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Diversity and Composition of Homegarden Agroforestry Implication for Biodiversity Conservation in Bure District, Ilubabor Zone, Southwest Ethiopia

Tadele Weldebirhan, Derebe Terefe*, Dawit Bekele*

Ethiopian Biodiversity Institute, Mattu Biodiversity Center, Mattu, Ethiopia

Email address:

tedelew.birhan@gmail.com (Tadele Weldebirhan), direlove6@gmail.com (Derebe Terefe), dawitbekele961@gmail.com (Dawit Bekele)

*Corresponding author

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Abstract: Homegarden agroforestry is a multi-purpose agroforestry approach used by rural farmers in and around their houses to diversify their livelihoods and stabilize their food security. Fifty three plant species, disperse into 23 families, were recorded in the study area from highland, lowland and midland Homegarden agroforestry. The Myrtaceae family is the dominant with 6 species, subsequently Fabaceae and Euphorbiaceae family with 5 species. From this finding result, midland agro ecology has a at great height number of plant species per home garden than other agro ecologies. Research design was used to gather data focused on smallholder homegarden agroforestry. It is acclimated describe homegarden agroforestry composition and diversity. One-way ANOVA was applyed to analyze data to compare as well as identify statistically difference between three agro-ecologies. The Shannon diversity index revealed that the midland woody species diversity index (H'=2.94) was higher than the highland (H'=2.91) and lowland (H'=2.89). According to Sorensen's similarity coefficient out of the three home gardens, midland and highland have agreat number of species compositions in common (76%). A relatively low similarity was perceived between highland and lowland. Awareness is required by concerned individuals to keep the multispecies farming system that contributes more diversity of native plant species of this system.

Keywords: Agroecologies, Composition, Diversity

1. Introduction

Homegarden agroforestry is a multidisciplinary approach used by rural farmers to diversify and sustain their livelihoods in and around their homes [5]. Homegardens are collections of plants that grow in a complicated house, such as trees, shrubs, vines, and herbaceous plants [8]. It is often defined as a land use system that combines the careful management of trees and shrubs in close proximity to annual and perennial crops and animals within a mix of individual homes, the entire plant, and the animal unit is heavily influenced by family functioning [7].

Homegardens are essential conservation sites for biodiversity [2]. They are a critical entity responsible for developing and implementing environmentally friendly food production methods while protecting biodiversity and natural resources. Homegardens, like other types of gardens, offer a number of functions, from addressing household needs to preserving biodiversity and landscape stability [13] (Woldeyes, 2011). It looks to be capable of maintaining rural life while protecting biodiversity [4]. Homegarden agroforestry systems of South Western Ethiopia are one such stable agro-ecosystem and these systems have provides for enhancement in food security, regional and national economies and environmental resilience [5]. The objective of this study was assess the floristic composition and diversity of homegarden agroforestry in Bure District.

2. Methodology

2.1. Description of the Study Area

The study was carried out in Bure District which is found in

Oromia region South West Ethiopia, at a distance of 690 km far from Addis Ababa and 90 Km far from Mattu town and the main road cross it to Gambela. It consists of 21 kebeles. Besides, Bure District is classified into three agro-ecological zones based on their altitudinal variation and climatic conditions. This town has latitude and longitude of 8°17′N 35°6′E coordinates: 8°17′N 35°6′E and an elevation of 1730 meters. According to Demographics figures from the Central Statistical Agency in 2007, Bure has an estimated total population of 5475 of whom 2705 are men and 2770 are women.

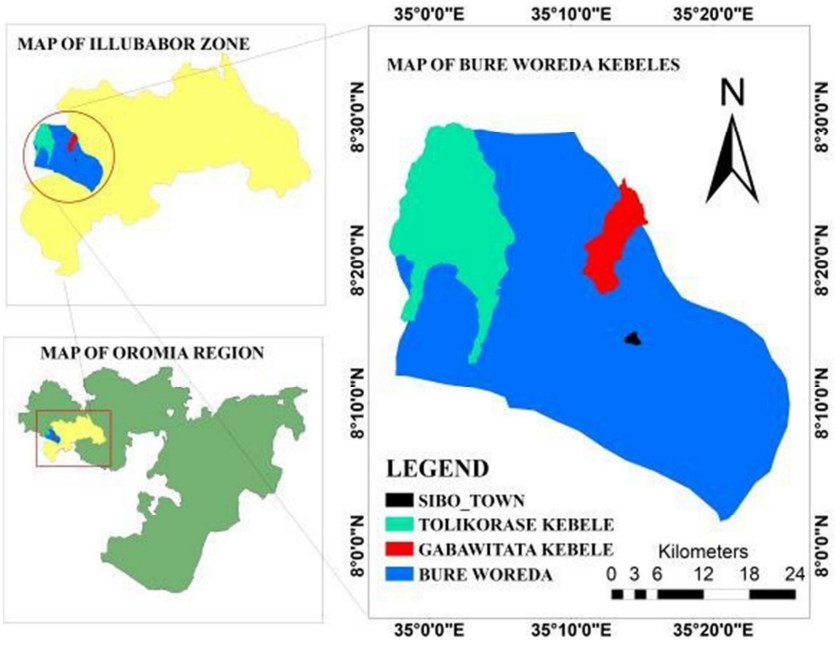

Figure 1. *Map of the study area.*

2.2. Research Design Sampling Methods

To determine the study approach and techniques to be used for the main study as well as to have an overview of the study area a preliminary assessment was carried. In this study, a research design was used to collect data focused on smallholder homegarden agroforestry. It is used to describe homegarden agroforestry composition and diversity. For woody species (trees and shrubs) data collection, homegardens were used as a sample plot [11], and a complete enumeration [9] was carried out in each sample home. Woody species with a diameter ≥5 cm at breast height (1.3 m above the ground) and a height ≥3 m were measured [3]. The CBH (Circumference at Breast Height) was measured using measuring tape and then converted to DBH. The height of the tree was measured by estimation. Useful published literatures [12, 1] were used to identify and nominate the species.

Table 1. *Study area and sample sizes used in this study.*

Agroecology	Name of kebeles	Sample size	Altitude
lowland	Toli korase	7	<1500
Midland	Gaba witata	7	1501-2300
Highland	Sibo	7	>2300
Total		21	

2.3. Data Analysis

2.3.1. Vegetation Data Analysis

For woody species (trees and shrubs) data, species richness, diversity, and evenness analysis was taken between three agro-ecologies was compared by using one-way ANOVA.

2.3.2. Species Richness

Species richness was known by recording plant species in a study area, regardless of abundance.

Shannon-Wiener diversity index

The Shannon index is a statistical information index, which means it implies that all species are represented in a sample and that they are sampled randomly. The index's (H') values are normally between 1.5 and 3.5, yet in rare circumstances, they can exceed 4.5 [6].

$$\text{Shannon Index (H')} = -\sum_{i=1}^{s}\left[\left\{\frac{ni}{N}\right\} \times \ln\left[\left\{\frac{ni}{N}\right\}\right]\right]$$

Where,

p is the proportion (n/N) of individuals of one species found (n) divided by the total number of individuals found (N), ln is the natural log, is the sum of the calculations, and S is the number of species in the Shannon index (H').

The Species evenness index

Species evenness (E) expresses how evenly the individual species of the community are distributed.

$$E = \frac{H^0}{\text{Hmax}}$$

Here, Hmax = ln S, where lnS is the natural logarithm of species richness. Species evenness ranges from zero (0) to one (1), with 0 indicating no evenness and 1 indicating complete evenness.

Sorensen‟s similarity index was used to determine the pattern of species turnover among successive communities and to compare the forest with other similar forests (home gardens in different agro ecologies) in the country. It is described using the following formula [6].

$$Ss = 2a/ (2a+b+c)$$

Where:
Ss = Sorensen‟s similarity coefficient;
a= Number of species common to both samples;
b= Number of species in sample 1;
c= Number of species in sample 2.

3. Result

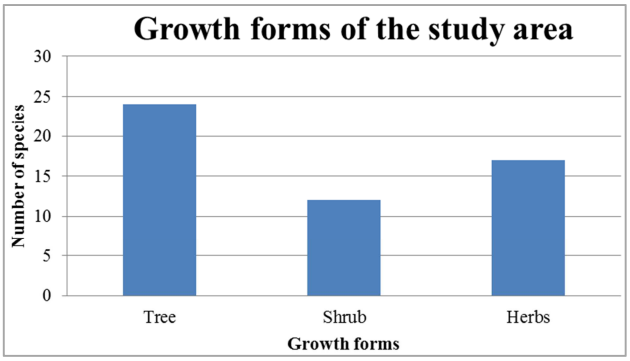

Figure 2. *Growth habit/life forms of home garden woody species.*

Table 2. *Families versus number of species in the Home gardens.*

№	Family name	№ of species	№	Family name	№ of species
1	Myrtaceae	6	18	Myrsinaceae	1
2	Euphorbiaceae	5	19	Proteaceae	1
4	Fabaceae	5	20	Rubiaceae	1
4	Rosaceae	4	21	Caricaceae	1
5	Asteraceae	4	22	Rhamnaceae	1
6	Myrtaceae	4	23	Bromeliaceae	1
7	Poaceae	3			
8	Rutaceae	3			
9	Celastraceae	3			
10	Sterculiaceae	2			
11	Moraceae	2			
12	Cupressaceae	2			
13	Anacardiaceae	1			
14	Arecaceae	1			
15	Araliaceae	1			
16	Boraginaceae	1			
17	Lauraceae	1			

Table 3. *Plant species richness of the Home gardens.*

Study sites	Species richness	Maximum number of species	Minimum number of species
Lowland	36	21	13
Midland	43	25	10
Highland	39	19	7

Table 4. *Sorensen's Coefficient of similarity index among different agro ecology home gardens.*

Home garden type	highland	Midland	lowland
Highland	1	0.76	0.71
Midland	0.76	1	0.69
Lowland	0.71	0.69	1

Table 5. *Major woody species found in the Home gardens.*

№	Afaan Oromo name	Botanical name	Lowland	Midland	Highland
1	Avokaado	*Persea americana*	exist	exist	exist
2	reejjii	*Vernonia auriculifera*	absent	exist	exist
3	ambabeessa	*Albiza gummifera*	absent	exist	exist
4	Gravilliyaa	*Grevillea robusta*	exist	Absent	absent
5	Jimaa/caatii	*Catha edulis*	absent	exist	exist
6	sondii	*Acacia abyssinica*	exist	exist	absent
7	qilxuu	*Ficus vasta*	exist	Absent	exist
8	baargamoo	*Eucalyptus globules*	exist	exist	absent
9	Loomii	*Citrus aurantifolia*	Absent	Absent	exist
10	Burtukaana	*Citrus sinensis*	exist	exist	exist
11	geeshoo	*Rhamnus prinoides*	exist	absent	exist
12	Buna	*Coffea Arabica*	exist	exist	absent
13	Maangoo	*Mangifera indica*	exist	exist	exist

№	Afaan Oromo name	Botanical name	Lowland	Midland	Highland
14	anaanas	*Annona cherimola*	absent	exist	exist
15	eebicha	*Vernonia amygdalina*	absent	exist	exist
16	wadeessa	*Cordia africana*	exist	absent	exist
17	shonkoora	*Saccharum officinarum*	exist	exist	absent
18	xidii	*Juniperus procera*	exist	exist	exist
19	Paapayaa	*Carica papaya*	absent	exist	exist

Table 6. *Woody species families and the relative number of species in the Home gardens.*

Family	No of Species	Family	No of species
Fabaceae	3	Celastraceae	1
Myrtaceae	3	Cuperssaceae	1
Rutaceae	3	Lauraceae	1
Asteraceae	2	Myrsinaceae	1
Euphorbiaceae	2	Proteaceae	1
Moraceae	1	Rosaceae	1
Rosaceae	1	Rubiaceae	1
Anacardiaceae	1	Sterculiaceae	1
Bromeliaceae	1		
Araliaceae	1		
Arecaceae	1		
Boraginaceae	1		
Caricaceae	1		
Poaceae	1		

Table 7. *Diversity, richness and evenness of woody species of the Home gardens.*

Agroecology	Species Richness	Diversity Index	Evenness
Lowland	16	2.89	0.89
Midland	18	2.94	0.90
Highland	17	2.91	0.88
P-value		P=0.059	

4. Discussion

4.1. Plant Species Composition

In this study, 31 plant species under 23 families were recorded from 21 surveyed homegardens. The Myrtaceae family comes first with 6 species, followed by Fabaceae and Euphorbiaceae family with 5 species, Asteraceae and Rosaceae with 4 species, and Poaceae, Rutaceae and Celastraceae family with 3 species. While, the Sterculiaceae, Moraceae and Cuppressaceae family with 2 species, and the other families each have one.

4.2. Species Richness and Similarities of Home Gardens

Plant richness in the study area varies among agro ecologies. Accordingly, 36, 43, and 39 plant species were recorded from lowland, midland, and highland areas, respectively. From the above results, midland agro ecology has a greater number of plant species per home garden than other agro ecologies. This is in line with the finding [10]. The result from one-way ANOVA implies that there is statistically significant difference ($p < 0.001$) in species richness between three agro-ecologies.

Based on Sorensen's similarity coefficient among the three home gardens, midland and highland have a high number of species compositions in common (76%). A proportionaly low similarity was percieved between highland and lowland. This could be related to environmental variables which were not considered in this study such as altitude, slope, aspect, anthropogenic, soil type and properties.

4.3. Growth Habits of Plant Species

Regarding the growth form of plants in the study area as shown in 24 (45.3%) were recorded as trees species, 17 (32.1%) were herbs species, 12 (22.6%) were shrubs. Trees were the most prevalent growth form in the study area, followed by herbs species.

4.4. Major Woody Species and Diversity

According to woody species richness among agro ecologies, the midland and highland had a high proportion of woody species with 17 species each belonging to 13 and 10 families respectively. The Shannon diversity index revealed that the midland woody species diversity index (H'=2.94) was higher than the highland (H'=2.91) and lowland (H'=2.89). According to the analysis of variance results, woody species diversity doesn't show a statistically significant variation ($p > 0.05$) between the three agro-ecologies. The evenness values of highland, midland, and lowland were 0.88, 0.90 and 0.89, respectively, indicating that the midland agro ecology's woody species evenness value was higher than other agro ecologies. The result from the analysis of variance indicates that there is a statistically significance difference ($p < 0.001$) in woody species evenness between highland, midland and lowland.

5. Conclusion

Homegarden agroforestry systems of the study area identified by ample plant species composition. The diverse plant species have supply the society in the area by providing a variety of benefits for small-holder farmers. In the study area's home garden, many plant species used as a source of food, such as fruits, vegetables, spices, and cash crops used for money, may be found. The home garden serves an important role in preserving plant variety in the study area. During the time of this investigation, 53 plant species were identified and preserved. The midland agro ecology, on the other hand, is more diversified than other agro ecologies and has a great variety of plant species. The addition of numerous trees, shrubs and herbs to their garden also contributes to plant diversity conservation by allowing individuals to manage different plants for a variety of purposes.

6. Recommendations

According to the findings of this study the following recommendations are mentioned.

Homegarden agroforestry systems need more attention to address the aims of conservation of biological diversity and improvement of the livelihood of the community.

The composition of home garden plant species in is dominated by economically feasible fruit and vegetable plant species. Thus awerness is required by stakeholders individuals to conserve the multispecies farming system that enhance more diversity of native plant species of this system.

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