

Diversity of woody species in agroforestry systems of Sokoru District, Jimma Zone, Southwest Ethiopia

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ABSTRACT: Agroforestry has played an important role in increasing land productivity and enhancing livelihoods in developed and developing countries. The geographical location of Ethiopia covers wide agro-climatic zones and very significant biodiversity. This wide geographical condition of Ethiopia has created diverse and convenience environments for the survival and development of a variety of flora. There are about 6000 species of higher plant taxa in Ethiopia of which about 10% are endemic. The main objective of this study was to investigate diversity of woody species in different agroforestry systems of Sokoru District, Jimma Zone. The study was conducted from February to May, 2018. First the population density, tree height, diameter at breast height and basal area for each tree were calculated. Next Analysis of Variance (one-way ANOVA) of SPSS version 20 was used to determine the variation of woody species density among different agroforestry systems of the study area. Whereas descriptive statistics such as: tables and graphs were used to present the analyzed data. The results showed high diversity of woody species in home garden (2.79) followed by pastureland (2.77) and cropland (2.1). Moreover, the high similarity in woody species composition was found in home garden and cropland (65.7%). There should be awareness among the people regarding to the direct and indirect significance of woody species in the agroforestry systems of the study area.

Keywords: Agro-forestry, cropland, diversity, land use types, pasture land, woody species.

Terminologies: Agro-climatic zones (Agro-ecological zone) = is a land unit, carved out of climatic zone, correlated with landforms, climate and the length of growing period.

INTRODUCTION

Silvopastoral systems have been promoted as new technologies to increase productivity and environmental services (Pagiola et al., 2004). Most farmers permit natural regeneration of woody species in pastures because it is a cost-effective way to introduce woody species into the grassland dominated landscape (Kuptz et al., 2011).

Agroforestry has played an important role in increasing land productivity and enhancing livelihoods in developed and developing countries (Schroth et al., 2004). The planting of trees along with crops on arable lands improve soil fertility, controls and prevents soil erosion, controls water logging, checks acidification and eutrophication of streams and rivers (Makundi and Sathaye, 2004).

The land of Ethiopia covers wide agro-climatic zones (Agro-ecological zone) and very significant biodiversity (Dawson et al., 2009). This wide geographical condition of Ethiopia has created diverse and convenience environments for the survival and development of a variety of flora (Dawson et al., 2009). There are about 6000 species of higher plant taxa in Ethiopia, of which about 10% are endemic (Kelbessa and Demissew, 2014).

Agroforestry is dynamic and involves the integration of trees on farms (Makundi and Sathaye, 2004). Agroforestry diversifies and sustains production for increased social, economic and environmental benefits for land users (ICRAF, 2002). There are several types of traditional

agroforestry practices in Ethiopia such as coffee shade tree systems, scattered trees on farmland, home gardens, woodlots, farm boundary practices and trees on grazing lands (Asfaw, 2003). In addition to support native plants and animals, agroforestry areas contribute to the conservation of biodiversity by increasing the connections of populations, communities, and fragmented landscapes (Harvey and Haber, 1998). Agroforestry systems can serve as *in-situ* conservation areas for many woody species like *Eucalyptus camaldulensis*, *Mangifera indica* and *Malus pumila* (Dawson et al., 2013).

Home garden is among the agroforestry systems with a potential to harbor biodiversity (Schroth et al., 2004). Home garden in Ethiopian highlands consists of higher woody species diversity than other nearby woodlands. This high woody species diversity ecosystem provides significant services such as nutrient recycling, soil and water conservation, and minimizes environmental deterioration (Tolera et al., 2008).

Agriculture is the main backbone of the economy and also is the major occupation of Ethiopian population (MoME, 2003). The increment of population growth has changed the land cover systems and caused environmental degradation in many developing countries including Ethiopia (Feoli et al., 2002). Cropland agroforestry is the integration of trees on farms that diversifies agricultural landscapes and sustains production for improved social, economic and environmental benefits (ICRAF, 2002). Agroforestry systems bring about changes in edaphic, microclimatic, floral, faunal, and other components of the ecosystem through bio recycling of mineral elements, environmental modifications, and changes in floral and faunal composition (Shukla, 2009).

The main objective of this study is to investigate woody species diversity in different agroforestry systems of Sokoru district, Jimma Zone, Southwest Ethiopia. There is no any current report from Sekoru District regarding woody species diversity. This shows that the status of woody species diversity in agroforestry systems of Sekoru District is not well known. Therefore, this study was designed to fill this knowledge gap.

METHODS AND MATERIALS

The study area

This study was conducted in Sokoru district of Jimma Zone from February to May, 2018. Sokoru district is found in Oromia Regional State, Jimma Zone (Figure1) at about 100 km East of Jimma town and 156 km southwest of Addis Ababa. The altitude of the district is 900 to 2,300 m above sea level. The district is located between 7° 55' - 7° 92' N latitude and 37° 25' -37° 42' E longitude (CSA, 2010).

Maximum and minimum temperature of the district was 28.3°C and 12.1°C respectively while the average annual rainfall was 1,458 mm. The crops grown in the area include

maize, sorghum, teff, sesame (selit), nug (niger seed), fruit crops like mango, orange, papaya, avocado, apple and the main cash crop is coffee. Among the animals: cattle, sheep, goat, mule, horse, donkey, chickens are common. There are also beekeeping activities in the area using modern and traditional beehives. In addition, there are also vegetables like green peppers, potatoes, tomatoes, sweet potatoes, yam, beet roots, and carrots grown in different sub districts of the study area (CSA, 2010).

Sampling design

A transect line of 24 km long with 2 km buffer was established across different land use types (home garden, pasture and cropland). The elevation of the study area is 1679 to 1934 m above sea level. Of 42 total sample plots, 14 sample plots of 100 m × 100 m were established in cropland and Pastureland while 14 plots of 20 m × 20 m were put in the homegardens (the homegarden was standardized to hectare for later comparison with cropland and pastureland)

Data collection

Stem count of woody species in pasture and cropland has been taken from each one-hectare plot (100 m × 100 m) whereas the stem count from home garden agroforestry was taken from 20 m × 20 m plot (this was later converted to hectare in order to compare with cropland and pastureland). The circumference of each stem with diameter at breast height (DBH) ≥ 5 cm, height ≥ 1.3 m was recorded from each plot (Mac Diken, 1997). The height of all individuals was also recorded using Clinometers. For the stem abnormalities, RAINFOR protocol was followed (Phillips et al., 2009). All woody species (trees and shrubs) were recorded from all plots. Latitude, longitude and altitude of the study site were recorded by using Global Positioning System (GPS). Samples of woody species (including their local names) were recorded. All woody specific gravity of each tree species was taken from global wood density data base developed by Chave et al. (2009). The samples were transported to Jimma University herbarium and identified using flora of Eritrea and Ethiopia.

Data analysis

Density

The density and relative density of woody species were the most important structural parameters considered during data analysis. The density per hectare of trees and shrubs were calculated by summing up all stems across all sample plots and converted into hectare.

$$\text{Density} = \frac{\text{Total number of individuals}}{\text{Sampled area in hectare}}$$

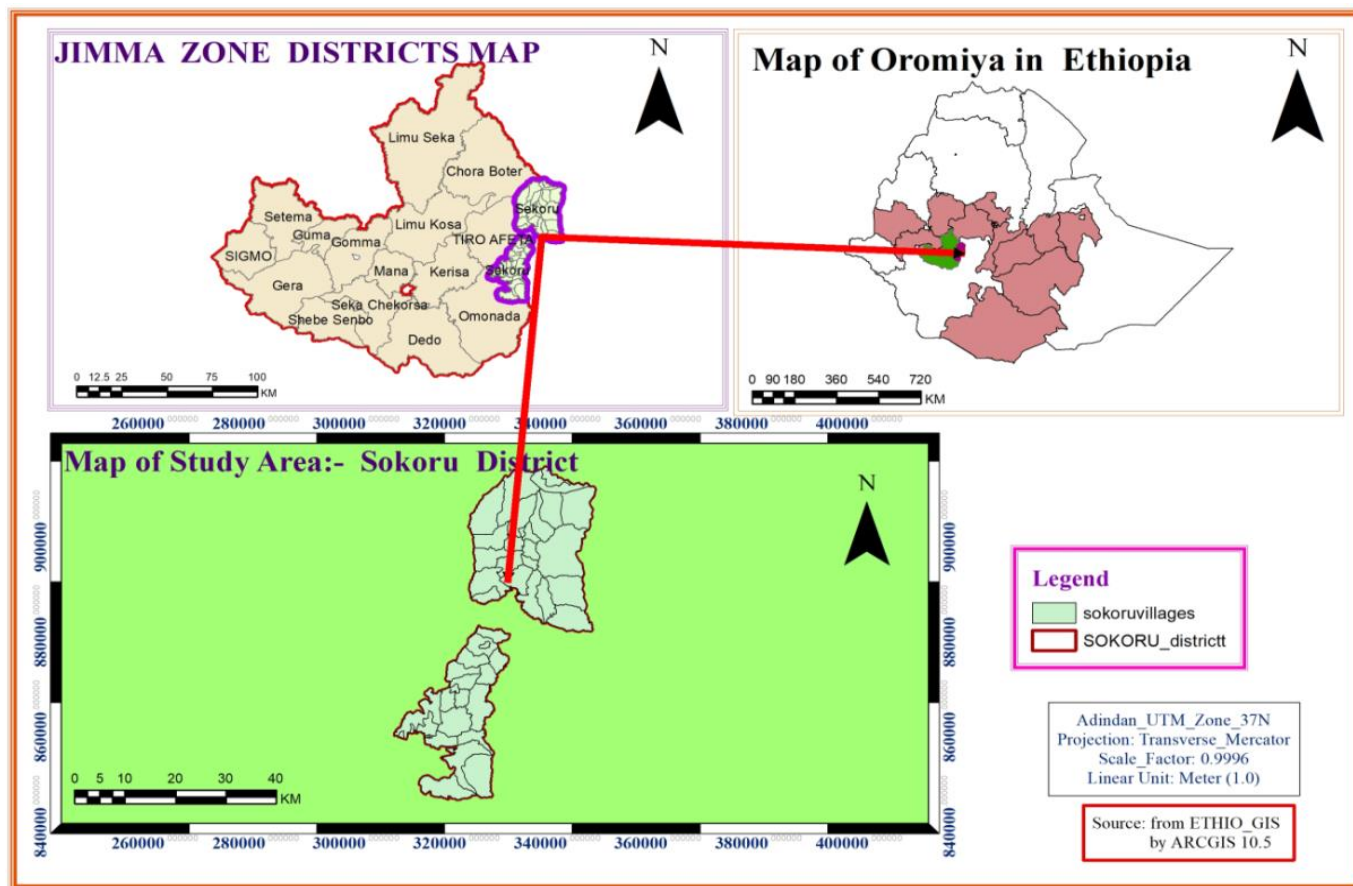


Figure 1. Location map of the study area (Source: from ETHIO-GIS).

$$\text{Relative Density} = \frac{\text{Number of individuals of species}}{\text{Total number of all individuals}} \times 100$$

Basal area (BA)

BA of the woody species in the three land use types was calculated on Microsoft office excel 2007 using the following equation

$$BA = \pi \left(\frac{D}{2} \right)^2$$

Where: D = diameter at breast height.

Frequency

The number of plots in which a given species found in the study area is referred to as frequency. Relative frequency for each woody species was taken using the following formula.

$$\text{Relative Frequency (RF)} = \frac{\text{Frequency of a woody species}}{\text{Frequency of all woody species}} \times 100$$

Species diversity

Woody species diversity of the study site was calculated using Shannon-Wiener diversity Index

$$H' = - \sum_{i=1}^S P_i \ln P_i$$

Where: Pi is the proportion of individuals found in the ith species.

Shannon's equitability (E)

Evenness was calculated as the ratio of observed diversity to the maximum diversity using the following equation.

$$E = H'/H'_{\text{max}}, H'_{\text{max}} = \ln S$$

Where: H' = Shannon-Wiener diversity Index, S = total number of species in the sample.

Table 1. Growth form and distribution of woody species across the three land use types of Sokoru District; April 2018.

Land use types	Habit		
	tree	Shrubs	Total
Homegarden	21	12	33
Cropland	29	8	37
Pasture land	29	8	37

Table 2. Woody species diversity across the three agroforestry of Sokoru District; April, 2018.

Land use type	Species richness	Diversity index (H')	H'max (lnS)	Equitability (J)
Homegarden	33	2.791	3.49	0.799
Cropland	37	2.1	3.6	0.58
Pastureland	37	2.77	3.6	0.77

Similarity in species composition

Similarity among the three land use types in woody species composition was calculated by using Sorenson's similarity index (SSI).

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

Where: a = number of common species, b = number of species unique to the first site and c = number of species unique to the second site.

Analysis of variance (one-way ANOVA) of SPSS version 20 was used to determine the variation among different agroforestry systems in woody species density. The data were log transformed as to maintain the normal distribution.

RESULTS

Woody species richness, evenness and diversity

Overall, 58 woody species (Appendix Table 1) belonging to 52 genera and 35 families (Appendix Table 2) were recorded from the three agroforestry systems along the study transect, of which 14(24%) were shrubs and 44(76%) were trees. Of the woody species families recorded in the study area, Fabaceae was the richest family with 6(10.34%) species followed by Euphorbiaceae 5(8.6%) and Rutaceae, with 5(8.6%) species each, whereas, Moraceae and Merytaceae were the third with 3(5.17%) species each. The other families such as Annonaceae, Asteraceae, Boraginaceae, Celasteraceae, Meliaceae and Rosaceae each of them has 2 (3.44%) species.

From the homegarden, 33 woody species belonging to 32 genera and 23 families were recorded. Similarly, 37 woody species belonging to 33 genera, 22 families from the cropland and 37 woody species belonging to 33 genera and 23 families were recorded from Pastureland. From all recorded samples from the three land use types, about 12 families were commonly found in all three land use types (Appendix Table 3).

Woody species life form

Majority of the woody species recorded were classified in form of trees while few species belong to shrub. Furthermore, shrubs were more common habit type in homegarden while trees were more recorded both in cropland and pastureland (Table 1).

Woody species diversity and evenness

Although, crop and pasturelands have high and equal number of woody plant species, home garden showed the highest diversity of species (Table 2).

Similarity in species composition

Home gardens and crop lands showed high similarity in woody species composition whereas the least similarity in between home garden and pastureland (Table 3).

Basal area

From the individual stem count recorded from home garden, *Cordia africana* has relatively the highest BA (9.84) followed by *Mangifera indica* (BA = 2.2), the highest

Table 3. Similarity of the three agroforestry in woody species composition of Sokoru District; April, 2018.

Land use types	Homegarden	Cropland	Pastureland
Homegarden	1	0.657	0.388
Cropland		1	0.64
Pastureland			1

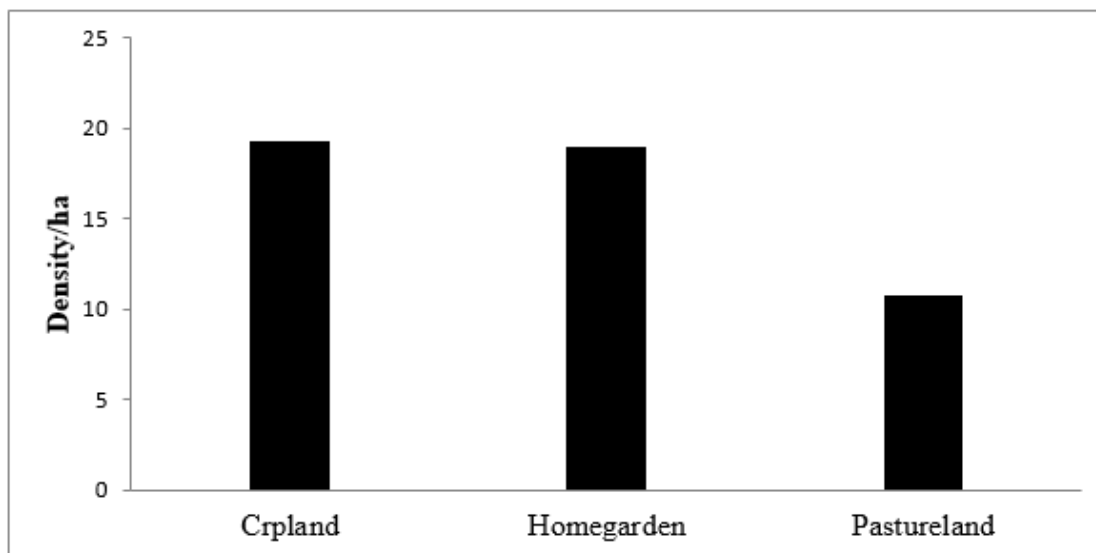


Figure 2. Woody species density of the three land use types of Sokoru District; April, 2018.

Table 4. The number and percentage of all individual tree and shrubs recorded from three land use types of Sokoru District; April, 2018.

Land use type	Tree		Shrub		Total	
	Number	%	Number	%	Number	%
Homegarden	197	28.6	70	10.17	267	38.81
Cropland	225	32.7	45	6.54	270	39.2
Pastureland	124	18	27	3.9	151	21.9
Total	552	80.16	136	19.65	688	100

basal area was calculated for *E. camaldulensis* followed by *C. africana* in the cropland.

Density and frequency of woody species

About 688 individuals of 58 woody species with ≥ 5 DBH were recorded from three agroforestry (homegarden, cropland and pastureland). Of these 688 individuals, 267 (from Homegarden), 270 (from Crop land) and 151 individuals were recorded from Pasture land (Table 4). Trees were with higher density when compared to shrubs of woody species from the three land-use types. The result

also indicated that cropland have more woody species density as compared to pasture lands and home gardens (Figure 2).

Trees such as *Cordia Africana*, *Eucalyptus Camaldulensis*, *Persea Americana* and *Croton macrostachyus* were very abundant while, *Citrus aurantifolia*, *Ehretia cymosa*, *Grewia ferruginea* and *Moringa oleifera* were rare trees species of the study area. *Coffea Arabica*, *Euphorbia trucalli*, *Catha edulis*, *Vernonia auriculifera* and *Psidium guajava* were abundant shrub species of the study area while *Clausena anisate*, *Justicia schimperiana*, *Acacia etbaica*, *Phytolacca dodecandra* and *Gossypium arboretum* were rare shrub species of the study area (Table 5).

Table 5. Abundant and rare woody species of Sokoru District; April, 2018.

Habit	AbundantSpecies		Rare species	
	Scientific name	No	Scientific name	No
Tree	<i>Cordia africana</i>	127	<i>Citrus aurantifolia</i>	2
	<i>Eucalyptus camaldulensis</i>	59	<i>Ehretia cymosa</i>	2
	<i>Persea americana</i>	40	<i>Grewia ferruginea</i>	2
	<i>Croton macrostachyus</i>	39	<i>Moringa oleifera</i>	2
	<i>Croton macrostachyus</i>	39	<i>Moringa oleifera</i>	2
Shrub	<i>Coffea arabica</i>	66	<i>Clausena anisata</i>	4
	<i>Euphorbia truncalli</i>	43	<i>Justicia schimperiana</i>	3
	<i>Catha edulis</i>	22	<i>Acacia etbaica</i>	2
	<i>Vernonia auriculifera</i>	14	<i>Phytolacca dodecandra</i>	2
	<i>Psidium guajava</i>	5	<i>Gossypium arboretum</i>	1

Table 6. The summary of significant value for one-way ANOVA between the three land use types of the study area for density.

Density/ha	Sum of Squares	Df	Mean Square	F	P.
Between Groups	657.762	2	328.881	6.544	0.004
Within Groups	1960.143	39	50.260		
Total	2617.905	41			

Table 7. Summary of ANOVA for the density of the three land use types (HG = Homegarden).

Group	(J) group	Mean D.(I-J)	Std. Error	Sig.	95% Confidence Interval	
					L. bound	U. bound
HG	Cropland	-0.21429	2.67955	0.996	-6.7425	6.3139
Cropland	Pasture	8.50000	2.67955	0.008	1.9718	15.0282
Pasture	HG	-8.28571	2.67955	0.010	-14.8139	-1.7575

Frequency

The most commonly sampled woody species from the three landuse types was *Cordia africana*. The *Coffea arabica* was the most frequently observed species in home gardens and croplands. Similarly, woody species such as *Albizia gummifera*, *Eucalyptus camaldulensis* and *Croton macrostachyus* were frequently recorded from cropland and pastureland.

Variations in woody species density

The result of analysis of variance (ANOVA) showed that there is significant variation ($F = 6.544$, $p = 0.004$) among the three agroforestry in woody species density. The significant variation between cropland and pastureland ($p = 0.008$) (Table 6); and between pasture land and home

garden ($p = 0.01$) (Table 7).

DISCUSSIONS

Woody species richness and diversity

The woody species from cropland were trees with high basal area and large canopy. These are *Cordia africana*, *Eucalyptus camaldulensis*, *Croton macrostachyus*, *Albizia gummifera*, *Coffea arabica* and *Ficus sur*. This result was supported by Hundera et al. (2013). The regeneration of six late-successional tree species (*S. guineense*, *Afrocarpus falcatus*, *O. welwitschii*, *P. africana*, *Ilex mitis* and *Pouteria adolfi-friederici*) were consistently greater in the forest coffee than in the semiforest coffee and semi plantation coffee agroforestry system. This observation is in agreement with earlier reports of Dereje Denu et al.

(2016) and Bajigo and Tadesse (2015).

Density of Woody plant species and variation among the three agroforestry systems

There is a variation of species richness among the three land use types (home garden, cropland and pastureland). The reason why the variation of species richness among the three land use types of the study area could be due to unequal management practice and socio-economic factors such as: preference of timber trees, edible fruit trees and the ability of woody species to fertile the soil. The result of the study investigated that, cropland was hosted with highest stem density when compared to homegarden and pastureland. This might be due to deliberately retained trees and other trees in their farmland for different purposes. Example, for improving soil fertility and reduce the impact of soil erosion. This is similar with the study reported by Makundi and Sathaye (2004) that indicates high stem density in croplands. By planting the trees along with crops on cropland improves soil fertility, controls and prevents soil erosion, controls water logging, checks acidification and eutrophication of streams and rivers, enhances local biodiversity, reduces pressure on forests for fuel and provides fodder for livestock.

Frequency and Abundance of woody species

The woody species with high basal area (1.6m²/ha) was *Cordia africana* and *Ficus vasta*. The main reason why these two species had large basal area was that they had high DBH value. Amongst the three land use types, cropland woody had the largest basal area followed by homegarden. The least value of basal area was calculated from pastureland and agroforestry. This might be influenced by the density of each stem count in each land use type. This is similar with the study conducted by Wassie (2004); particularly, in northern Ethiopia, *C. africana* has been pushed out of its wild habitat and conserved in protected areas such as monasteries and in agricultural lands. People preference for different purposes like household furniture and now days are confined to the farm lands and home garden in south west Ethiopia (Etana, 2010).

This is in line with the study conducted by Muleta et al. (2011) in the Yayu Hurumu and Bonga forests, the fourth most preferred shade species was *Cordia africana*. This is a multi-purpose tree, providing good shade for coffee and also high-quality timber. It is widely used for making doors and window frames, cabinets, mortars and beds. The farmers stressed the importance of *Cordia africana* as an alternative source of income from cropland. The most frequent woody species in the three land use types were *Cordia africana* followed by *Croton macrostachyus*. Others were found at medium and lower class frequency. This showed that most of the woody species were found in

lower class frequency and small numbers of woody species in higher frequency. The reason why the frequency of woody species differs from one land use type to the other and from species to species might be either unequal conservation by human being or the difference in soil types. There was similar study reported from Bangladesh by Kibria and Anik (2010). Most of the stem count recorded from the study area were categorized in lower class frequency.

Conclusion and recommendation

About 58 woody species were collected from Sokoru district of which 44 were trees while 14 were shrubs. Of all woody species recorded from the three agroforestry systems, *Cordia africana* was the most frequent and abundant species with highest basal area. Cropland was the highest land use type in woody species density followed by homegarden. Amongst the three land use types, cropland woody had the largest basal area followed by homegarden. The least value of basal area was calculated from pastureland agroforestry. It is therefore recommended that:

1. People of the study area are conserving woody species found in cropland and homegarden very well than pastureland. Bearing this in mind, any concerned body including the local people of the study area should work for the conservation and plantation of the woody species in pasture land.
2. There should be an awareness among the people of the study area regarding the direct and indirect significance of the woody species in the agroforestry systems of the study area.
3. This study was about woody species diversity of the three land use types (homegarden, cropland and pasture land) and did not include riverine, natural forest and others. Therefore, it recommended that further studies should be carried out to fill the above mentioned gaps.

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

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Appendixes

Appendix Table 1. List of woody species recorded from the study area (L. name= local name, ha= habit, A/O= Afan Oromo).

No	Scientific name	L. name in A/O	Family	ha
1	<i>Acacia abyssinica</i> Hochst ex Bench.	Lafto	Fabaceae	T
2	<i>Acacia etbaica</i> Schweinf.	Doddota	Fabaceae	S
3	<i>Albizia gummifera</i> (J. f. Gmel.) C. A. Sm	Hambabessa	Fabaceae	T
4	<i>Annona reticulata</i> L.	Gishxa	Annonaceae	T
5	<i>Apodytes dimidiata</i> E.Mey. ex Arn.	Wendabiyo	Metteniusaceae	T
6	<i>Azadirachta indica</i> A. Juss	Nimi	Meliaceae	T
7	<i>Bersama abyssinica</i> Fresen.	Lolchisa	Meliantaceae	T
8	<i>Calpurnia auria</i> (Lam.) Benth.	Chekata	Fabaceae	T
9	<i>Carica papaya</i> L.	Papaya	Caricaceae	T
10	<i>Carissa spinarum</i> (Forssk.) Vahl	Hagamsa	Apocynaceae	S
11	<i>Casimiroa edulis</i> (La.) Liave and lex.	Kasmira	Rutaceae	T
12	<i>Casuarina equisetifolia</i> L.	Shuwashuwe	Casuarinaceae	T
13	<i>Catha edulis</i> (Vahl) Frossk. ex Endl.	Caatii	Celastraceae	S
14	<i>Celtis Africana</i> Burm. f.	Matakoma	Ulmaceae	T
15	<i>Citrus aurantifolia</i> (Christm.) Swingle	Lomi	Rutaceae	T
16	<i>Citrus sinensis</i> (L.) Osbeck.	Burtukana	Rutaceae	T
17	<i>Clausenaanisata</i> (Wild.) Hook. F. ex. Benth	Ulmayi	Rutaceae	S
18	<i>Coffea arabica</i> L.	Buna	Rubiaceae	S
19	<i>Combretum paniculatum</i> Vent	Dhandheessa	Combretaceae	T
20	<i>Cordia africana</i> Lam.	Wadessa	Boraginaceae	T
21	<i>Croton macrostachyus</i> Hochst. ex Del.	Makanisa	Euphorbiaceae	T
22	<i>Cupressus lusitanica</i> Mill.	Gattira	Cupressaceae	T
23	<i>Dodonaea angustifolia</i> L. f.	Etacha	Sapindaceae	T
24	<i>Dracaena afromontana</i> Mildbr.	Rukessa	Agavaceae	T
25	<i>Ehretia cymose</i> Thonn.	Ulaga	Boraginaceae	T
26	<i>Ekebergia capensis</i> Sparm.	Sombo	Meliaceae	T
27	<i>Erythrina burecei</i> Schweinf.	Walensu	Fabaceae	T
28	<i>Eucalyptus camaldulensis</i> Dehmk.	Bargamodima	Myrtaceae	T
29	<i>Euphorbia abyssinica</i> Gmel.	Adami	Euphorbiaceae	T
30	<i>Euphorbia truncata</i> L.	Cadaa	Euphorbiaceae	S
31	<i>Ficus sur</i> Forssk.	Harbu	Moraceae	T
32	<i>Ficus thonningii</i> Blume	Dambi	Moraceae	T
33	<i>Ficus vasta</i> Frossk.	Qilxu	Moraceae	T
34	<i>Flacourtia indica</i> (Burm. f.) Merr	Akukkuu	Flacourtiaceae	T
35	<i>Gossypium arboreum</i> L.	Jirbi	Manaceae	S
36	<i>Grevillea robusta</i> A. Cunn.	Giravila	Proteaceae	T
37	<i>Grewia ferruginea</i> Hochst. ex A. Rich.	Dhoqonu	Tiliaceae	T
38	<i>Justicia schimperiana</i> (Hochst. ex A. Nees) T. Anders	Dhumuga	Acanthaceae	S
39	<i>Maesa lanceolata</i> Forssk	Abbayyi	Myrsinaceae	S
40	<i>Malus pumila</i> Mill.	Appili	Rosaceae	S
41	<i>Mangifera indica</i> L.	Mango	Anacardiaceae	T
42	<i>Millettia ferruginea</i> (Hockst.) Bak	Askira/Sotelo	Fabaceae	T
43	<i>Moringa oleifera</i> Lam.	Moringa	Moringaceae	T
44	<i>Maytenus arbutifolia</i> (A. Rich.) Wilczek	Kombolcha	Celastraceae	S
45	<i>Olea europea</i> ssp. Cuspidata	Ejersa	Oleaceae	T
46	<i>Persea americana</i> Mill.	Avokado	Lauraceae	T
47	<i>Phoenix reclinata</i> Jacq.	Mexxii	Areaceae	T
48	<i>Phytolacca dodecandra</i> L. Herit	Andode	Phytolaccaceae	S
49	<i>Prunus persica</i> (L.) Batsch	Kookii	Rosaceae	T

Appendix Table 1. Cotnd.

50	<i>Psidium guajava</i> L.	Zayituna	Myrtaceae	T
51	<i>Rhamnus prinoides</i> L. Her.	Gesho	Rhamnaceae	S
52	<i>Ricinus communis</i> L.	Qobboo	Euphorbiaceae	T
53	<i>Sapium ellipticum</i> (Krauss) Pax	Bosoqa	Euphorbiaceae	T
54	<i>Spathodea campanulata</i> P. Beauv	Annonobo	Bignoniaceae	T
55	<i>Syzygium guineense</i> (Wild.) Dc.	Baddessa	Myrtaceae	T
56	<i>Vernonia amygdalina</i> Del.	Dhebicha	Asteraceae	S
57	<i>Vernonia auriculifera</i> Hiern	Rejji	Asteraceae	S
58	<i>Ziziphus mauritiana</i> Lam.	Qurqura	Rhamnaceae	T

Appendix Table 2. Family and Genera of the study area.

No	Family	No of Genera	No of Species
1	Acanthaceae	1	1
2	Agavaceae	1	1
3	Anacardiaceae	1	1
4	Annonaceae	1	1
5	Apocynaceae	1	1
6	Arecaceae	1	1
7	Asteraceae	2	2
8	Bignoniaceae	3	3
9	Caricaceae	1	1
10	Casuarinaceae	1	1
11	Celastraceae	1	1
12	Combretaceae	1	1
13	Cupressaceae	1	1
14	Euphorbiaceae	4	5
15	Fabaceae	5	6
16	Flacourtiaceae	1	1
17	Lauraceae	1	1
18	Manaceae	1	1
19	Meliaceae	2	2
20	Melanthaceae	1	1
21	Metteniusaceae	1	1
22	Moraceae	1	3
23	Moringaceae	1	1
24	Myrsinaceae	1	1
25	Myrtaceae	3	3
26	Oleaceae	1	1
27	Phytolaccaceae	1	1
28	Proteaceae	1	1
39	Rhamnaceae	2	2
30	Rosaceae	2	2
31	Rubiaceae	1	1
32	Rutaceae	3	5
33	Sapindaceae	1	1
34	Tiliaceae	1	1
35	Ulmaceae	1	1

Appendix Table 3. List of woody species commonly found in three land use types (L. name= local name, A/O= Afan Oromo)

Scientific name	L. name in A/O	Family
<i>Grevillea robusta</i> A. Cunn.	Giravila	proteaceae
<i>Cordia Africana</i> Lam.	Waddessa	Boraginaceae
<i>Croton macrostachyus</i> Hochst.ex Del.	Makanisa	Euphorbiaceae
<i>Erythrina burecei</i> Schweinf.	Walensu	Papilionoideae
<i>Calpurnia auria</i> (Lam.)Benth.	Chekata	Fabaceae
<i>Vernonia auriculifera</i> Hiern	Rejji	Asteraceae
<i>Albizia gummifera</i> (J. f. Gmel.) C.A.Sm	Hambabessa	Fabaceae
<i>Ekebergiacapensis</i> Sparm.	Sombo	Meliaceae
<i>Cupressus lusitanica</i> Mill.	Gattira	Cupressaceae
<i>Eucalyptus camaldulensis</i> Dehnk.	Bargamodima	Myrtaceae
<i>Euphorbia trucall</i> L.	Cadaa	Euphorbiaceae
<i>Maesa lanceolata</i> Forssk	Abbayyi	Myrsinaceae