DMU

Advanced Journal of Interdisciplinary Studies 9(2025) 1651-1677

AJIDS

Journal homepage: www.ajids.dmu.edu.et

Volume 9(1), June 2025

Home garden Agro-biodiversity Conservation and Its Contribution to Rural Livelihoods in Bure District, Northwestern Ethiopia

Berhanu Tadesse Beyene*, Kiros Getachew Belachew

Department of Natural Resources Management, College of Agriculture and Natural Resource, Debre Markos University, Debre Markos

*Corresponding author email: berhanu_tadesse@dmu.edu.et

Abstract

Home gardens are traditional agroforestry systems that are essential for sustaining rural livelihoods and preserving agro-biodiversity. This study investigates the significance of home gardens in the Bure district of Northwestern Ethiopia, focusing on plant diversity, conservation strategies, and their effects on rural livelihoods. A sample of 300 households was randomly selected to assess the distribution and types of home gardens, categorized as front yard, backyard, side yard, or other, across different agro-ecological zones. A mixed-methods approach, which included ethnobotanical surveys, quantitative analysis, and key informant interviews, was utilized for an in-depth examination of the floristic composition across 30 home gardens from five kebeles. The findings reveal that 87.6% of households participate in home gardening, with backyard (38.78%) and side yard (32.5%) gardens being the most prevalent. A total of 90 plant species, showcasing various growth habits and multiple functional groups, were recorded. Species diversity and evenness differed by location, with the highest Shannon-Wiener index observed in Arbisi Menfesawit (H’ = 3.2). The home gardens support a wide range of plant species, including food crops, medicinal plants, spices, and forage species, which are crucial for improving food security, generating income, and preserving cultural traditions. However, the productivity and sustainability of these systems encounter challenges such as water scarcity, pest infestations, land limitations, and labor shortages. In spite of these challenges, home gardens are vital for preserving agro-biodiversity and facilitating the transfer of indigenous knowledge, with women significantly contributing to their management. This study underscores the necessity of improving home garden systems to maintain their ecological and socio-economic advantages. Regional agricultural bureaus ought to acknowledge home gardens as productive agroecosystems, and agricultural extension personnel should receive training in sustainable garden design, organic soil management, pest control, and the conservation of agro-biodiversity. Furthermore, collaboration with NGOs focused on food security, women's empowerment, and climate resilience is essential.

Keywords: Agro-biodiversity, home garden, rural livelihoods, species diversity, traditional agroforestry

1. Introduction

1.1. Background of the Study

Agro-biodiversity, which encompasses the variety and variability of animals, plants, and microorganisms utilized directly or indirectly for food and agriculture, is essential for food security, ecosystem resilience, and sustainable rural livelihoods (Kumar et al., 2015). Home gardens have increasingly been recognized worldwide as essential reservoirs of agro-biodiversity and as integral elements of sustainable food systems. In tropical and subtropical areas, these small-scale, diverse agroecosystems facilitate the growth of a broad spectrum of plant species, including fruits, spices, medicinal plants, and ornamental varieties, thereby preserving genetic resources, improving soil fertility, and regulating microclimates (Agbogidi & Adolor, 2013; Galluzzi et al., 2010). The United Nations Food and Agriculture Organization (FAO) emphasizes the importance of home gardens in bolstering household food security, enhancing nutrition, and improving resilience against economic and environmental challenges (Canton, 2021).

Furthermore, home gardens play a crucial role in providing ecosystem services such as pollination, nutrient cycling, and the regulation of microclimates (Sarkar et al., 2022). In Africa, home gardens are essential components of traditional agricultural systems, significantly contributing to the maintenance of agro-biodiversity, enhancing food security for households, and sustaining rural economies (Korpelainen, 2023; Mellisse et al., 2018). These systems are especially common in densely populated and ecologically varied areas such as East and West Africa, where smallholder farmers cultivate multifunctional gardens that feature indigenous fruit trees, leafy greens, medicinal herbs, and spices (Galhena et al., 2013). Studies conducted in nations like Uganda have shown that home gardens make a significant contribution to dietary diversity and serve as informal conservation areas for endangered or underutilized species (Whitney et al., 2018). Despite their socio-ecological importance, home gardens in Africa are increasingly threatened by issues such as land tenure insecurity, urban encroachment, and climate change (Jamnadass et al., 2013). Additionally, the decline of indigenous knowledge and insufficient institutional support impede the complete integration of home gardens into formal conservation and agricultural development strategies.

In Ethiopia, a nation recognized as a biodiversity hotspot due to its diverse altitudes and climates, home gardens are pivotal in conserving plant diversity (Abdel-Meguid, 2016). Research conducted in areas such as Gedeo and Sidama has recorded that traditional home garden agroforestry systems incorporate over 50 plant species per household, including economically and ecologically important species like *Cordia africana*, *Millettia ferruginea*, and *Coffea arabica* (Kassa et al., 2023). These systems not only bolster biodiversity but also improve food security and generate income through the sale of surplus produce. Despite their significance, home gardens in Ethiopia are threatened by modernization, changes in land use, and population pressures, which result in genetic erosion and the decline of indigenous knowledge (Mellisse et al., 2018). The proliferation of monoculture agriculture and the degradation of habitats further exacerbate the susceptibility of these traditional systems, highlighting the necessity for conservation and sustainable management approaches (Galluzzi et al., 2010).

Although home gardens are commonly practiced in Ethiopia, there is a scarcity of scientific documentation, particularly in the Bure district of Northwestern Ethiopia. Current research predominantly emphasizes species diversity and management techniques, resulting in a lack of understanding regarding their significance in rural livelihoods. In the absence of adequate documentation, genetic erosion, pest infestations, and the decline of indigenous plant management practices pose threats to the sustainability of these systems, particularly in light of climate change.

While investigations have been conducted on home garden systems in various regions of Ethiopia, including the Gedeo and Sidama zones, there is a notable deficiency of research concentrating on the Bure district in Northwestern Ethiopia. This study seeks to address this gap by assessing the role of home gardens in conserving agro-biodiversity in the Bure district and their impact on rural livelihoods. By examining species diversity, management practices, and socio-economic advantages, the research offers valuable insights into their ecological and economic importance. The results would guide sustainable land-use strategies and biodiversity conservation initiatives, ensuring the enduring viability of home garden agroforestry systems in comparable agro-ecological regions.

2. Materials and Methods

2.1. Description of the Study Area

The study was carried out in the Bure district of Northwestern Ethiopia, situated approximately 411 km from Addis Ababa. It is geographically positioned between 11°37′727″–11°97′343″ N latitude and 26°67′63″–30°14′04″ E longitude (refer to Figure 1), with elevation levels ranging from 2,305 to 2,573 meters above sea level. The district comprises three agro-ecological zones: Dega (1%), Woynadega (72.33%), and Kolla (26.67%), with an annual rainfall between 1,000 mm and 1,800 mm and an average temperature ranging from 12°C to 25°C.

Bure district is noted for its mixed crop-livestock farming and home garden agroforestry systems, supported by a variety of soil types, including red soil (63%), brown soil (20%), and black soil (17%) (BWRADO, 2022). The total area of the district is 58,795 hectares, with 50.45% designated for agriculture, 5.24% for grazing, 7.97% for forests, 17.09% for perennial fruit trees, and 19.3% for other uses such as water bodies, homesteads, and degraded lands. These ecological and land-use features render the district an appropriate location for investigating home garden agro-biodiversity conservation and its significance in rural livelihoods.

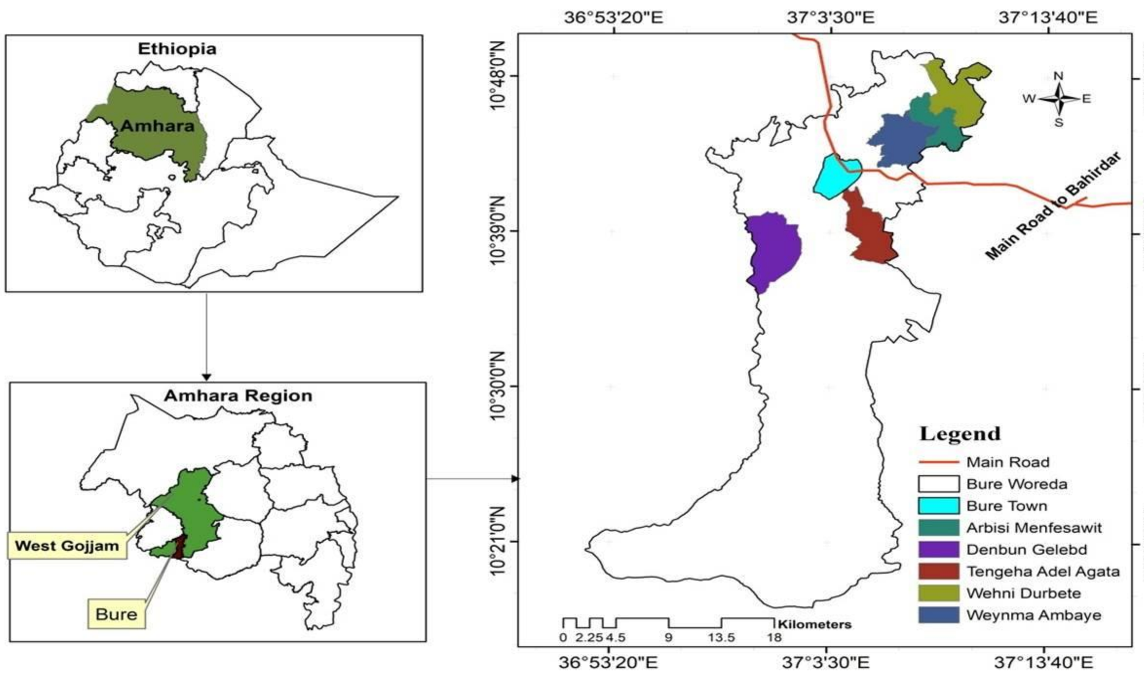

Figure 1. Map of the study area

2.2. Research Design

This study utilized a mixed-methods approach, combining both quantitative and qualitative research methodologies to improve data reliability. A cross-sectional design was employed to gather botanical data, including species identification and abundance, at a designated time. Primary data were collected through questionnaires, interviews, focus group discussions (FGDs), and key informant interviews, which captured demographic information (age, sex, education level), farmers' knowledge regarding medicinal plants, cultural values, labor distribution, and home garden management practices. Additionally, data on preferred tree species for construction, income generation, consumption, medicinal purposes, spices, stimulants, forage, and cultural importance were recorded. Secondary data sources were also utilized to enhance the analysis, providing a thorough understanding of home garden agro-biodiversity conservation and its contributions.

2.3. Sampling Techniques

A multi-stage sampling method was employed to guarantee representativeness across various agro-ecological zones. Initially, five kebeles were purposefully chosen based on their active involvement in traditional home garden practices, with two selected from the Kolla zone (Denbun and Adel Agata) and three from Woynadega (Ambaye, Woheni, and Arbisi). From a total of 5,875 households within the five kebeles, 300 households (60 from each kebele) were randomly chosen for the general household survey aimed at evaluating home garden distribution, types, sizes, and their contributions to livelihoods. Among these, 263 households were recognized as participants in home gardening, while the remaining 37 households were classified as non-participants, primarily due to recent relocations or other limitations.

Within the 263 households engaged in home gardening, a subsample of 30 home gardens plots (6 from each kebele) was purposefully selected for the analysis of floristic composition and species diversity, concentrating on active, well-managed home gardens as identified by development agents and community elders. This approach facilitated targeted documentation of biodiversity while maintaining a representative perspective on livelihoods. The sample plot size for the 30 home gardens was determined following the methodology of Storck et al. (1991), which allows for sample size determination based on practical constraints such as time, budget, and accessibility, particularly in exploratory or baseline studies. Although the total population size was known, this purposive strategy was employed to ensure manageability and depth in data collection across diverse sites. To improve representativeness, a combination of probability and purposive sampling was implemented, focusing on households actively involved in home gardening. In line with Martin (1995), systematic selection was employed to gather indigenous knowledge from 10 knowledgeable individuals (two from each site), aged between 35 and 75, who were identified with the assistance of community elders and development agents.

2.4. Data Collection

2.4.1. Ethnobotanical Data Collection

Ethnobotanical data were collected from September to December 2022 through guided garden walks, semi-structured interviews, market surveys, and discussions with key informants, adhering to the methodology proposed by Martin (1995). The data collection involved structured household surveys, market assessments, and qualitative interviews. Household income information was gathered using recall methods, where participants estimated their annual earnings from home garden products. The nutritional and medicinal advantages were recorded through preference rankings and interviews with holders of indigenous knowledge.

Field observations or systematic garden walks with key informants documented plant species, their functions, and applications. Participants shared cultural and ecological insights, while field notes, photographs, and garden sketches enriched the documentation process. A semi-structured questionnaire was utilized to gather information on household demographics, home garden management, species diversity, and conservation practices.

To investigate gender roles and indigenous knowledge, qualitative data were obtained through semi-structured interviews, focus group discussions (FGDs), and key informant interviews. Three FGDs (one in Kolla and two in Weynadega) were held with 8–10 participants each, ensuring gender representation. Furthermore, ten key informants (two from each site), chosen for their extensive indigenous knowledge and experience with home gardens, were interviewed in detail. The discussions and interviews were conducted in the local language (Amharic) and concentrated on gender-specific roles in planting, decision-making, harvesting, and the transmission of knowledge regarding traditional plant use and cultural practices. Field notes and audio recordings were transcribed for subsequent analysis.

2.4.2. Plant Specimen Collection and Identification

Plant specimens were collected from 30 sample plots (each measuring 10 m × 10 m, totaling 0.30 ha). GPS coordinates were documented for spatial precision. During fieldwork, key informants supplied local names, growth habits, and uses of the species. Specimens were assigned numbers, pressed, and dried for subsequent identification. Species were recognized using vernacular names and field botanical identification, adhering to the nomenclature established in the Flora of Ethiopia and Eritrea. In each plot, the number of plant species was recorded, and percentage cover was estimated.

2.5. Data Analysis

Ethnobotanical data and contributions to livelihoods were examined through descriptive statistics (mean, frequency, and percentage) for quantitative data, alongside thematic coding for qualitative responses. The floristic composition was assessed by evaluating species frequency, relative frequency, species density, and relative density.

Quantitative Ethnobotanical Analysis: -

Analysis Preference Ranking: Informants ranked species according to their importance (e.g., food, medicine, construction), with the highest scores indicating priority species (Martin, 1995).

Direct Matrix Ranking: Six multipurpose species were evaluated for their utility in medicine, spices, food, and construction, using a numerical scale from 0 to 7.

Paired Comparison: Five species were compared through n(n-1)/2 pairwise assessments, ranking them based on informants' preferences.

Market Survey: A market survey conducted in Bure underscored the economic significance of products from home gardens, involving producers, sellers, and buyers to assess demand and trading patterns.

Informant Consensus Analysis: To improve data reliability, key informants were consulted two to three times. Inconsistent responses were excluded to ensure data accuracy.

The Shannon-Wiener Index (1949) and Sorensen's Similarity Index were employed to analyze species diversity and floristic similarity. Statistical analysis was conducted using SPSS (version 20) and Microsoft Excel 2007.

- **Shannon-Wiener Diversity Index** (H'): Quantify species diversity using the formula:

$$\mathrm{H}' = -\sum_{i=1}^{s} PilnPi$$

Where Pi is the proportion species i, s is the total number of species. A higher value indicates greater diversity.

- **Species Evenness (J'):** Measures the distribution of individuals among species:

$$J' = \frac{H'}{H'max} = \frac{\sum_{i=1}^{S} PilnPi}{lnS}$$

Where H' max = lnS, with "S" being the total number of species. Evenness values range from 0 to 1, with 1 indicating an even distribution.

- **Sorensen's Similarity Index (SS):** Assesses species overlap between sites:

$$\mathrm{SS} = \frac{2a}{2a + b + c}$$

Where "a" is the number of shared species, "b" *is* species unique to one site, and "c" is species unique to another site. Similarity values range from 0 (complete dissimilarity) to 1 (total similarity).

- **Beta-diversity:** compared community composition using the formula:

$$\beta - \text{diversity} = \frac{b + c}{2a + b + c}$$

- **Frequency and Relative Frequency:**

$$\text{Frequency} = \left(\frac{\text{Number of plots containing a species}}{\text{Total plots sampled}}\right) \times 100$$

$$\text{Relative Frequency} = \left(\frac{\text{Frequency of a species}}{\text{Total frequency of all species}}\right) \times 100$$

- **Density and Relative Density:**

$$\text{Density} = \frac{\text{Total individuals of a species}}{\text{Total area sampled}}$$

$$\text{Relative Density} = \left(\frac{\text{Individuals of a species per ha}}{\text{Total Individuals per ha}}\right) \times 100$$

3. Results and Discussion

3.1. Results

3.1.1. Socio-Demographic Characteristics of Respondents

The demographic characteristics of the respondents revealed essential elements that affect the management of home gardens. A notable majority (83.33%) of the respondents were male, while females represented 16.67%. Age-wise, the predominant group (46.66%) fell within the 55-75 year range. In terms of education, 20% of the respondents were illiterate, 36.67% possessed basic literacy skills, and the remaining participants had undergone primary or secondary education (refer to Table 1). These results highlight the significance of indigenous knowledge in the management of home gardens.

Socio-economic conditions varied, with 36.67% of households categorized as wealthy and 16.66% as impoverished.

Concerning landholdings, 60% of households' maintained gardens that measured between 100 m² and 400 m², indicating limitations on land availability for diversification purposes. Only 10% of households had larger gardens, which ranged from 1001 m² to 1500 m².

Table 1: Socio-demographic profile of the 300 surveyed households across five kebeles

Variables	Categories	No. of respondents	Percentage
Sex	Male	250	83.33%
	Female	50	16.67%
Age	35-45	80	26.67%
	46-54	80	26.67%
	55-75	140	46.66%
Education status	Illiterate	60	20%
	Reading/Writing	110	36.67%
	Primary school	90	30%
	Secondary school	40	13.33%
Home garden land size (m^2)	$100m^2$-$400m^2$	180	60%
	$401m^2$-$1000m^2$	90	30%
	$1001m^2$-$1500m^2$	30	10%

3.1.2. Home garden Practices and Frequency

Of the 300 households surveyed, 263 (87.66%) were engaged in home gardening, while 37 (12.33%) did not participate. The reasons for non-participation included recent relocation, insufficient land, or physical constraints. These figures indicate a significant prevalence of home garden agro-biodiversity conservation within the study area. The frequency of home gardening practices varied among the five sampling sites, with Ambaye (96.66%) and Adel Agata (95%) was demonstrating the highest frequencies, whereas Denbun recorded the lowest at 75%. In the region, home gardens are locally referred to as Yeguaro Irsha, Yeguaro Atikilt, and Tegan. The types of home gardens differed across the sampled locations; with the majority being backyard (38.78%) and side yard (32.5%) gardens. Collectively, these two categories accounted for 71.28% of the total gardens surveyed (Table 2).

3.1.3. Growth Habits of Plant Species in Sampled Home gardens

A comprehensive survey identified a total of 90 plant species belonging to five distinct families within the study area. The documented species encompassed trees, shrubs, herbs, and climbers, which were categorized across various growth strata.

In detail, 31 species (34.44%) were classified as trees, 17 species (18.8%) as shrubs, 39 species (43.33%) as herbs, and 3 species (3.33%) as climbers (Figure 2).

Table 2. Distribution of home garden types and their frequency across five kebeles

Sample areas	Sample size	Recorded Home gardens					Not Recorded home garden
		Backyard	Side yard	Front yard	All rounded	Total (%)	
Arbisi	60	28 (46.67%)	9 (15%)	1 (1.67%)	16 (26.67%)	54 (90%)	6
Ambaye	60	20 (34.48%)	23 (39.66%)	4 (6.9%)	11 (18.97%)	58 (96.66%)	2
Woheni	60	12 (24.49%)	23 (46.94%)	4 (8.16%)	10 (20.41%)	49 (81.66%)	11
Denbun	60	14 (31.11%)	14 (31.11%)	10 (22.22%)	7 (15.56%)	45 (75%)	15
Adel Agata	60	28 (49.12%)	16 (28.07%)	6 (10.53%)	7 (12.28%)	57 (95%)	3
Total	300	102	85	51	25	263 (87.66%)	37

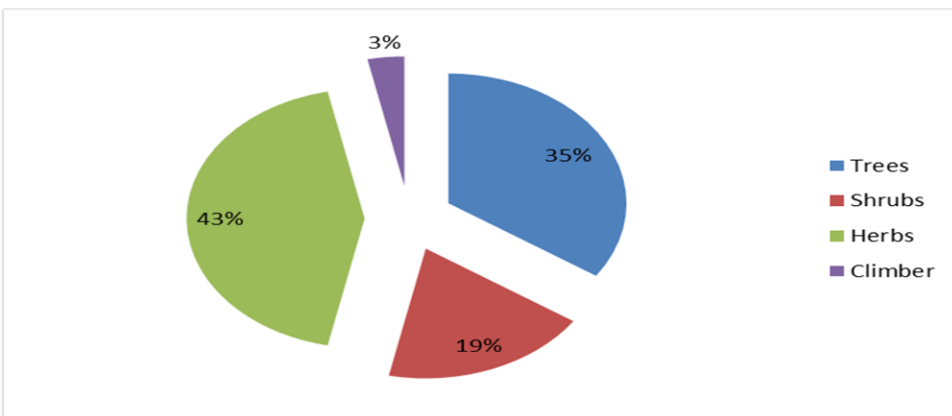

Figure 2: Growth habits of plant species recorded in the study home gardens

3.1.4. Composition and Diversity of Home garden Species

A total of 90 plant species were recorded in the home gardens of the study area, with the families Fabaceae (13 species), Poaceae (9 species), and Solanaceae (7 species) being the most diverse. Among these, 48 species were classified as woody, while 42 were herbaceous (Table 3).

Species diversity reached its highest in Arbisi Menfesawit (Shannon-Wiener index, H' = 3.2), followed by Woyenema Ambaye (H' = 2.6) and Adel Agata (H' = 2.9). In contrast, Woheni Durbete displayed the lowest diversity (H' = 2.4). The observed variation in species diversity was affected by factors such as water availability, the size of the garden, and pest management practices. The species evenness index, which reflects the balance of species distribution, was highest in Arbisi (0.83) and lowest in Woheni (0.62). These results indicate that larger and well-maintained gardens are associated with greater diversity and improved species distribution (Table 3).

Diversity indices for both woody and herbaceous species exhibited comparable trends. Arbisi Menfesawit demonstrated the highest diversity for woody species (H' = 3.2) as well as for herbaceous species (H' = 2.7), whereas Woheni Durbete recorded the lowest diversity for both categories (H' = 2.4 and H' = 2.3, respectively) (Table 3). These findings underscore the importance of site-specific factors in influencing biodiversity within home gardens.

Table 3. Woody and herbaceous species diversity indices across sites

Study sites	Woody species			Herbaceous species		
	No. of Species	Shannon and Wiener (H') index	Evenness	No. of Species	Shannon and Wiener (H') index	Evenness
Arbisi Mefesawit	43	3.2	0.83	29	2.7	0.72
Woyenema Ambaye	40	2.6	0.67	29	2.6	0.7
Adel Agata	38	2.9	0.75	28	2.54	0.68
Woheni Durbete	29	2.4	0.62	21	2.3	0.62
Denbun	31	2.56	0.66	28	2.5	0.67

3.1.5. Plant Species Density, Relative Density, Frequency, and Relative Frequency

Field observations and data collected from 30 home gardens, each measuring 10m × 10m (100m²), which collectively cover a total area of 0.3 hectares (100m² × 30 = 3000m² = 0.3 ha), revealed significant variations in species frequency and density. The species that were most prevalent within the higher frequency categories included *Cordia africana*, *Rhamnus prinoides*, *Eucalyptus camaldulensis*, *Vernonia amygdalina*, *Croton macrostachyus*, *Grevillea robusta*, and *Ruta chalepensis*. These species demonstrated notable adaptability, ease of cultivation, and substantial market demand, thus solidifying their prominence in home gardens. Conversely, *Brucea antidysenterica* was recognized as the least frequently observed species in the study area.

Regarding species density, *Coffea arabica L.*, *Rhamnus prinoides*, *Cordia africana*, and *Eucalyptus camaldulensis* were ranked first, second, third, and fourth, respectively. In contrast, *Brucea antidysenterica* exhibited the lowest density. Density is defined as the number of standing trees per hectare for each species, along with the total number of species surveyed. Relative density, on the other hand, reflects the proportion of a specific species in relation to the overall vegetation cover, thereby offering a clearer perspective on species abundance and dominance within the home garden ecosystem. Furthermore, frequency and relative frequency provided valuable insights into the distribution of species across the plots. Frequency refers to the occurrence rate of a species within sample plots, while relative frequency indicates the proportion of plots occupied by a specific species compared to the total number of sample plots. These metrics are crucial for evaluating species distribution patterns and their ecological importance within home gardens.

Table 4. Home gardens Plant species with the highest Frequency, Relative Frequency, Density, and Relative Density in Bure district

Scientific Name	Local Name	No. of Plots	No. of Individuals	Frequency (%)	Relative Frequency	Density	Relative Density
Eucalyptus camaldulensis	Key Baher zaf	25	80	83.33	6.6	266.67	5.83
Rhamus prinoides	Gesho	29	108	96.66	7.6	360	7.86
Ruta chalepensis	Tena Adam	23	46	76.66	6.1	153.33	1.38
Grevillea robust	Gravilia	21	76	70	5.56	253.33	5.53
Cordia Africana	Wanza	30	93	100	7.9	310	6.77
Vernonia amygdalina Delile	Grawa	27	60	90	7.1	200	4.37
Croton macrostachyus Del.(Euphorbiaceae)	Bisana	20	34	66.66	5.29	113.33	2.48
*Carica papaya L. (*Caricaceae)	Papaya	10	30	33.33	2.64	100	2.18
Catha edulis (Vahl) Forssk.ex. Endl	Chat	7	50	23.33	1.85	166.67	3.64
Citrus aurantifolia (Christm.)	Lomi	6	15	20	1.58	50	1.09
Citrus sinensis (L.)	Birtukan	5	10	16.67	1.32	33.33	0.73
Coffea arabica L.	Bunna	16	500	53.3	4.23	1666.6	36.41
Cupressus lussitanica Mill.	Yeferenji tid	3	6	10	0.79	20	0.44
Cytisus scoparius (L)	Trilusern	7	12	23.33	1.85	40	0.87
Eucalyptus globulus Labill. (Myrtaceae)	Nech baherzaf	2	5	16.66	1.32	16.67	0.36
Juniperus procera Hochst,ex.Endl	Tid	5	10	16.66	1.32	33.33	0.73
Mangifera indica L.	Mango	7	30	23.33	1.85	100	2.18
Olea europaea ssp.	Woyera	15	19	50	3.97	63.33	1.38
Opuntia ficus-indica (L.)	Qulqual	6	9	20	1.59	30	0.65
Persea americana Mill	Avocado	13	25	43.33	3.4	83.33	1.82
Phoenix reclinata	Zebaba	3	8	10	0.79	26.67	0.58

Jacq.							
Phytolacca dodecandra L'	Endod	2	3	6.66	0.53	10	0.22
Psidium guajava L.	Zeyetuna	4	7	13.33	1.1	23.33	0.51
Ricinus communis L.	Chaqema	5	12	16.66	1.32	40	0.87
Acacia abyssinica	Girar	3	5	10	0.79	16.67	0.36
Arundo donax L.	Shebeko	2	2	6.66	0.53	6.67	0.145
Acacia Decurens	Decurens girar	7	10	23.33	1.85	33.33	0.73
Jacaranda mimosifolia	Yetemenja zaf	3	7	10	0.79	23.33	0.51
Malus sylvestris Miller	Apple	2	4	6.66	0.53	13.33	0.29
Millettia ferruginea	Birbira	6	11	20	1.58	36.67	0.8
Ficus sur Forssk	Shoala	3	3	10	0.79	10	0.22
Albiziasc himperiana Oliv.	Sesa	8	12	26.66	2.12	40	0.87
Vernonia myriantha Hook.f.	Gengerita	4	10	13.33	1.1	33.33	0.73
Lycopersicon esculentum Mill	Timatim	13	15	43.33	3.4	50	1.09
Podocarpus falcatus (Thunbr.) R.B.ex.Mirb	Zegiba	2	2	6.66	0.53	6.667	0.15
Prunus persica (L.) Batsch	Kok	5	8	16.66	1.32	26.67	0.58
Rosa hybrida L.	Tsigereda	3	5	10	0.79	16.67	0.36
Sesbania sesban L.	Subaneya	8	30	26.66	2.12	100	2.18
Dombeya torrida (J.F.Gmel) P. Bamps	Wulkifa	3	4	10	0.79	13.33	0.29
Clausena anisata (Willd.)	Limich	2	2	6.66	0.53	6.66	0.14
Rumex nervosus Vahl	Ambacho	2	2	6.66	0.53	6.66	0.15
Acanthus sennii Chiov.	Kosheshil a	3	13	10	0.79	43.33	0.95
Erythrina brucei Schweinf.	Korch	2	2	6.66	0.53	6.67	0.15
Buddleja davidii Fresen.	Amfar	2	2	6.66	0.53	6.67	0.15
Ficus vasta	Warka	2	2	6.66	0.53	6.67	0.15
Brucea antidysenterica	Abalo	1	1	3.33	0.26	3.33	0.07
Total			1400	1259.98	100	4666.7	100

3.1.6. Similarity among Home gardens

The Sorenson similarity index was employed to evaluate the degree of species similarity across the five sampling locations. The findings exhibited a range from 0.65 to 0.85, with all values exceeding 0.5, which signifies a considerable level of similarity and a balanced distribution of species throughout the study sites (Table 5). The most elevated similarity coefficient (0.85) was noted between the home gardens of Arbisi and Ambaye kebeles, indicating a robust likeness in species composition. In contrast, the lowest similarity coefficient (0.65) was documented between Arbisi and Wohini kebeles, reflecting a relatively greater disparity in species composition between these two locations. These results imply that while Arbisi and Ambaye kebeles possess a comparable plant composition, Arbisi and Wohini exhibit more pronounced differences in home garden biodiversity.

Table 5: Similarity index among the five sampling sites

Study sites	Arbisi	Ambaye	Denbun	Adel Agata	Wohini
Arbisi	1.00				
Ambaye	0.85	1.00			
Denbun	0.76	0.78	1.00		
Adel Agata	0.79	0.81	0.72	1.00	
Wohini	0.65	0.80	0.82	0.77	1.00

3.1.7. Home garden Plants and Their Benefits

Home gardens within the study area play a crucial role in food production, providing a diverse array of crops throughout the year. The availability of nutrient-dense products from home gardens peaks during the primary rainy season (June–September). Nevertheless, even with the cultivation of various plants, some households remain unaware of the nutritional advantages offered by vegetables and fruits.

A preference ranking conducted by ten indigenous experts revealed that *Carica papaya* is the most preferred fruit, followed by *Musa paradisiaca* and *Persea americana*. Furthermore, home gardens are essential sources of medicinal plants utilized for addressing human health issues. As shown from table 6, a total of 10 species (11% of the documented plants) were recognized for their medicinal properties, with six species frequently employed to treat a range of health conditions. These medicinal plants are intentionally cultivated near residences for convenient access, and traditional healers highlight their cost-effectiveness and efficacy.

In addition to the medicinal plants, six species of spices were documented, which are vital for culinary preparation and cultural traditions. Two stimulant species, *Coffea arabica* (coffee) and *Catha edulis* (chat), are also grown, appreciated for their economic and cultural importance (Table 6). Several forage species are cultivated to ensure a steady supply of livestock feed without the need for replanting, primarily utilizing young branches and leaves.

Table 6: Major Uses of Home garden Plants

Major uses of home garden	List of plant species		Parts used
	Scientific Name	Local Name	
Food and nutrition	*Carica papaya L.*	Papaya	Fruit
	Musa paradisiaca	Muz	Fruit
	Persea americana	Avocado	Fruit
	Prunus persica	Kok	Fruit
	Psidium guajava	Zeyetuna	Fruit
Medicinal value	*Allium sativum*	Nech shenkurt	Bulb (Headache, flu)
	Carica papaya	papaya	Seed (Intestinal parasites)
	Ensete ventricosum	Enset	Corm (Bone fractures)
	Eucalyptus globulus	Nech bahirzaf	Leaves (shoe odor)
	Vernonia amygdalina	Grawua	Leaves (General sickness)
	Lepidium sativum	Feto	Seed (Evil eye)
Spice	*Ruta chalepensis*	Tena adam	Top branches
	Rosmarinus officinalis	Siga metbesha	Leaves
	Rhamnus prinoides	Gesho	Top parts
	Curcuma domestica	Erdi	Rhizomes
	Coriandrum sativum	Dinbilal	Seeds
	Allium cepa aggregatum	Nech shinkurt	Bulbs
Stimulant	*Coffea arabica*	Buna	Seeds
	Catha edulis	chat	Young leaves
Forage for livestock	*Cytisus scoparius*	Treelucern	Young branches, leaves
	Medicago stiva	Alfalfa	Top parts
	Pennisetum purpureum	Zihone sar	Top parts
	Sesbania sesban	Sesbania	Young branches, leaves

3.1.8. Contribution of Home gardens to Rural Livelihoods in the Study Area

3.1.8.1. Marketed Value of Home garden Species

Home gardens are essential for improving the livelihoods of farmers by offering both food and income opportunities. They act as a form of financial security, enabling farmers to accumulate wealth through crops that can be consumed or sold as necessary. Although this study did not specifically examine the economic conditions of households, variations in income generation were noted, primarily influenced by the size of the home gardens. Households with larger home gardens generally achieve higher incomes due to increased crop yields.

Farmers tend to prioritize cash crops to fulfill their financial requirements, and those situated nearer to market centers often cultivate fewer cereal crops. The accessibility of markets encourages these farmers to concentrate on high-value cash crops, while staple foods are acquired for household consumption (Table 7). Improved road access across the study areas has supported the cultivation and sale of high-value crops and tree species such as *Cordia Africana* (wansa), *Lycopersicon esculentum* (tomato), *Coffea Arabica* (buna), *Catha edulis* (chat), *Rhamnus prinoides* (gesho), and *Brassica oleracea* (cabbage). These crops are marketed in either fresh or dried forms in local markets like Bure, Derequa, and Manikusa. Farmers with medium sized hom gardens frequently engage in intensive cultivation, focusing on a select few highly profitable crops for sale while purchasing other essential items. Nevertheless, this transition towards market-oriented production, potentially at the cost of dietary diversity and nutritional security, may adversely affect agro-biodiversity and the long-term viability of home gardens.

Table 7. Marketed home garden plant species

Botanical name	Local name	Rank
Lycopersicon esculentum Mill.	Timatim	3
Olea europaea ssp.	Woyira	5
Rhamnus prinoides	Gesho	2
Musa x paradisiaca L.	Muz	7
Catha edulis	Chat	4
Cordia Africana	Waniza	1
Thymus schimperi Ronninger	Tosign	8
Brassica oleracea	Yabesha Gomen	6

Household income derived from home gardens exhibited significant variability, influenced by factors such as the size of the land, the prevalence of pests and diseases, the availability of water, and the farmers' capacity to manage their gardens effectively. Among the 30 households surveyed, annual incomes ranged from 2,000 to 50,000 birr, with an average household income calculated at 14,566.97 birr per year (refer to Table 8).

Table 8: Annual household income from home gardens

Annual income (ETB)	No. of Respondents	Percentage (%)
2,000 – 10,000	12	40
10001 – 20,000	13	43.33
20001 – 30,000	2	6.67
30001 – 50,000	3	10

3.1.8.2. Cultural Value of Home garden Species

Beyond their practical applications, home gardens in the study area possess considerable cultural and spiritual significance. Numerous plant species are intricately woven into local traditions and rituals, serving essential roles in the spiritual and cultural fabric of the community.

Five plant species were recognized for their ritual and spiritual importance. Notably, *Otostegia integrifolia* is believed to offer protection to postpartum mothers against malevolent spirits, while *Vernonia* *amygdalina* is thought to shield individuals from hidden adversaries (see Table 9). Other species are closely linked to ritualistic practices, particularly during New Year celebrations. *Cymbopogon citratus* and *Artemisia absinthium* are frequently distributed among households during this time as emblems of good fortune and prosperity for the upcoming year. Furthermore, *Lepidium sativum* seeds are consumed with injera (a traditional flatbread) prior to breakfast on holidays to aid in the elimination of intestinal parasites, thereby reinforcing the plant's cultural and medicinal relevance.

Table 9. Cultural and spiritual plant species in Bure district

Botanical name	Local name	Cultural belief	Parts used	Application
Otostegia integrifolia	Tijit	Protects postpartum mothers from evil spirits	Leaves, branches	Fumigation
Cymbopogon citratus	Teg Sar	Symbolizes good fortune	Whole plant	Household decoration during new year
Lepidium sativum	Feto	Cleanse the parasites of stomach	Seeds	Consumed with injera before breakfast
Carica papaya	Papaya	Used to soften raw meat	Fresh leaves	Covering meat
Vernonia amygdalina	Girawa	Protects against hidden enemies	Leaves	Applied to the body

3.1.9. Home garden Management Practices in the Study Area

Home garden owners in the study area implemented a range of management strategies aimed at enhancing the productivity and sustainability of their gardens. These strategies encompassed the application of both organic and inorganic fertilizers, various fencing techniques, and the procurement of planting materials.

Out of the 30 participants surveyed, 25 (83.33%) indicated that they exclusively utilized organic fertilizers, while 5 (16.66%) reported using a mix of organic and inorganic fertilizers. This pattern suggests a significant inclination towards organic farming practices within the area (Figure 3). Organic fertilizers, including compost and manure, are extensively employed, highlighting a commitment to environmentally sustainable agricultural methods.

The fencing of home gardens exhibited variability throughout the study area; some gardens were completely enclosed, others partially fenced, and some remained unfenced. To safeguard plants from livestock damage, live fencing, which incorporates trees and shrubs, was frequently adopted. Based on the feedback from the 30 home garden owners, 9 (30%) possessed fully fenced gardens, 11 (36.67%) had semi-fenced gardens, and 10 (33.33%) had no fencing whatsoever (Figure 3). These variations in fencing practices were often shaped by factors such as the size of the garden, its location, and the resources available. Live fencing, utilizing trees and shrubs, was a prevalent technique used to shield home garden species from livestock damage.

The accessibility of high quality planting materials is essential for the sustainable management of home gardens. Survey participants indicated that they sourced their planting materials from various origins. Specifically, 46.67% acquired materials from government nurseries, 26.67% bought them at local markets, 16.66% received them from friends and family, and 10% collected them from wild or forested regions (Figure 3). The practice of exchanging planting materials, which includes interregional and cross-boundary networks, was notably prevalent within the community. This exchange not only aids in the preservation of plant genetic diversity but also promotes the sharing of traditional knowledge regarding plant care and management. These results imply that government nurseries are crucial in supplying planting materials, while local markets and social networks such as exchanges among friends, family, and neighboring communities also play significant roles. The act of exchanging planting materials contributes to both the enhancement of plant diversity and the cultural knowledge linked to home garden management.

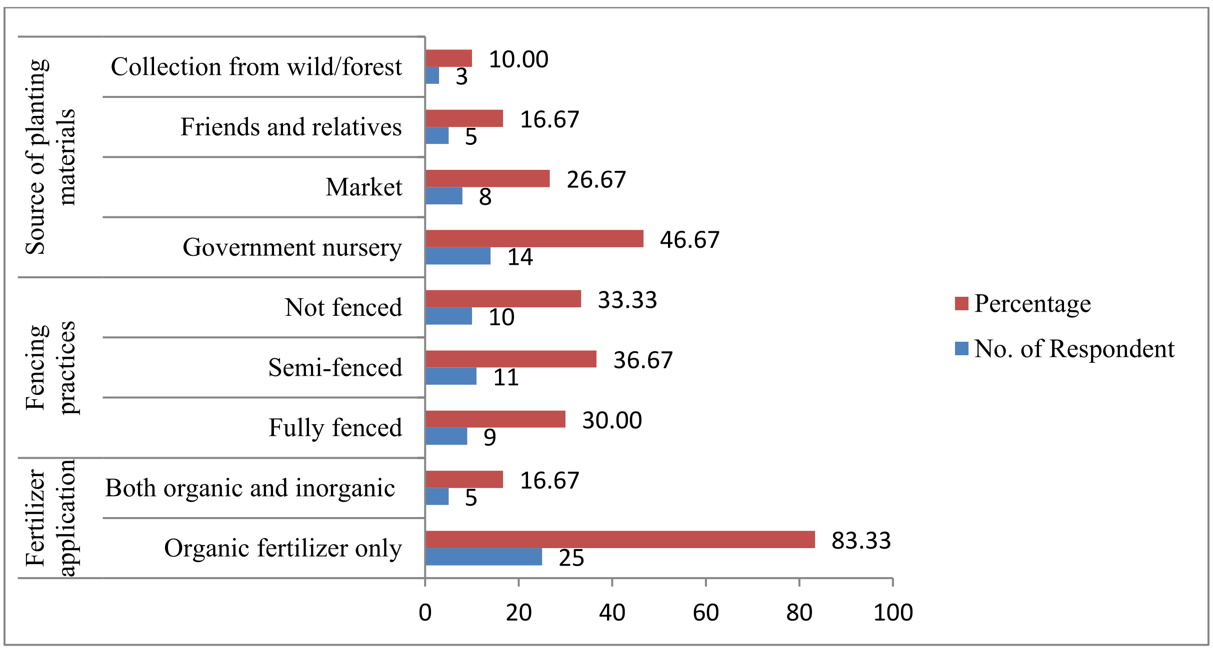

Figure 3. Home garden management practices applied in the study area

3.1.10. Challenges in Home garden Conservation Practices in the Study Area

The establishment and ongoing viability of productive home gardens in the Bure district face numerous obstacles, as highlighted by the respondents. The primary challenges identified include water scarcity, limited garden sizes, pest and disease outbreaks, inadequate agricultural inputs, and a shortage of labor. Among these issues, water scarcity is perceived as the most significant limitation. The home gardens within the study area predominantly depend on rainfall, resulting in a marked reduction in species diversity during the dry season. Farmers with access to alternative irrigation sources can sustain plant diversity and productivity year-round. However, for the majority of households, irrigation demands considerable labor and time, intensifying the challenges of maintaining flourishing gardens.

The dimensions of home gardens differ significantly across households. Some gardens located in the Arbisi and Adel Agata kebeles can reach sizes of up to 1,500 m², whereas smaller gardens are generally linked to diminished species diversity. These smaller gardens often concentrate on a restricted variety of species, thereby limiting overall biodiversity (Table 10). Pests and diseases pose a considerable risk to the productivity of home gardens, particularly in regions adjacent to main roads, such as the Denbun and Wohini kebeles. Farmers have indicated that infestations lead to a decrease in both plant diversity and total yields, further complicating the efforts to maintain healthy gardens.

The absence crucial agricultural inputs', including fertilizers and high-quality planting materials, significantly limits garden productivity. Furthermore, labor shortages, especially in households with restricted family labor, impede efficient garden management and the prompt implementation of essential interventions. A pairwise ranking, derived from the aggregated votes of ten key informants, revealed that water scarcity and pest infestations are the two most critical challenges impacting home garden income and productivity (Table 10).

Table 10. Pairwise ranking of major factors limiting home garden productivity in the study area

Factors	Lack of water	Pest and disease	Lack of farmland	Lack of inputs	Lack of labor	Collective votes	Rank
Lack of water	-	6, 4 (water)	8, 2 (water)	4, 6 (Inputs)	7, 3 (water)	4	1
Pest & disease	-	-	7, 3 (pests)	6, 4 (pests)	6, 4 (pests)	3	2
Lack of farmland	-	-	-	6, 4 (Farmland)	8, 2 (farmland)	2	3
Lack of inputs	-	-	-	-	6, 4 (labor)	1	4
Lack of labor	-	-	-	-	-	1	4

(C/V = Collective votes, Rank = Final ranking based on informant perceptions)

3.2. Discussion

3.2.1. Types, Size, and Structures of Home gardens in the Study Area

The study indicated that 87.6% of households in the Bure district are engaged in the preservation of home gardens (Table 2), highlighting the importance of these gardens for local agriculture and livelihoods. This notable level of involvement aligns with previous research, including studies by Tefera et al. (2019) in the Bule Hora district of Southern Ethiopia, and Semu (2018) in the Holeta district, where a similar pattern of home garden conservation was observed.

In the study area, 71.28% of home gardens were located in side and backyard areas (Table 2). These gardens are referred to by various local names such as Yeguaro Irsha, Yeguaro Masa, and Yeatikilit Bota, which reflect the terminology used in other regions of Ethiopia. The results of this study are consistent with findings from comparable home garden studies by Semu (2018) in Holeta District; Mellisse et al. (2018) and Tadesse et al. (2019) in Southern Ethiopia, which also reported high species diversity and the predominance of backyard gardens, confirming a preference for spatial efficiency and accessibility. This suggests a common inclination to utilize back or side yards for agricultural purposes. However, in the wider context of Ethiopia, front yards often rank as the second most common site for home gardens (Amberber et al., 2014). The choice of locations for home gardens may be influenced by factors such as land availability, household preferences, and cultural practices (Mdiya & Mdoda, 2021).

Home gardens located in the Bure district demonstrated considerable variability in size, ranging from 100 m² to 1,500 m², with an average area of 275.93 m². This size variation exemplifies the diverse scales at which home gardens are maintained within the area, reflecting disparities in household resources and priorities.

The gardens also exhibited a variety of plant arrangements, characterized by two primary structural types: horizontal patch-like configurations and three-layered vertical stratification. The upper strata (10–15 m) were predominantly occupied by *Cordia africana*, a significant tree species. The middle strata (1–10 m) primarily consisted of *Citrus sinensis*, which typically includes fruit-bearing trees such as oranges. The lower strata (up to 1 m) were composed of herbaceous species like *Brassica carinata* and *Cymbopogon citratus*, which are common low-growing plants.

The observed vertical stratification patterns, reminiscent of those documented in Southern Ethiopia (Mellisse, 2017), suggest that home gardens in the Bure district are designed to optimize space, diversify plant production, and enhance resource utilization. This multilayered configuration serves as an effective strategy for cultivating a wide range of species, thereby promoting biodiversity and improving the sustainability of the home garden ecosystem. Additionally, the stratified design contributes aesthetic value to home gardens, allowing them to function as both productive areas and cultural landscapes.

3.2.2. Diversity and Functional Groups of Plants in the Study Area

The study emphasizes the significant variety of plant species found in home gardens across the Bure district, categorizing them according to their ecological, economic, and cultural importance. These plants provide a multitude of benefits, including enhancing food security, generating income, offering medicinal properties, and promoting environmental sustainability (Bantihun Mehari & Abera, 2019; Galhena et al., 2013; Korpelainen, 2023; Mekonen et al., 2015; Regassa, 2016; Woldemichael & Belayneh, 2017). This underscores the critical role of agro-biodiversity in the livelihoods and welfare of rural communities, as highlighted by Sime et al. (2024).

Plant Family Dominance and Diversity: Within the diverse array of plant families, Fabaceae has emerged as the most dominant in the home gardens of the Bure district. This finding is consistent with results from other studies conducted in Ethiopian sub-humid lowlands, southern Ethiopia by Tadesse et al. (2019) and Kebebew (2018), as well as in home garden of Jharkhand, India by Shukla et al. (2017). Additionally, Doffana (2017) and Beyene et al. (2018) noted that both Fabaceae and Solanaceae were among the leading families, which aligns with the floristic composition observed in this research. The prominence of Fabaceae, which includes legumes such as beans and peas, highlights the significant roles these species play in the economy (as cash crops) and in the ecosystem (as nitrogen fixers that improve soil fertility).

The diversity of plant species was found to correlate directly with the size of home gardens. Larger gardens exhibited a greater level of plant diversity, a trend that aligns with previous studies linking garden size to species richness (Kassa et al., 2023; Yinebeb et al., 2022). This suggests that households with more resources (in terms of land or labor) are able to cultivate a broader range of plant species, thus promoting biodiversity. The study cataloged 90 plant species, categorized by their growth habits, from various plant families. Among these, the most commonly represented families were Fabaceae (13 species), Poaceae (9 species), Solanaceae (7 species), Rutaceae (5 species), and Asteraceae (4 species). This rich variety of species contributes to diverse food production and provides medicinal, cultural, and economic benefits.

Diversity Indices and Evenness: The Shannon-Wiener diversity index (H') values ranged from 3.2 (in Arbisi Kebele) to 2.4 (in Woheni Kebele), which are consistent with the range typically foundWelenne Wereda, SNNPR, Ethiopia (Amare, 2018). These diversity index values suggest that the home gardens in the Bure district demonstrate high levels of diversity and are organized in a manner akin to natural ecosystems concerning species richness and evenness. The species richness per site varied from 50 to 72, while evenness values fluctuated between 0.64 and 0.79. Since evenness values above 0.5 indicate a balanced distribution of species, this suggests that the species within these home gardens are relatively evenly distributed, further supporting the notion of well-maintained biodiversity.

Species Frequency and Similarity: The study revealed significant variations in the frequency of plant species across home gardens. For instance, *Eucalyptus camaldulensis*, *Rhamnus prinoides*, *Ruta chalepensis*, *Grevillea robusta*, *Cordia africana*, *Vernonia amygdalina*, *Croton macrostachyus*, and *Coffea arabica* were identified as some of the most common species. In contrast, certain species, such as *Brucea antidysenterica*, were observed less frequently. The Sorenson similarity index was utilized to evaluate species composition across the five sampling locations. The results indicated a considerable degree of species overlap, with the similarity index ranging from 0.65 to 0.85. The highest similarity was noted between Arbisi and Ambaye kebeles (0.85), suggesting that these two areas have highly comparable species compositions, while the lowest similarity (0.65) was recorded between Arbisi and Woheni kebeles. This indicates that although the home gardens within the district share many species, there are also local variations that may be influenced by microclimatic conditions, individual household preferences, or specific agricultural practices.

The Significance of Home gardens in Food Security and Nutrition: The home gardens within the studied area play a vital role in providing a wide variety of food crops, such as cereals, pulses, root vegetables, greens, and fruits, which are essential for maintaining consistent household nutrition. Food security was further enhanced by the cultivation of 5 to 12 commonly utilized edible species per household, illustrating the contribution of home gardens to dietary diversification. This aligns with previous a study that highlights the significance of home gardens in fostering food security and dietary variety (Mellisse et al., 2018; Regassa, 2016). The presence of a diverse selection of nutrient-dense crops is crucial for combating hidden hunger, a condition associated with micronutrient deficiencies (Bantihun Mehari & Abera, 2019; Galhena et al., 2013). These gardens allow households to access essential vitamins and minerals, which are vital for overall health, particularly in rural areas where the availability of a variety of foods may be limited.

3.2.3. Market Values of Home garden Products

The market assessment indicated that, despite the presence of home garden products such as fruits, vegetables, spices, and root crops in local markets, a considerable amount of this produce is not commercially obtained from home gardens. Instead, the majority of the produce cultivated at home is consumed by the households themselves, primarily serving to enhance family nutrition rather than acting as a source of income. In terms of financial returns, households reported earnings ranging from 2,000 to 50,000 Ethiopian Birr (ETB) annually from garden products, with an average income of 14,567 ETB, which underscores the economic significance of home gardens. From a medicinal perspective, ten plant species were recognized as being utilized by households, including notable species such as *Vernonia amygdalina* and *Carica papaya*, highlighting the contributions of these gardens to traditional healthcare practices. Culturally, five plant species, including

Otostegia integrifolia, were identified as possessing considerable ritual and spiritual significance, illustrating the profound cultural integration of biodiversity within home gardens. This study corroborates the findings of Tola (2023)**,** who observed that home gardens primarily address the food security needs of households, with income generation being a secondary role (Atiso & Fanjana, 2020). This suggests that while home gardens are crucial for the nutrition and health of families, they do not consistently serve as a primary source of income. The limited scale of home garden production and the restricted market access for many households likely contribute to this scenario.

3.2.4. Home garden Agro-biodiversity Conservation Practices

The study identified multiple avenues for obtaining planting materials within the district, which encompass exchanges among family and friends, purchases from local markets, and foraging from natural environments (Figure 3). The practice of sharing planting materials, especially among community members, is essential for the conservation of agrobiodiversity and the safeguarding of traditional knowledge. Such exchanges play a significant role in preserving local plant varieties that may not be available through formal seed systems, thus ensuring a rich diversity of species is maintained in the area. Notably, medicinal plants such as *Asparagus africanus*, *Ocimum lamiifolium*, *Otostegia integrifolia*, *Thymus schimperi*, and *Vernonia amygdalina* were primarily sourced from the wild, underscoring the traditional knowledge that has been passed down through generations.

As a result, home gardens are not only crucial for food production but also for sustaining important cultural practices and traditional medicinal knowledge, corroborating the findings of Woldemichael and Belayneh (2017). This highlights the significance of home gardens in preserving plant genetic diversity, which is essential for ensuring food security and maintaining cultural heritage. Likewise, Galhena et al. (2013) observed that home gardens significantly contributed to both food and cultural security, with women playing pivotal roles (Huss et al., 2020), aligning with our findings on gender roles and indigenous knowledge. On an international scale, studies conducted in Sri Lanka dry zone Williams et al. (2018) and Indonesia Yusriadi et al. (2024) **a**lso emphasize the multifunctionality of home gardens in conserving agro-biodiversity, enhancing food security, and bolstering household resilience. These comparisons reinforce the notion that home gardens are critical socio-ecological systems in both tropical and subtropical area, highlighting their importance in rural development and climate adaptation strategies.

The study also examined gender roles in the management of home gardens. Their involvement is crucial not only for enhancing food security but also for the sustainability and conservation of agro-biodiversity. This finding challenges traditional gender norms that limit women's decision-making power in certain societies. In the study area, women are pivotal in managing home gardens, particularly in the areas of species selection, planting, harvesting, and utilizing medicinal and culinary plants. Gender-disaggregated data presented in figure 3 indicated that women make 45% of household decisions regarding home gardens.

Additionally, 72% of the knowledge concerning medicinal plants (including identification, preparation, and application) was reported by female respondents, particularly in relation to treating childhood illnesses, postpartum care, and food preparation. Women also showed a tendency to prioritize the planting of species that provide direct benefits to the household, such as *Ruta chalepensis* (spice), *Vernonia amygdalina* (medicine), and *Brassica carinata* (vegetable). Conversely, men were more engaged in the cultivation of cash crops and the management of larger tree species. This gendered division of labor highlights the necessity for gender-sensitive policies that empower women as custodians of agro-biodiversity and traditional knowledge systems, aligning with the findings of Yaregal and Sime (2024) and Pradhan et al. (2021).

3.2.5. Challenges to Home garden Development in the Study Area

Despite the numerous benefits associated with home gardens, the study uncovered several challenges that affect their productivity in the area. The primary challenge identified was water scarcity, which hinders farmers' ability to maintain crop production year-round. This observation aligns with the findings of Amberber et al. (2014), Regassa (2016), and Tefera et al. (2019), all of whom emphasized the detrimental impacts of water shortages on small-scale agriculture. Additional limitations reported by participants included: restricted access to land, which limits the size of home gardens and the diversity of species that can be cultivated; outbreaks of pests and diseases, which reduce crop yields and jeopardize plant diversity, particularly near major roads; labor shortages, especially for households with fewer family members or those whose members are engaged in off-farm employment; and inadequate agricultural inputs, such as fertilizers and quality planting materials, which further limit the potential productivity and sustainability of home gardens.

Beyond their direct contributions to livelihoods, home gardens play a crucial role as buffers against climate variability and economic shocks. Their high species diversity enhances ecological resilience, enabling households to continue harvesting food and medicinal plants even when field crops fail due to drought, irregular rainfall, or pest infestations. Perennial and drought-resistant species in home gardens, such as *Rhamnus prinoides*, *Vernonia amygdalina*, and *Coffea arabica*, can support households during dry spells or times of limited market access. Furthermore, the capacity to consume or sell products from home ardens during financial difficulties offers a safety net that can lessen reliance on external assistance or debt. This buffering ability has been observed in similar situations by Keprate et al. (2024) and Tefera et al. (2019), who noted that diversified agroforestry systems enhance rural resilience to shocks by ensuring a continuous supply of resources.

4. Conclusions

Home gardens in the Bure district serve as essential ecological and economic agroecosystems that facilitate biodiversity conservation, ensure food security, generate income, and preserve indigenous knowledge. These systems, when managed sustainably over generations, bolster household resilience against climate-related and economic shocks by sustaining a diverse array of perennial and seasonal species. Women are pivotal in the processes of species selection, decision-making, and the transmission of knowledge. Nevertheless, home gardens encounter ongoing challenges such as water scarcity, pest infestations, limited agricultural inputs, and socio-economic disparities. It is imperative to address these challenges through targeted interventions to enhance the resilience, productivity, and equity of home garden agroecosystems in the area.

Based on the findings, the study proposes several recommendations aimed at improving the sustainability of home gardens and their role in rural livelihoods. Regional agricultural bureaus should acknowledge home gardens as productive agroecosystems, and agricultural extension workers ought to receive training in sustainable garden design, organic soil management, pest control, and agro-biodiversity conservation. Collaboration with NGOs focused on food security, women's empowerment, and climate resilience is also essential. Establishing community-managed seed banks and nurseries is recommended to preserve indigenous plant species and enhance access to quality planting materials. Policies should advocate for equitable access to land, agricultural inputs, and training opportunities for women. Future research should take into account seasonal and climate variability as well as the long-term impacts of home gardens under stress conditions.

Acknowledgement

We would like to express our deep gratitude to Debre Markos University for providing the essential resources required for this research. We also extend our heartfelt thanks to the home garden owners in the Bure district and the local community members who generously shared their time and invaluable perspectives. Additionally, we wish to acknowledge the support of the leaders of the kebele Development Agents across the five kebeles for their assistance throughout the initial field observations and the data collection process.

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