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FLORISTIC COMPOSITION OF HOMEGARDEN AGROFORESTRY SYSTEM IN HABRO DISTRICT, OROMIA REGIONAL STATE, ETHIOPIA

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Abstract: The Homegardens are one of the most important niche in which farmers feel confident to plant and maintain tree and shrub species. Homegardens floristic composition in western Hareghe in general and Habro district have not been given much research attention. The study investigated the floristic composition of the homegarden agroforestry system in 36 homegardens. The study was carried out in Habro district at three sites (Melka Belo, Haro Chercher and Lega Bera) *Kebeles*. A total of 77 plant species were recorded from homegardens of the study area. The families Fabaceae, Solanaceae and Euphorbiaceae were the most diverse, each having nine, seven and five species. The most abundant woody species in the study area were *Catha edulis, Coffea arabica* and *Cordia africana* where as the most abundant herbaceous species were *Lycopersicon esculentum*, *Capriscum spp* and *Nicotina tabacum*. The highest species richness (40 woody and 19 herbaceous) was recorded at Haro Chercher site for both woody and herbaceous species and lowest number of species was recorded at Melka Belo. According to Jaccard's and Sørensen's similarity indices Melka Belo and Haro Chercher Homegardens Agroforestry System (69.23 and 81.82) were the most similar pairs followed by Melka Belo and Lega Bera (61.54 and 76.19) while Haro Chercher and Lega Bera (52.70 and 69.03) were the most dissimilar pairs. Hence, the research encourages agroforestry systems that are found to have positive effects on plant diversity.

Keywords: Floristic Composition; Homegarden; Similarity index.

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INTRODUCTION

Homegarden is land use system involving deliberate management of multipurpose trees and shrubs in intimate association with annual and perennial agricultural crops and invariably livestock within the compounds of individual houses, the whole tree-crop, and animal unit is being intensively managed by family labour (Kumar and Nair, 2006). Homegardens are prevalent in the highlands of Ethiopia and accommodate supplementary fruits and vegetables as a principal means of livelihood for households and sites that have been considered as a sign of prestige and pride (Zemede, 2001). Homegardens are one of the most important niches in which farmers feel confident to plant and maintain tree and shrub species on the other hand, from the conservation point of view, homesteads are the *in situ* and *circa-situ* conservation sites of a wide range of plant biodiversity (Mekonnen *et al.,* 2009). In the last few decades increased human population has resulted directly and indirectly in depletion of the natural vegetation which in turn increases the pressure on the homegardens especially in the developing countries (Alam and Masum, 2005). The absence of formal or informal links between the homegardens on the one side and the national research and extension service on the other do not allow this important production system to benefit from the outcome of research.

Additionally, homegardens are not considered economically important or rather marginal and are often neglected in national and international agricultural research (Mekonen, 2010). This situation leads to a continued neglect of the homegardens, excluding them from national or regional conservation efforts, and requiring due attention and improvement (Regassa, 2014).

In Ethiopia inventory and documentation of homegarden diversity and species composition are very few and focused in south and south-western parts of the country (Ewuketu *et al.,* 2014) and there were not done in western Harerghe homegarden agroforestry system in general and Habro district. Investigation of floristic composition of homegarden agroforestry system (HAgFS) of the district is imperative to overcome the stated problems and up-scaling best practices through research to increase agricultural productivity in a sustainable way to enhance agricultural growth and achieve food security, disseminate technologies in faster pace, to appropriately utilize the plant and soil resource. Knowledge of the floristic composition is useful in identifying ecologically and economically important plants and their diversities, protecting threatened and economical important plant species (Addo-Fordjour *et al.,* 2009). To maintain the ecological equilibrium, conservation of plant genetic diversity and to meet the homegarden products for requirements of the people, scientific information is required. Lack of such scientific knowledge of homegarden may let destruction of diverse plant and results loosing of homegarden and its genetic diversity. To improve our understanding on how the agroforestry systems, work, there is a need to design scientific investigation, and study the contribution of the existing traditional agroforestry systems including floristic composition.

Hence, the present study is proposed to investigate the floristic composition of the homegarden agroforestry system.

EXPERIMENTAL

Description of the Study Area

This study was conducted in Habro district in Melka Belo, Haro Chercher and Lega Bera *kebele* administrations (Figure 1). The district is found in West Harerghe Zone of Oromia National Regional State, eastern part of Ethiopia. The district is located at 8.57° N - 8.91° N and 40.34° E - 40.69° E. Gelamso town is the administrative seat of the district.

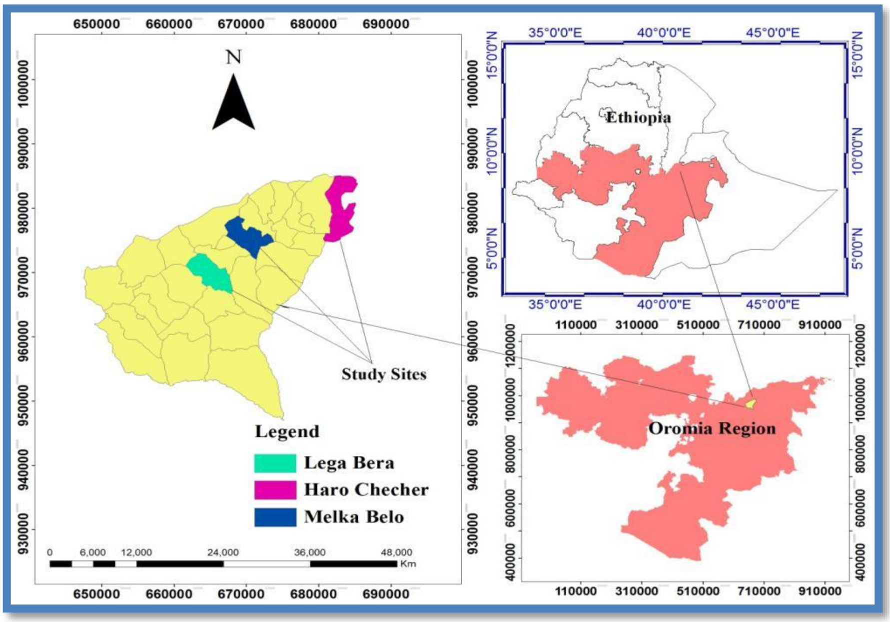

Figure 1. Map of the study area

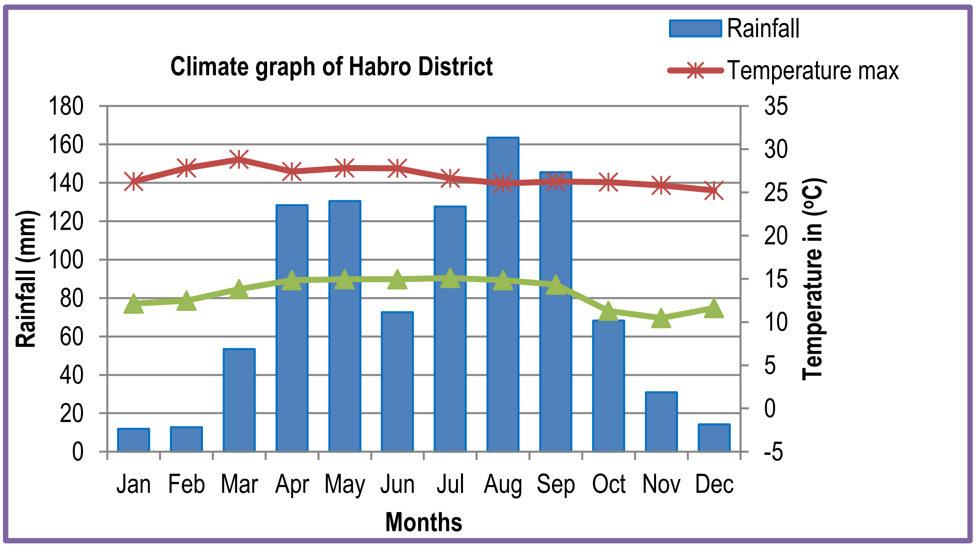

Figure 2. Mean Monthly Rainfall and Mean Minimum and Mean Maximum Monthly Temperatures of Habro District (2001-2016) (Source: Habro District Metrology station)

The elevation of the district ranges from 1600 to 2400 m.a.s.l. The district is characterized by plateaus, mountains, hills, plains and valleys. The district is generally classified into 3 agro ecologies, the lowland, the midland and the high land constituting 5%, 80% and 15% of the total area of the district respectively (HDoANRO, 2014). Climatically Habro district has a mean minimum and mean maximum temperature of 13.4°C and 26.8°C, respectively and receive mean monthly rainfall of (80mm) and mean annual rainfall of 959.7 mm (Figure 2). Rainfall type is bimodal, erratic and uneven in nature with high amount of rainfall occurring during the main rainy season between June to September and the short rainy season stretching from March to June. The highest rainfall is received in August. The higher mean maximum airs temperature is from February to June while the higher mean minimum airs temperature is from April to September.

Soil map obtained from the Ministry of Water Resources (MoWR) indicates the presence of five major soil types in Habro District including Vertic Luvisols, Rendzic Leptosols, Haplic Luvisols, Eutric Vertisols and Eutric Leptosols. Of these soil types, Vertic Luvisols occupy a major portion of the area followed by Rendzic Leptosols, Eutric Leptosols, Haplic Luvisols and Eutric Vertisols (Mengesha *et al.,* 1990). The existing land use system of the Habro district consists of 33.7% cultivated area of which10.3% is under perennial crops, 22.9% pasture and 1.7% forest and shrub and bush lands, while the rest is accounted for barren, settlement area and others. Agricultural production and productivity in the district are generally found to be poor mainly because of many natural and anthropogenic adversities, such as higher population density, shortages of farm land, deforestation, soil erosion, and loss of soil fertility (http://www.oromiyaa.com).

Mixed crop-livestock agriculture is a common farming system in the study area. The main crops grown in the area are cereals such as *teff (Eragrostis tef),* maize *(Zea mays),* wheat *(Triticum aestivum*), barley *(Hordeum vulgare*), haricot bean (*Phaseolus vulgaris*) and sorghum (*Sorghum bicolor*) and cash crops such as coffee (*Coffea arabica*), *chat* (*Catha edulis*), pepper (*Capsicum species*) and onion (*Alluim cepa*). The major animals kept in the area are cattle, goats, donkeys, chickens and bees (HDoANRO, 2014). Agricultural land is very limited and as a result, intercropping is a common practice in these areas. Common bean and maize are often intercropped to increase yields and maximize land use. Growing maize and sorghum in chat alleys is also another common practice. There are no protected forests and wildlife conservation areas in the district. Only a few *Junipperus procera*, *Podocarpus falcatus*, *Olea europaea* subsp. *cuspidata* and plantation forests of *Eucalyptus* *globulus* are the most important tree species that are found scattered here and there in the district, but many areas are being protected and different indigenous trees species are being planted to regenerate the native vegetation cover of degraded hill slope of the areas (Dereje, 2013). The district has population of about 214,591, of which 103,472 are females. Young, economically active and old age populations accounted for 45.3%, 52.4% and 2.3%, respectively. An average family size for rural area is 5 persons (HDoANRO, 2014).

Sampling Method

Purposive sampling was used based on extensive presence of homegarden agroforestry systems in the area. Three sites (here after *Kebele* Administration, KA) were selected. Six villages (2 from each KA) were identified based on the extensive presence of the system through preliminary field observation and discussion with natural resource management experts of the district. Thirty-six homegardens (six from each village) were randomly selected from the 6 selected villages for floristic composition study.

Data Collection

To assess the floristic composition of plant species, two 10 m x 10 m sample main plots were laid in 36 randomly selected homegardens giving a total of 72 main quadrates (7200 m^2). The first quadrat/plot was selected randomly, and the second plot was selected systematically as described by (Ewuketu *et al.,* 2014) where they selected the first plot randomly and the second plot selected systematically) to cover all species types occurring in the garden. Using X design within the main plot, either from the corners or at the middle one 2 m x 2 m sub-plots were laid to catch herbs interspersed between woody plants. Since almost all herbaceous plants (spice, vegetable, tubers and roots) were concentrated near an individual house alone, another two sub-plots close to the home was laid out (randomly for the first plot and systematically for the second plot) to cover all herbaceous species in the garden and making a total of four sub-plots (16 m^2) per homegarden as described by (Ewuketu *et al.,* 2014). Plant species identification was carried out using the owner of the homegarden and the researcher for vernacular name. In this study, plant species nomenclature follows flora of Ethiopia and Eritrea, a glossary of Ethiopian plant names and other identification materials was used.

Data Analysis

Following floristic composition data collection, descriptive statistical methods such as, frequencies, relative frequencies, abundance, Shannon-Wiener index, Shannon Evenness, Simpson's index, Sørensen's and Jaccard's Index of similarity were used to analyze the data collected in two main sample plots of 10 m x 10 m (200 m^2) for trees/shrubs and 4 plots of 2 m x 2 m (16 m^2) subplots for herbaceous plants in 36 homegardens: 12 homegardens from each KA.

Species Richness and Diversity Indices

Woody species diversity index was analyzed by using different diversity indices. Shannon diversity index (H'), Shannon equitability/evenness index (E), species richness (S), and Simpson diversity index (D) were calculated and analysed. These diversity indices provided important information about rarity and commonness of species in a community. Species richness is the total number of species in the community (Krebs, 1999).

Shannon-Wiener Diversity Index (H')

The Shannon diversity index is calculated as follows:

$$\mathrm{H'} = -\sum_{i=1}^{S} (pi \ln pi)$$

Where, H' is Shannon diversity index and *pi* is proportion of individuals found in the i^{th} species. Evenness (Shannon equitability) index (E) was calculated as described by (Kent and Coker, 1992) to estimate the homogeneous distribution of plant species in the homegarden:

$$\mathrm{E} = \frac{\mathrm{H'}}{\mathrm{H'max}} = \frac{\mathrm{H'}}{\ln \mathrm{S}} \quad \text{with} \quad \mathrm{H'max} = \mathrm{S}$$

Where, S is the number of species and *pi* is proportion of individuals of the i^{th} species or the proportion of the total species.

Simpson's diversity index (D)

Simpson's diversity index is derived from a probability theory and it is the probability of picking two different species at random (Krebs, 1999). Simpson's index provides an accurate estimate of diversity for relatively small sample sizes. Simpson's diversity (D) is calculated as:

$$D = 1 - \sum pi^2$$

Where, D is Simpson's diversity index and *pi* is proportion of individuals found in the i^{th} species.

The above indices, which are generally referred to as alpha diversity, indicate richness and evenness of species within a locality, but they do not indicate the identity of the species where it occurs. Hence, variation in composition of plant species among the different homegarden agroforestry was determined by computing similarity index.

Similarity Indices

Similarity indices measure the degree to which the species compositions of different system are alike. Similarity between the villages was assessed using Jaccard's coefficient of similarity with respect to the proportion of occurrence of shared species and Sorenson's coefficient of similarity about the density of shared species (Comiskey *et al.,* 1998).

Sørensen Similarity Index (Ss)

The Sørensen similarity index 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 similarity of species composition between the six study villages was calculated with the Sørensen similarity index with the formula:

$$\mathrm{Ss} = \frac{2\mathrm{A}}{\mathrm{B} + \mathrm{C}} * 100\%$$

Where, A = number of species common to two villages (X and Y); B = total number of species in village X; C = total number of species in village Y. The coefficient values range from 0 (complete dissimilarity) to 1 (total similarity)

Jaccard's Similarity Indices (I)

The Jaccard's index of similarity (I) was calculated for each pair wise plot. The index is given by;

$$\mathrm{I} = \frac{C}{\mathrm{Ux} + \mathrm{Uy} + C} * 100\%$$

Where, *C* = number of species common to both village X and Y.

Ux = number of species found only in village X and *Uy* = number of species found only in village Y.

Frequency

Frequency describes the distribution of a species throughout the stands. It is determined by calculating the percentage of plots (quadrants) in a sample area on which a given species occurs (Martin, 1995).

$$\text{Percent of frequency} = \frac{\text{Total number of plots in which the species occurs}}{\text{Total number of plots enumerated}} * 100\%$$

Relative Frequency

Relative frequency is the number of occurrences of a species, as a percentage of the total occurrences of all species (Martin, 1995).

$$\text{Relative frequency} = \frac{\text{Frequency of a species in the plot}}{\text{Total frequency of all species in the plot}} * 100\%$$

Abundance (A)

Abundance is the number of individuals encountered.

Density

Density is the average number of individuals of a species on a unit area basis. Density is number of stems or plants per unit area. It is closely related to abundance but more useful in estimating the importance of a species (Martin, 1995).

$$\text{Density} = \frac{\text{Number of individuals in the sample}}{\text{Total area of the sample } (m^2)}$$

RESULTS AND DISCUSSION

Floristic Composition of Homegarden

A total of 77 plant species (52 woody and 25 herbaceous) were recorded from homegardens of the study area which belong to 40 families. The families Fabaceae, Solanaceae and Euphorbiaceae were the most diverse, each having nine, seven and five species, respectively. Lamiaceae and Rutaceae families each were having four species also contribute to the diversity of homegarden. Cucurbitaceae was represented by 3 species where as Anacardiaceae, Annonaceae, Asteraceae, Boraginaceae, Brassicaceae, Flacourtiaceae, Malvaceae, Musaceae, Myrtaceae and Poaceae with two species the rest was represented by one species (Table 1).

Table 1. Plant Species Scientific and Local Name, Family and Origin

S. No.	Botanical name	Family	Local Name (Oromic)	Origin
1	*Acacia seyal*	Fabaceae	Wachu	Indigenous
2	*Anethum graveolens L.*	Apiaceae	Insilale/Kamuni	Indigenous
3	*Annona muricata L*	Annonaceae	Hambeshok	Exotic
4	*Annona senegalensis*	Annonaceae	Gishta	Indigenous
5	*Brassica carinata A. Br.*	Brassicaceae	Midhan-Rafu	Indigenous
6	*Brassica oleracea L.*	Brassicaceae	Rafu marama	Indigenous
7	*Capsicum frutescens L.*	Solanaceae	Mixmita	Exotic
8	*Capsicum annum L.*	Solanaceae	Qara/berbare	Exotic
9	*Carica papaya L.*	Carricaceae	Papaya	Exotic
10	*Casimiroa edulis Liave and Lex.*	Rutaceae	Asamiro/Hambadeda	Indigenous
11	*Cassia /Senna didymobotrya*	Fabaceae	Ceka/Asene meka	Indigenous
12	*Catha edulis (Vahl) Forssk. ex Endl.*	Celastraceae	Jima	Indigenous
13	*Celtis africana Burm.f.*	Ulmaceae	Ameleka/Metekoma	Indigenous
14	*Citrus aurantifolia (Christm.) Swingle*	Rutaceae	Tuto	Indigenous
15	*Citrus sinensis (L.) Osb.*	Rutaceae	Burtukana	Exotic
16	*Coffea arabica (L.)*	Rubiaceae	Buna	Indigenous
17	*Cordia africana (Lam.)*	Boraginaceae	Wadessa	Indigenous
18	*Croton macrostachyus (Hochst. Ex Del.)*	Euphorbiaceae	Mekanisa	Indigenous
19	*Cucurbita pepo L*	Cucurbitaceae	Debakula	Exotic
20	*Cupressus lusitanica Mill.*	Cupressaceae	Getira-ferenji	Exotic
21	*Dodonaea viscosa (L.F.)*	Sapindaceae	Itecha	Indigenous
22	*Dovyalis abyssinica (A. Rich) Warb*	Flacourtiaceae	Koshim/Ankekute	Indigenous
23	*Ehretia cymosa Thonn.*	Boraginaceae	Ulaga	Indigenous
24	*Ensete ventricosum (Welw.) Cheesman*	Musaceae	Warke	Indigenous
25	*Entada abyssinica Steudel ex A. Rich.*	Fabaceae	Kontir/Amazaze	Indigenous
26	*Erythrina abyssinica Lam. ex DC.*	Fabaceae	Wolensu	Indigenous
27	*Eucalyptus camaldulensis Dehnh.*	Myrtaceae	Bergamo-dima	Exotic
28	*Euphorbia abyssinica Gmel.*	Euphorbiaceae	Adami	Indigenous
29	*Euphorbia tirucalli L.*	Euphorbiaceae	Kinchib/anno	Indigenous
30	*Faidherbia albida(Delile) A.Chev.*	Fabaceae	Gerbi	Indigenous
31	*Gossypium abyssinicum Watt.*	Malvaceae	Jibri	-
32	*Grevillea robusta (A.Cunn.Ex.R.Br.)*	Proteaceae	Giravila	Exotic
33	*Grewia bicolor Juss.*	Tiliacea	Haroresa	Indigenous
34	*Hibiscus rosa-sinensis L.*	Malvaceae	Yechayna tsegereda	Exotic
35	*Ipomoea batatas (L.) Lam.*	Convolvulaceae	Bekule	Exotic
36	*Jacaranda mimosifolia D.Don*	Biginoniaceae	Muka kawe	Exotic
37	*Jatropha curcas L.*	Euphorbiaceae	Jatrova	Exotic
38	*Justicia schimperiana Hochst. Ex Nees) T.Anders.*	Acanthaceae	Dumuga	Indigenous
39	*Kleinia longiflora DC.*	Asteraceae	Huluko	-
40	*Lagenaria abyssinica (Hook.f.) C.Jeffrey*	Cucurbitaceae	Dubba hori	Indigenous
41	*Lagenaria siceraria (Molina) Standl.*	Cucurbitaceae	Buke/kulu	Indigenous
42	*Lawsonia inermis L.*	Lythraceae	Hina	Indigenous
43	*Leucaena leucocephala (Lam.) de Wit*	Fabaceae	Lucina	Exotic
44	*Lycopersicon esculentum Mill.*	Solanaceae	Timatima ferenji	Exotic
45	*Malus domestica Borkh.*	Rosaceae	Apili	-
46	*Mangifera indica L.*	Anacardiaceae	Mango	Exotic
47	*Melia azedarach L.*	Meliaceae	Muka kinin	Exotic

48	*Millettia ferruginea (Hochyst, Baker)*	Fabaceae	Birbira	Indigenous
49	*Moringa oleifera Lam.*	Moringaceae	Shifera	Exotic
50	*Musa paradisiaca L.*	Musaceae	Muza	Indigenous
51	*Nicotiana glauca R. Grah.*	Solanaceae	Lenja	Exotic
52	*Nicotiana tabacum L.*	Solanaceae	Tambo	Exotic
53	*Ocimum basilicum L.*	Lamiaceae	Bosobila	Indigenous
54	*Ocimum lamiifolium Hochst.ex Benths*	Lamiaceae	Dama-kase	Indigenous
55	*Olea africana L.*	Oleaceae	Ejerssa	Indigenous
56	*Oncoba spinosa Forssk.*	Flacourtiaceae	Jilbo/Akuku	Indigenous
57	*Otostegia integrifolia Benth*	Lamiaceae	Tunjiti	Indigenous
58	*Pennisetum purpureum Schumach*	Graminae	Shankora hori	Indigenous
59	*Persea americana Mill.*	Lauraceae	Avocado	Indigenous
60	*Plumbago zeylanica L.*	Plumbaginaceae	Martas	Indigenous
61	*Psidium guajava L.*	Myrtaceae	Zeyituna	Exotic
62	*Rhamnus prinoides L" Herit.*	Rhamnaceae	Gesho	Indigenous
63	*Ricinus communis (L.)*	Euphorbiaceae	Kobo	Indigenous
64	*Rosmarinus officinalis L.*	Lamiaceae	Kora	Exotic
65	*Rumex abyssinicus Jacq.*	Polygonaceae	Meqmeqo	Indigenous
66	*Ruta chalepensis L.*	Rutaceae	Xalasan/(Tenadam)	Indigenous
67	*Schinus molle L.*	Anacardiaceae	Qundo berbere	Exotic
68	*Sesbania sesban (L.) Merr.*	Fabaceae	Enchini, Harcha	Indigenous
69	*Solanum tuberosum L.*	Solanaceae	Dinicha	Indigenous
70	*Sorghum bicolor (L.) Moench*	Poaceae	Mishinga	Indigenous
71	*Unknown*	Unknown	Dakika	-
72	*Unknown*	Unknown	Gizaw	-
73	*Punica granatum L.*	Punicaceae	Rumana/Roman	Exotic
74	*Vernonia amygdalina (Del.)*	Asteraceae	Obicha (Ebicha)	Indigenous
75	*Vigna unguiculata (L.) Walp*	Fabaceae	Atara horii	Indigenous
76	*Withania somnifera (L.) Dunal.*	Solanaceae	Hidii-bude	Indigenous
77	*Zea mays L.*	Poaceae	Bokolo	Exotic

There could be other environmental factors such as soil, moisture, and other factors that can be coupled with human disturbance to result in different number of species as well as different species composition. The data on plant composition of homegardens indicated that the area had floristic richness and included plant species from diverse genera and families. This fits well with the assertion that homegardens are valuable sources of plant agrobiodiversity (Brookfield, 2001).

Species Richness and Diversity Indices

The highest species richness (40 woody and 19 herbaceous) was recorded at Haro Chercher site for both woody and herbaceous species and lowest number of species was recorded at Melka Belo for both woody and for herbaceous species (Table 2). The result of species richness ranged from 51 to 59 per sampling site with species evenness confirms that Habro homegardens are rich in species content. The results indicated that the total woody species richness (57) was comparatively like that recorded in enset-coffee-based agroforests (58 woody of species) and tree-cereal-based agroforestry systems (64 woody species) of the south- central and southern highlands of Ethiopia, respectively (Negash *et al.,* 2012). Farmers give more emphasis to managing and cultivating *Catha edulis* and *Coffea arabica*. They practice thinning to create more space for production of these species. Wider spacing of trees would allow more growth in tree diameter rather than in stem numbers in homegarden agroforestry. The mean number of woody species (averaged across villages) per homegarden in this study (11.22) (Table 3) was similar with (11.0) that reported by (Zemede and Ayele, 1995) from 111 sample homegarden in Ethiopia and higher than the mean number of species (3.94) reported from Hintalo Wajerat homegarden of Tigray (Hinsa, 2012). The mean number of woody species per homegarden in this study is also higher than (7.32) that reported by (Ewuketu *et al.,* 2014) from 48 sample homegarden in Ethiopia. In general, the difference in species richness from place to place could be attributed to income difference, altitude, personal preference of species, soil type climate and homegarden size. Farmers in the study villages retain various tree components based on spaces available and their compatibility with agricultural crops and household objectives.

Haro Chercher HAgFS had the highest Shannon diversity index, Evenness and Simpson index than Melka Belo and Lega Bera HAgFS where for herbaceous species; Melka Belo HAgFS had the highest Shannon diversity index, Evenness and Simpson index (D)as compared to Haro Chercher and Lega Bera HAgFS (Table 4).The highest Shannon evenness, 67% of woody species at Haro Chercher and 81% of herbaceous at Melka Belo indicates relatively highest homogeneity of woody and herbaceous species compared to other homegarden (Table 4). Evenness (E) refers to how the species abundance is distributed among the species. The values of Shannon evenness showed that the abundance of woody plant species was most even in Haro Chercher as compared to Melka Belo and Lega Bera HAgFS. Higher number of species resulted in higher Shannon diversity index. Shannon diversity index is composed of species richness (number of species) and equitability or evenness and an increase in this index might be due to either greater richness or greater evenness or both. Mean Shannon indices vary widely in tropical homegardens and could range from 0.93 to 3.00 (Tynsong and Tiwari, 2010). In this study, the diversity indices and evenness were in line with the stated ranges. It was also comparable with the studies from enset-coffee-based agroforests (H'=1.07), Sidama homegardens, (H'= 1.44) of the south central and southern highlands of Ethiopia, (respectively (Tesfaye, 2005; Negash *et al.,* 2012). but lower than homegarden of Meghalaya (H'=2.37) (Tynsong and Tiwari, 2010). The variation perhaps depends on differences in farmers' management intensity, and on environmental conditions.

Table 2. Overall Woody and Herbaceous Species Richness

KA (Study site)	Number of Species (richness)		Total
	Woody	Herbaceous	
Melka Belo	37	14	**51**
Haro Chercher	40	19	**59**
Lega Bera	38	16	**54**
Overall	**52**	**25**	**77**

Note: Melka Belo, Haro Chercher and Lega Bera were the study sites (*kebele* administration) in Habro districts, West Harerghe, Ethiopia.

Table 3. Mean Woody and Herbaceous Species Richness per Homegarden

KA (Study site)	Number of Species (richness)	
	Woody	Herbaceous
Melka Belo	11	1.92
Haro Chercher	11.92	4.083
Lega Bera	10.75	4.33
Overall mean	**11.22**	**3.44**

Table 4. Overall Shannon, Evenness and Simpson Indices of Woody and Herbaceous Species

KA	Shannon index		Evenness		Simpson Index	
	Woody	Herbaceous	Woody	Herbaceous	Woody	Herbaceous
Melka Belo	1.96	2.15	0.54	0.81	0.69	0.84
Haro Chercher	2.48	2.07	0.67	0.70	0.83	0.81
Lega Bera	1.86	1.95	0.51	0.72	0.72	0.79
Mean	**2.10**	**2.06**	**0.57**	**0.74**	**0.75**	**0.81**

Table 5. Jaccard and Sørensen Similarity Index of Plant Species Between the Three KA

KA	Haro Chercher	Lega Bera
Melka Belo	69.23(81.82)	61.54(76.19)
Haro Chercher		52.70(69.03)
Note: Index outside brackets was calculated using Jaccard index (I) while the index inside brackets was calculated using Sørensen similarity index (S).		

Species Similarity between Survey Sites

Based on presence-absence of woody species in the sampled plot, more than half similarities were existed between overall the KA (Table 5). Sorenson and Jaccard's similarity index among the three sampling sites (KA) were calculated and the results ranged from 69.03% to 81.82% for Sorenson and 52.70% to 69.23% for Jaccard's or higher than 0.5 which showed significant similarity/even distribution of species among the sampling areas. According to Jaccard's and Sørensen's similarity indices at *Kebele* level Melka Belo and Haro Chercher were the most similar pairs followed by Melka Belo and Lega Bera while Haro Chercher and Lega Bera were the most dissimilar pairs (Table 5).These results agree with the case reported from homegardens of Bishoftu town where Sorenson similarity index among all the sampling sites ranged from 0.7239 to 0.8421 (Ragassa, 2014). Slight similarity among species in the homegardens of Habro district might be because of less diverse ethnic groups that are dominated by Oromo. Such a case might have made the community needs and preferences similar in the case of Habro district that could have in turn made the homegardens species slightly similar and even in distribution.

The species diversity of the homegarden to provide varied functions is affected by many factors like access to water, economic activities of owners and availability of labour, traditional social organization, modernization processes and economic development (Blanckaert *et al.,* 2004). The studied sites were subjected to varying degrees of disturbance severity like pest and deceases, freely moving goat feed on the herbaceous plant. Water is also the main factor limiting an increase in species number and species diversity in homegardens, because water is not always sufficiently available. Because of land scarcity, there has been decrease in plot size of the homegardens. The people of the study area largely cultivate homegarden species, which have market values like *Catha edulis* and *Coffea arabica* and depend on this resource for the household cash income. Agroforestry land use can provide potential sites for maintaining both species in agricultural landscapes. The increased incorporation of woody species in agroforestry land can reduce pressure on forests and protected conservation areas. The result of present study indicates that HAgFS constitutes plant (species woody and herbaceous), which may reflect the conservation of biodiversity in the agricultural landscapes. Our results also indicate that the HAgFS in the three studied *kebeles* shown the similar of 69.03% up to 81.82% according to Sørensen similarity index.

Frequency, Relative Frequency, Abundance and Density

Plant species and their frequencies, relative frequencies and abundance of occurrences in the study area are given in table 6. From the total number of species recorded from the study area, *Cordia africana* (100%) was the most frequent species followed by *Casimiroa edulis* (91.7%) and *Catha edulis* (72.2%). The most abundant woody species in the study area were *Catha edulis* (1248), *Coffea arabica* (824), *Cordia africana* (205) and *Casimiroa edulis* (161) where as the most abundant herbaceous species were *Lycopersicon esculentum* (322), *Capriscum spp* (132), *Nicotina tabacum* (131) and *Ipomoea batatas* (92), respectively (Table 6). On per hectare basis the densest woody species in the study area were *Catha edulis* (1733), *Coffea arabica* (1144), *Cordia africana* (285) and *Casimiroa edulis* (224) whereas the densest herbaceous species were *Lycopersicon esculentum* (201250), *Capriscum spp* (82500), *Nicotina tabacum* (81875) and *Ipomoea batatas* (57500) respectively. Such overlap of plant species indicated that the HAgFS taken as conservation strategy for threatened forest resource. Many indigenous, rare woody species like *Cordia africana, Croton macrostachyus* and *Olea europaea* conserved in HAgFS because of their high multiple values. This finding was supported by (Gebremariam *et al.,* 2009); they reported that *C. africana* and *P. falcatus* are accounted as locally endangered species, and are not legally permitted to be felled in state and private forests, owing to their high exploitation in natural forests in Ethiopia. Agroforestry can also create habitat for wild animal species in landscape matrices surrounding forest conservation areas (Buck *et al.,* 2004).

Table 6. Frequencies, Relative Frequencies, Abundance and Density of Plant Species

S. No.	Botanical name	F	RF	A	D
1	*Cordia africana*	100	6.77	205	285
2	*Casimiroa edulis*	91.67	6.20	161	224
3	*Catha edulis*	72.22	4.89	1248	1733
4	*Musa paradisiaca*	55.56	3.76	80	111
5	*Coffea arabica*	52.78	3.57	824	1144
6	*Lycopersicon esculentum*	52.78	3.57	322	201250
7	*Ricinus communis*	52.78	3.57	106	147
8	*Faidherbia albida*	50	3.38	26	36
9	*Mangifera indica*	47.22	3.20	26	36
10	*Jatropha curcas*	44.44	3.01	113	157
11	*Capriscum spp*	41.67	2.82	132	82500
12	*Ehretia cymosa*	41.67	2.82	28	39
13	*Grevillea robusta*	38.89	2.63	92	128
14	*V. amygdalina*	38.89	2.44	61	85
15	*Melia azedarach*	36.11	2.26	28	39
16	*P. purpureum*	33.33	2.26	68	42500
17	*Psidium guajava*	33.33	2.07	20	28
18	*Brassica carinata*	30.56	1.88	52	32500
19	*Carica papaya*	27.78	1.88	29	40
20	*Ocimum lamifolium*	27.78	1.69	25	15625
21	*Annona senegalensis*	25.00	1.50	12	17
22	*Cassia didymobotrya*	22.22	1.50	25	35
23	*Lawsonia inermis*	22.22	1.50	16	22
24	*Nicotiana glauca*	22.22	1.50	79	49375
25	*Nicotina tabacum*	22.22	1.32	131	81875
26	*Cucurbita pepo*	19.44	1.32	13	8125
27	*Erythrina abyssinica*	19.44	1.32	16	22
28	*Gossypium abyssinicum*	19.44	1.32	14	19
29	*Olea europaea*	19.44	1.32	24	33
30	*Sesbania sesban*	19.44	1.13	20	28
31	*Acacia seyal`*	16.67	1.13	20	28
32	*Ruta chalepensis*	16.67	1.13	8	5000
33	*Withania somnifera*	16.67	0.94	9	5625
34	*Citrus sinensis*	13.89	0.94	12	17
35	*Eucalyptus camaldulensis*	13.89	0.94	12	17
36	*Ipomoea batatas*	13.89	0.75	92	57500
37	*Ensete ventricosum*	11.11	0.75	7	10
38	*Justicia schimperiana*	11.11	0.75	32	44
39	*Ocimum basilicum*	11.11	0.56	19	11875
40	*Annona muricata*	8.33	0.56	21	29
41	*Brassica oleracea*	8.33	0.56	24	15000
42	*Citrus aurantifolia*	8.33	0.56	3	4
43	*Croton macrostachyus*	8.33	0.56	5	7
44	*Lagenaria siceraria*	8.33	0.56	3	1875
45	*Leucaena leucocephala*	8.33	0.56	14	19

46	*Milletia ferruginea*	8.33	0.56	4	6
47	*Otostegiai ntegrifolia*	8.33	0.56	7	10
48	*Schinus molle*	8.33	0.38	5	7
49	*Anethum graveolens*	5.56	0.38	3	1875
50	*Celtis africana*	5.56	0.38	2	3
51	*Daqiqa*	5.56	0.38	4	6
52	*Entada abyssinica*	5.56	0.38	3	4
53	*Euphorbia candelabrum*	5.56	0.38	3	4
54	*Hibiscus rosacinus*	5.56	0.38	2	3
55	*Rhamnus prinoides*	5.56	0.38	5	7
56	*Rumana*	5.56	0.19	2	3
57	*Capsicum annum*	2.78	0.19	6	3750
58	*Cupressus lusitanica*	2.78	0.19	2	3
59	*Dodonaea viscose*	2.78	0.19	1	1
60	*Dovyalis abyssinica*	2.78	0.19	3	4
61	*Euphorbia tirucalli*	2.78	0.19	6	8
62	*Gizaw*	2.78	0.19	3	1875
63	*Grewia bicolor*	2.78	0.19	3	4
64	*Jacaranda acutifolia*	2.78	0.19	2	3
65	*Kleinia longiflora*	2.78	0.19	1	625
66	*Lagenaria abyssinica*	2.78	0.19	2	1250
67	*Malus domestica*	2.78	0.19	1	1
68	*Moringa olifera*	2.78	0.19	2	3
69	*Oncoba spinosa*	2.78	0.19	1	1
70	*Persea americana*	2.78	0.19	1	1
71	*Pisum sativum*	2.78	0.19	2	1250
72	*Plumbago zelanica*	2.78	0.19	1	1
73	*Rosmarinus officinalis*	2.78	0.19	1	625
74	*Rumex ellenbeckii*	2.78	0.19	2	1250
75	*Salanum tuberosum*	2.78	0.19	2	1250

Where, F= frequency, RF= relative frequency, A=abundance and D= density

CONCLUSION

Homegarden is one of the most elaborate systems of indigenous agroforestry practice found most often in tropical and sub-tropical areas where subsistence land use systems predominate. It can provide a sound ecological basis for increase crop and animal productivity, more dependable economic returns and greater diversity in social benefits on sustained basis. However, floristic composition and fertility of the soil under this system has not been exhaustively evaluated and properly documented. The present study, was therefore, initiated to investigate the floristic composition of the homegarden agroforestry system and assess the influence of two widely grown indigenous tree species (*Cordia africana* and *Faidherbia albida*) components of the system on soil physicochemical properties. The study was carried out on farmers' homegardens at Melka Belo, Haro Chercher and Lega Bera *kebeles* in Habro district, west Harerghe Zone. 36 villages (12 from each KA) were identified based on the extensive presence of HAgFS; and from these villages 36 homegardens (one from each village) were used for floristic composition study while three homegardens (one from each KA) were used for soil physicochemical properties study. Two of the widely grown indigenous tree species in the homegarden agroforestry system namely, *Cordia africana* and *Faidherbia albida,* were used to assess their influence on the soil physicochemical properties. Homegarden plays an important role within the overall farming system. The contribution of individual gardens to biodiversity conservation in the study areas should not be underestimated. High plant diversity was found in the studied homegardens. A total of 77 plant species (52 woody and 25 herbaceous) were recorded from homegardens of the study area which belong to 40 families. The families Fabaceae, Solanaceae and Euphorbiaceae were the most diverse, each having 9, 7 and 5 species, respectively.

The highest species richness (40 woody and 19 herbaceous) was recorded at Haro Chercher site for both woody and herbaceous species and lowest number of species was recorded at Melka Belo for both woody and for herbaceous species. The highest Shannon evenness, 67% of woody species at Haro Chercher and 81% of herbaceous at Melka Belo indicates relatively highest homogeneity of woody and herbaceous species compared to other homegarden. According to Jaccard's and Sørensen's similarity indices at *Kebele* level Melka Belo and Haro Chercher were the most similar pairs followed by Melka Belo and Lega Bera while Haro Chercher and Lega Bera were the most dissimilar pairs. From the total number of species recorded from the study area, *Cordia africana* (100%) was the most frequent species followed by *Casimiroa edulis* (91.7%) and *Catha edulis* (72.2%). *Catha edulis* was the most abundant plant species in Habro HAgFS followed by *Coffea arabica.* Homegarden agroforestry can also act as a refuge for woody species like *Cordia africana*, *Catha edulis, Coffea arabica, Faidherbia albida, and Casimiroa edulis* and for herbaceous species like *Capriscum spp, Lycopersicon esculentum, Brassica oleracea, Musa paradisiaca, Nicotina tabacum, Ensete ventricosum* and *Ocimum lamifolium.* The species diversity of the homegarden to provide varied functions is affected by a number of factors. The people of the study area largely cultivate homegarden species, which have market values like *Catha edulis* and *Coffea arabica* and depend on this resource for the household cash income. Although the present study indicated a substantial contribution of HAgFS for plant diversity conservation, these could not be an end. Much more research work needs to be done to harness the potential benefits the HAgFS could provide, and hence to improve the HAgFS in the area.

The high diversity of species in homegardens contributes to biodiversity conservation of plant genetic recourses. However, the tendency of local people towards the production of few cash generating plant species threatens the long-term sustainability of homegardens. Therefore, the agricultural office should play an active role by educating people to grow diverse plant species. Suitable subsistence and cash crops for improving homegarden productivity without destroying its structure and functioning should be identified and promoted. The owners of HAgFS(gardeners) should be integrated as an active part in the whole process of developing a holistic approach for raising and maintaining the sustainability of homegardens together with conserving its agrobiodiversity. Socioeconomic studies regarding the uses of HAgFS and its tree species and farmers' attitudes towards the trees should be conducted.

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