.29	0.2	2.35
Juniperus procera	3	1.67	0.14	0.1	2.26
Senna singueana	2.5	1.67	0.12	0.1	1.80
Grevillea robusta	3.5	1.11	0.17	0.2	1.45
Rhamnus prinoides	3.5	1.11	0.17	0.2	1.29
Citrus medica	2.5	1.11	0.12	0.1	1.25
Awo (local name)	1	0.56	0.05	0.1	0.65
Rhus vulgaris	1	0.56	0.05	0.1	0.62

Table 6. Distribution of woody species in cropland

Botanical name	Density (ha^{-1})	Relative Frequency %	Relative Abundance %	A/F	IVI
Eucalyptus camaldulensis	150	8.91	54.27	6.09	63.93
Faidherbia albida	93.75	13.86	33.92	2.45	54.70
Acacia etbaica	10.875	8.91	3.93	0.44	12.90
Euclea racemosa	5.75	7.92	2.08	0.26	10.01
Acacia abyssinica	3	7.92	1.09	0.14	9.02
Cordia africana	4.25	6.93	1.54	0.22	8.56
Olea europaea	2	6.93	0.72	0.10	7.76
Maytenus senegalensis	0.5	6.93	0.18	0.03	7.11
Carissa spinarum	1	5.94	0.36	0.06	6.30
Maytenus arbutifolia	1.5	4.95	0.54	0.11	5.49

Commiphora africana	1.375	4.95	0.50	0.10	5.45
Leucaena leucocephala	0.75	4.95	0.27	0.05	5.22
Ficus vasta	0.875	3.96	0.32	0.08	4.46
Croton macrostachyus	0.375	3.96	0.14	0.03	4.10
Ziziphus spina-christi	0.375	2.97	0.14	0.05	3.11

Table 7. Distribution of woody species in grazing land

Botanical name	**Density (ha^{-1})**	**Relative Frequency %**	**Relative Abundance %**	**A/F**	**IVI**
Faidherbia albida	35.2	9.6	27.12	2.81	97.83
Eucalyptus camaldulensis	39.4	3.61	30.35	8.40	45.56
Ficus vasta	1.6	3.61	1.23	0.34	27.44
Euclea racemosa	10.8	8.43	8.32	0.99	17.16
Maytenus senegalensis	9	8.43	6.93	0.82	15.85
Acacia etbaica	4.6	9.64	3.54	0.37	13.62
Acacia abyssinica	3.8	9.64	2.93	0.30	13.03
Maytenus arbutifolia	4.4	7.23	3.39	0.47	10.94
Acacia seyal	3.6	7.23	2.77	0.38	10.35
Ficus sycomorus	5.6	4.82	4.31	0.90	9.34
Carissa spinarum	3.2	6.02	2.47	0.41	8.72
Euphorbia abyssinica	3.4	4.82	2.62	0.54	7.69
Ziziphus spina-christi	1.2	4.82	0.92	0.19	5.89
Croton macrostachyus	1.2	3.61	0.92	0.26	4.94
Rhus vulgaris	1.2	2.41	0.92	0.38	3.55
Phoenix reclinata	0.8	2.41	0.62	0.26	3.23
Senna singueana	0.6	2.41	0.46	0.19	3.00
Olea europaea	0.2	1.20	0.15	0.13	1.77

Table 8. Distribution of woody species in forest land

Botanical name	**Density (ha^{-1})**	**Relative Frequency %**	**Relative Abundance %**	**A/F**	**IVI**
Faidherbia albida	533	10.00	11.09	1.11	77.88
Euclea racemosa	1133	10.00	23.57	2.36	41.78
Acacia etbaica	683	10.00	14.21	1.42	29.16
Maytenus senegalensis	625	6.67	13.00	1.95	25.83
Dodonaea angustifolia	250	10.00	5.20	0.52	17.01
Carissa spinarum	325	5.83	6.76	1.16	16.78
Maytenus arbutifolia	242	7.50	5.03	0.67	14.28
Acacia abyssinica	175	8.33	3.64	0.44	13.70
Acacia seyal	183	5.00	3.81	0.76	10.62
Ziziphus spina-christi	125	3.33	2.60	0.78	9.56
Commiphora africana	117	4.17	2.43	0.58	8.50
Olea europaea	50	3.33	1.04	0.31	7.63
Ficus sycomorus	142	3.33	2.95	0.88	7.31
Rhus vulgaris	75	2.50	1.56	0.62	4.80

Cordia africana	17	1.67	0.35	0.21	2.77
Nibi (local name)	42	1.67	0.87	0.52	2.74
Acacia saligna	25	1.67	0.52	0.31	2.31
Buddleia polystachya	17	0.83	0.35	0.42	1.39
Phoenix reclinata	8	0.83	0.17	0.21	1.34
Schinus molle	17	0.83	0.35	0.42	1.26
Syzygium guineense	8	0.83	0.17	0.21	1.21
Senna singueana	8	0.83	0.17	0.21	1.09
Euphorbia abyssinica	8	0.83	0.17	0.21	1.05

Eucalyptus camaldulensis is the most important woody species in croplands which showed an IVI value of 63.93 followed by *Faidherbia albida* (54.70), *Acacia etbaica* (12.90) and *Euclea racemosa* (10.01) (Table 6). The most frequent woody species encountered is *Faidherbia albida* with 100 per cent (n = 14) of the plots in the cropland. *Eucalyptus camaldulensis* (54.27%) is the most abundant woody species followed by *Faidherbia albida* (33.92%). *Faidherbia albida* is the most important woody species in the grazing land which showed an IVI value of 97.83 followed by *Eucalyptus camaldulensis* (45.56), *Ficus vasta* (27.44) and *Euclea racemosa* (17.16) (Table 7).

Faidherbia albida is also the most frequent species (100%, n=8) in addition to *Acacia etbaica* and *Acacia abyssinica*. An estimate of IVI in the natural forest showed that *Faidherbia albida* (77.88) is the most important woody species followed by *Euclea racemosa* (41.78) and *Acacia etbaica* (29.16) (Table 8). *Faidherbia albida*, *Euclea racemosa* and *Acacia etbaica* are the most frequent species recorded in 100 per cent (n = 12) of the plots. *Euclea racemosa* is the most abundant woody species followed by *Acacia ethbaica*.

About 98 per cent of the respondents have maintained different woody species in their homegardens, crop fields and grazing lands. Although the number and type of species retained by respondents differed, *Faidherbia albida* and *Acacia etbaica* were more frequently retained than others (Figure 3). These species also ranked the top preference of the local people according to the respondents. Totally, 31 species were retained in the study area. In addition to retention of woody species, the planting of different woody species is widely practiced in the study area. About 96 per cent of the sample households had experienced planting woody species. Maintaining and planting of woody species in agro-ecosystem follows certain patterns of distribution and arrangement. Majority of the respondents explained that they had a greater diversity of woody species in their homegardens than in any other agricultural lands.

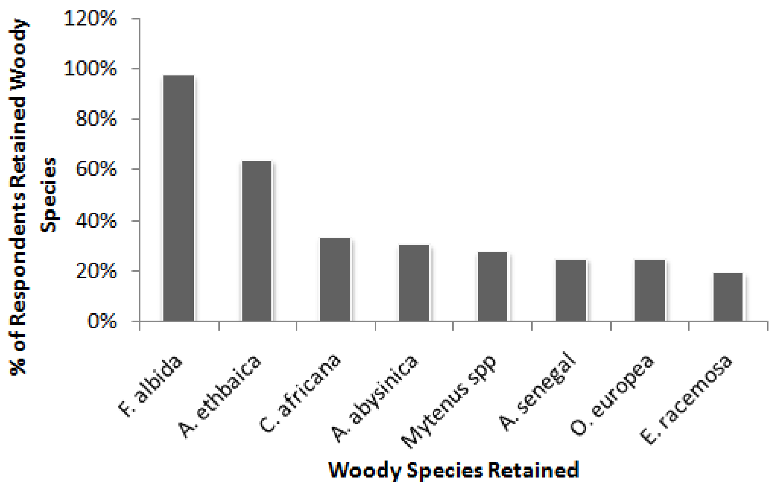

Fig. 3. Retention of woody species

The agricultural landuse practices in the study area involve mixed farming system that include crop production, animal-rearing and tree/shrub planting and management. Farmers derive sources of their livelihoods both from agricultural production and some off-farm activities. Major sources of livelihood from on-farm activities include crop cultivation (ranked as first), animal-rearing (ranked as second) and tree growing (ranked as third) as sources of livelihood. The motives for retaining different woody species depend on the uses or benefits that they render to the household. The respondents' major reasons for retaining woody species were in the order of their applications as: fuelwood, conservation, shade, fencing, construction, farm tools, fodder, fruit and medicinal value (Figure 4). The respondents explained that they plant trees mainly for the purpose of fuelwood, construction, fencing, income, fodder, shade, soil fertility, fruits and farm tools (Figure 5) which varies from the degree of the purpose in maintaining trees. They also receive additional benefits (income) from planted fruit trees and commercial trees like *Eucalyptus* species.

Different management methods were practiced on woody plant species planted/maintained on agricultural lands. About 84 per cent of the respondents practiced different types of management activities. The common management practices include watering, plant protection, thinning, pruning, pollarding and fertilizing. Thinning is mainly practiced for *Eucalyptus* woodlots while pollarding and pruning are for trees on crop lands. The pruning of indigenous species retained in crop fields is meant for reducing the effect on crops, getting fodder for animals, and collecting wood to be used for fencing and firewood.

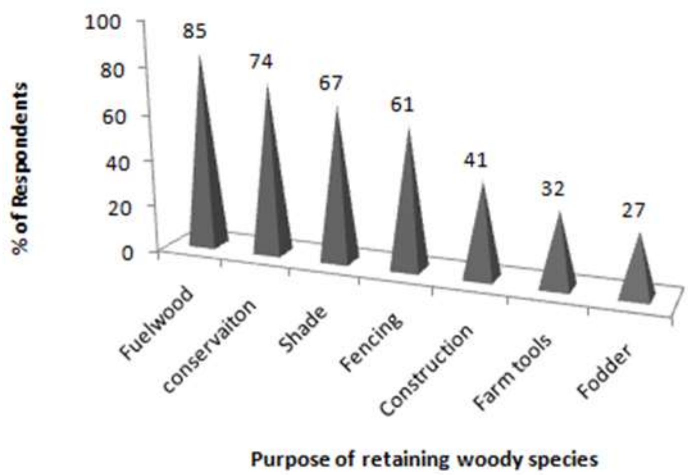

Fig. 4. Purpose of retaining woody species in agricultural landscapes

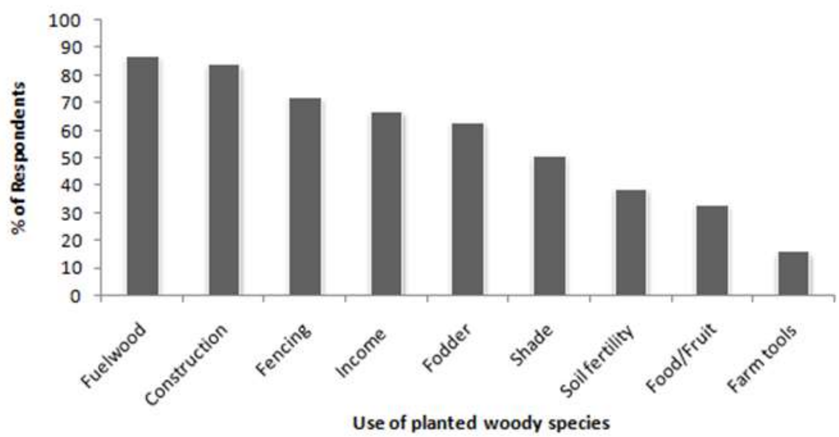

Fig. 5. Utility of planted woody species

Discussion

The finding of this study depicted that agricultural landscapes host high number of woody species. In particular, the highest number of woody species was recorded in homegardens as compared to crop fields, grazing lands and the natural forest. The likely explanation for this is that, the planting of various exotic and native woody species in the homegardens as the condition is favourable and easy to manage trees at backyard. In each farm of agroforesty land use, 13 woody species were recorded on average. In general, the diversity of woody species in human managed landscapes (homegarden, cropland and grazing land) is almost double to that of protected natural forest. This result is similar with the findings of other researchers who did comparison of woody species diversity between crop field and forest; Nikiema (2005) in Ethiopia (Central Burkina Faso), Motuma (2006) from Ethiopia (Arsi Negele Zonw) and Biruk (2006) from Ethiopia (South Eastern langano). The present study showed the reduction of woody species richness from forest to cropland. This can be explained by the way people manage their farmland to reduce shading effect and competition with their crop. This result is consistent with the findings of Bobo (2006) from Cameroon.

The Shannon diversity indices showed high value in the natural forest as compared to the agricultural landscapes. This is because of the high evenness value of the woody species in the natural forest. The low evenness in agricultural lands could be attributed to the dominance of some species in terms of total population such as *Eucalyptus* spp., *Faidherbia albida, Euclea racemosa* and *Acacia etbaica* which farmers often plant/retain and tend deliberately in high density. The number of common woody species in natural forest and homegardens and similarly in natural forest and grazing land were highest while lowest values were recorded in cropland and homestead. However, the Sorensen coefficient of similarity estimated for cropland and grazing land as well as in natural forest and grazing land were greater as compared with others. This can be explained by the presence of more woody species in the homegardens than natural forest and high number in natural forest than cropland.

The result of this study showed that farmers retain about 31 woody species, out of which, *Faidherbia albida* is commonly retained particularly in farmland. This can be explained by the species foliage shedding characteristics. The tree sheds its foliage at the start of the rainy season and with full leaf in the dry season (Wood, 1989). This inverted phenology means that its presence in the farmers field does not interfere with agriculture, gives it enormous value for sustaining soil fertility and provides animal fodder in the dry season.

The high woody species richness in agricultural landscapes in the present study indicates that human managed agricultural landscapes can play a vital role in preserving woody species diversity. Agroforestry bring onto farmland some of the biodiversity benefits associated with woodland (Stamps and Linit, 1998). The diversity of woody species has a direct relation with other biological diversity. The presence of woody species serves as a nesting, roosting and feeding site for a variety of birds and it also enriches faunal biodiversity (Harvey and Haber, 1999). The existence of a range of different woody species in agricultural landscapes also plays a great role for micro-organisms in the soil which support production of diversified crops. They can also support agriculture by serving as refuges for economically important species, such as pollinators or predators of agricultural pests. Moreover, the contribution of agroforesty to biodiversity conservation can be used for mitigating the impacts of changing ecological circumstances and worsening economic environments, and is more stable than mono-cropping or livestock rearing alone (Jama and Zeila, 2005).

The result of the current study showed that people retain/plant trees intentionally to obtain different economic and social benefits from the trees. Major benefits they obtain from trees retained/planted on their own land include fuelwood, soil fertility, construction, fodder, fencing, farm tools, shade, fruit, medicine and income from fruit and planted commercial trees. Agroforestry is a system that blends production (food and income security at household and community level) with ecosystem services (Jama and Zeila, 2005).

Conclusion

The result of the present study showed that the agricultural landscape play a major role in the conservation of native woody species in which 39 woody species were recorded on different agro ecosystems as only 23 woody species were recorded in enclosures indicating highest species richness on agricultural land uses than in forests. Moreover, the presence of woody species in these landscapes may favour the survival of other living organisms and hence contribute to a wider conservation of biological diversity. Agroforestry is the alternative for biodiversity conservation in environmental limitated areas such as dry land areas in addition to area closures activities. Highest species richness in homegarden might be associated with ease of planting and managing the trees than agricultural land and forest lands. The foliage shedding characteristics of *Faidherbia albida* attract the attention of farmers thus, retain it on their farmlands than any other species.

Farmers retain/plant trees intentionally to derive different socio-economic benefits as a source of their livelihood. Dwellers in dryland region need to be encouraged to practice tree planting on their agricultural lands predominantly at their backyards owing to its convenience for management of the trees so that the acute environmental degradations and wood product shortages will be reversed. Woody species which are highly valuable for the farmers and that have no negative effect on the productivity of the crops has to be introduced to the crop fields considering the preferences of the farmers with appropriate managements. Further research is very vital on the role of dryland agroforestry in biodiversity conservation, socioeconomic development and environmental protection.

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