

The Role of Homegarden Agroforestry in Household Livelihoods at Yayo Coffee Forest Biosphere Reserve, Chora District, Southwestern Ethiopia

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Abstract

Traditional homegardens in southwest Ethiopia is well-known land use practices playing an important role in livelihood aspects. Thus, the objective of this study was to examine the contribution of homegardens towards of local people livelihoods. A household interview data collection method was used. A systematic random sampling method was used to select 139 households. Descriptive statistics, one way ANOVA were used for analysis. Homegarden agroforestry was more important for a food source, and contribute about 4079.70Birr annual income on average. This study suggests that homegardens contribute to the sustenance of the livelihoods of smallholder farmers in the study area.

Keywords: Yayo, Coffee Forest, Buffer Zone, Cash Crop, Food Security

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1. INTRODUCTION

1.1 Background and Justification

Agroforestry is a dynamic land use practices that maintain overall farm productivity by combining herbaceous food crops with woody perennial and livestock on the same piece of land. Homegardens are among agroforestry practices with the most complex and diverse agroecosystem that have been developed by numerous human cultures worldwide. They played an important role towards the development of early agriculture and domestication of crops. Homegardens often show a promising option for biodiversity conservation and mitigation of ecosystem degradation. In some cases, they were found to be equally effective as natural forests in the conservation of tree species diversity (Abdoellah *et al.*, 2006; Mohri *et al.*, 2013; Jhariya *et al.*, 2015).

Homegardens as an ecosystem contain multiple levels of diversity, including cultural, genetic and agronomic diversity. The high diversity of species in homegardens, which combines crops, trees and animals have different uses and production cycles is considered as an essential component of sustainable agriculture because of the wide socioeconomic and ecological roles it plays in these systems. Studies carried out in homegardens of various regions have recorded notable richness of species and varieties that provide an additional food supply and cash income for the people. They have been playing essential socioeconomic and ecological role due to the fact that it is related to the production of food and other products such as the source of firewood, fodder, medicinal plants, cash crops, and ornamentals (Das and Das 2005; Bharucha and Pretty, 2010; Olango *et al.*, 2014).

In relation to conservation of biodiversity, Galluzzi *et al.* (2010), describes that homegardens are taken as key places for conserving plant biodiversity. It is exhibited that homegardens are serving as refugees camp for a number of plants species especially for those plant species that are not widely grown in the larger agroecosystem. They are microenvironments containing high levels of species and genetic diversity which serves not only as sources of food, fodder, fuel, medicines, spices, construction materials and income in many countries around the world, but are also important for *in-situ* conservation of a wide range of plant genetic resources. However, homegardens structure, composition, and species and cultivar diversity are influenced by changes in the socioeconomic circumstances and cultural values of the households that maintain these gardens (Emmett and Nye, 2017).

Integrating multipurpose trees with food crops and livestock in homegardens in the intimate association is an ancient activity in Ethiopia (Anjulo and Mezgebu, 2016). According to Berhanu and Asfaw (2014), Ethiopian homegardens as an ecosystem encompass multiple levels of diversity, including cultural, genetic and agronomic diversity. About 539 species belonging to 352 genera and 109 families were recorded in Ethiopian homegardens which make up nearly 9% of the Ethiopian higher flora, were reported. Conversely, the recent transition of the homegardens into commercial production of new cash crops, including khat (*Catha edulis*) is a farming strategy undertaken by smallholders to address demographic, market and socioeconomic changes in the country. The changing socioeconomic conditions and advent of commercial forces have introduced the concept of cash with homegardens (Bargali *et al.*, 2015; Gebrehiwot *et al.*, 2016).

On the other hand, the ongoing land fragmentation and the declining farm size in rural Ethiopia have limited the livelihood choices and opportunities of most smallholder farmers. The expansion of cultivated area is

likely to require further infrastructure development that would result in further negative environmental implications with huge loss of biological diversity. In order to adapt to such socioeconomic changes, subsistence-oriented agroforestry homegardens are increasingly becoming more commercially oriented. This ongoing land use change has been carried out at the expense of diversity and stability of the long-existing farming practices important for sustainable livelihoods and food security (Gole *et al.*, 2009; Seyoum *et al.*, 2012; Mohri *et al.*, 2013; Gebrehiwot *et al.*, 2016).

In addition, reduction of forest resources and increasing demand for its products especially in areas where people rely on natural resources for their livelihood needs are common. Finding alternative options to this widened gap between the demand and supply of forest products for local livelihood sustenance coupled with the natural resources conservation goal attainment is a fundamental concern. Homegarden seems to have the potential to provide options for sustained rural livelihoods and biodiversity conservation. It integrates protected areas with the surrounding landscapes and mediates the livelihood need of people within the conservation goal of the protected area. Thus it provides a potential to reduce land-use pressure and improve rural livelihoods in human-dominated landscapes and at the same time conserving a large proportion of biodiversity (Jose, 2012).

Although extensive areas of traditional agroforestry homegarden exist in southwestern Ethiopia, the locals' priorities to satisfy the immediate needs for food and cash under socioeconomic changes are being carried out at the expense of the diversity and stability of existing land use systems in the area (Abebe, 2005; Abebe *et al.*, 2010). According to Kassa *et al.* (2012), the conversion of natural forest to monoculture in the area results in significant impacts on biodiversity richness of homegarden.

Moreover, following the nomination of Yayo Coffee Forest Biosphere Reserve (YCFBR), as a site for biodiversity conservation in southwestern Ethiopia (Gole *et al.*, 2009), the local people dependency on homegarden as an alternative option is increasing. However, less emphasis is given towards assessing existing plant diversity in homegarden, particularly in Chora district. The homegardens potential for conservation of biological diversity and economic returns are not fully studied. Thus, there is no inventoried documentation about structure, composition and plant diversity for the district.

According to Agbogidi and Adolor (2014), to determine how homegardens can best contribute to conservation, it is necessary to understand what diversity is being maintained by farmers. Hence, in order to strengthen and make the existing practice effective for plant diversity conservation and thereby to meet the homegarden products for locals need, scientific information is required. The study has a vital role for natural resources conservation and local people livelihood sustenance; it documents the role of homegarden towards of plant biodiversity conservation by describing floristic richness and diversity of the practice. It also describes their role to communities' livelihood, food security and income generation at the household level.

1.2 Objective of the Study

To investigate homegardens role to households livelihood

1.3 Research Questions

The study was aimed to address the following research question:

What is the role of homegarden to the households' livelihood in the study area?

2. REVIEW OF LITERATURES

2.1 Homegarden Agroforestry

Homegarden refers to the deliberate management of multipurpose trees and shrubs (the woody component) grown in intimate association with herbaceous species (mainly annual, perennial, and seasonal agricultural crops) and invariably livestock within the compounds of individual houses the whole crop-tree-animal unit being intensively managed by family labor). It is an integrated system which comprises different things in its small area that produces a variety of foods and agricultural products including staple crops, vegetables, fruits, medicinal plants and so on (Panwar and Kaushal, 2017).

Homegarden agroforestry is an age-old and time-tested land use approach that makes the best use of nature's goods and services. These homegardens are evolved either through growing food crops in the forests or establishing tree crop production systems on arable lands. Furthermore, the homegarden agroforestry reflects the wisdom of the traditional culture and ecological knowledge of the local community. Most of the homegardens form a rich biodiversity source having several types of diversity, including cultural, genetic and agro-economic diversity (Lambin and Meyfroidt, 2011).

Homegardens are intensively cultivated agroforestry systems managed within the compounds of individual homes having diversity on the basis of local conditions. They comprise of a wide variety of productive trees, shrubs, vegetables, medicinal plants, herbs, fodder, and sometimes even staples and provide both economic and social benefits that are essential to the nutritional welfare and security of the household. These gardens, with their diversified agricultural crops and trees, fulfill the basic needs of the local population. Growing and

maintaining plant species in the vicinity of home and making their products by household members were primarily intended for the family consumption. They are one of the best known traditional practices for livelihood, and sustainable development (Kittur and Bargali, 2013; Bargali *et al.*, 2015; Parihaar *et al.*, 2015).

Homegarden is a sustainable multiple-production system whose outputs can be adjusted to local needs. While the multistoried arrangement and high species diversity of the homegardens help to reduce environmental deterioration commonly associated with monocultural production systems. Moreover, it can be regarded as an informal plant introduction and distribution centers. Homegardens are commonly defined as a piece of land with a definite boundary surrounding a homestead, being cultivated with a diverse mixture of perennial and annual plant species, arranged in a multilayered vertical structure, often in combination with raising livestock, and managed mainly by household members for subsistence production (Kebede, 2010).

Homegardens appeared to have developed in the Indian subcontinent, Indonesia, Philippines, Malaysia, Sri Lanka and other parts of Southeast Asia, the tropical Pacific island, the Caribbean and various parts of tropical Latin America and Africa and can be found in almost all tropical-subtropical ecozones where subsistence land use systems predominate. The presence of homegardens in the highlands of Ethiopia (eastern Sidama highlands, enset, and cereals around Amhara settlements) similar to other tropical nations and they collectively house a large diversity of plant types that range from staple food crops to ornamental plants (Nayar, 2010; Jaganmohan *et al.*, 2012; Haile, 2017).

2.1.1. Structure and composition of homegardens

Lope-Alzina and Howard (2012), report that tropical homegardens consist of an assemblage of plants which may include trees, Shrubs, vines and herbaceous plants growing in or adjacent to a homestead or home compound. Okafor and Fernandes reported that in this system, multipurpose trees and Shrubs in a multistory association with agricultural crops are raised with livestock in the homestead. In agroforestry, it implies the intimate association of multipurpose trees and Shrubs with annuals and perennial crops and invariably livestock within the compound of individuals with the whole crop-tree-animal- the unit being managed by family labor.

Bijalwan (2012), also studied structure, composition, and diversity of fruit trees and shrub species in mid hill situation of Garhwal Himalaya (between 1000 to 2000 m asl), India, covering winter and summer season. This was also an aspect based study included the northern and southern aspects of the study area. A total of 12 fruit tree species (4 trees were common in northern and southern aspect and 6 trees were only noticed in northern aspect while 2 in the southern) were recorded in an agri-horticulture system with apple tree (*Malus domestica*) was a dominant fruit tree in both the aspects. A remarkable high agricultural crop diversity was also from the northern aspect in both the seasons.

Almost all homegardens have the most visible characteristics such as layered canopy and harmonious admixture of species, and specific place and functions but the main difference are seen in homegarden size, shape, and intensity of cultivation, the types of crops grown and complexity of species diversity. In general terms, all homegardens consist of three main layers, of this herbaceous layer near the ground, a tree layer at upper levels, and intermediate layers in between. The lower layer can usually be partitioned into two, with the lowermost (less than 1m height) dominated by different vegetable and medicinal plants, and the second layer (1 - 3 m height) being composed of food plants such as cassava, banana, yam, and so on (Ajah, 2013; Sinku, 2016).

Zaman *et al.* (2010), conducted a study to assess the composition, structure, diversity of plant species and contribution of homegarden to household food security, conservation of plant species, socio-economic importance and the constraints of the total production system in Thakurgaon district of Northern Bangladesh. They stated that the homegarden size in average in the study area increased with the size of total land holding and total income was found higher in large farm category than that of marginal. They also recorded 37 useful plant species and mentioned the diversity and abundance of fruit tree species were higher in all farm categories followed by timber and fuelwood species. Mango and jackfruit were identified as an important cash-growing crop in the study area. Tree management practices and the scopes were very common but the farmer faced many problems during tree plantation including the animal and insect problems.

The compositions of crops grown in homegardens can be grouped based on function as ornamental, fruits, food crops, vegetables, medicinal, spices and fodder, building materials and fuelwoods. The patterns and compositions of homegardens are disordered due to the educational level of gardener, the indigenous knowledge of farmer, the market and the size of land availability. Thus, several patterns of homegarden have no particular patterns also sociocultural, environmental and ecological factors determine species composition and types of homegardens. Plant compositions in Ethiopian homegardens are grouped under the three main types of garden crops, live fence species, useful wild and semi-wild plants (Asfaw; 2001; Acheampong *et al.*, 2012).

Depending on the cultural factors, the size, shape and plant diversity of homegardens also vary across the globe. Homegardens in Ethiopia have variable shapes: some almost encircle the house others square, rectangle or irregular. Patterning of the crop also varies from place to place. For instance, the plants like bamboos are on the outer margins, some are planted inside margin next to the fence, chat, coffee, and enset are planted in the depressions of rows, others like perennial planted far apart with water collection depressions. Gardens usually

have boundaries from home of other homegardens by fences; dry woody material, stones, and live plants (thorny shrubs) and sometime bounded by natural barriers like rivers, gorges (Tshiguvho, 2008; Goddard *et al.*, 2010).

2.1.2. Identification feature of homegardens

According to Calvet *et al.* (2016), homegardens are identified by five characteristics. First; the garden is located near the residence. Second, the garden contains a high diversity of plants. To these criteria, some add that the garden recycles nutrients in a sustainable manner that plants are planted densely, and that plants are layered to mimic natural forest. Third, garden production is additional rather than a main source of family consumption or income. Fourth, the garden occupies a “small” area. A fifth distinguishing characteristic of homegardens that offered by is that homegardens are a production system that the poor can easily enter at some level since it may be done with practically no economic resources, using locally available planting materials, natural manures and indigenous methods of pest control.

In the tropics, two types of homegardens are recognized based on their contribution to the benefits of households. The first types are small-scale supplementary food production systems around the house in areas where the subsistence of the owners is based on their land use. The Java monoculture rice production and homegardens in Latin America belong to this category. The second types of homegardens stretched from fields around the house that constitute the most important means of the livelihood for farming households. Most of the homegardens in the highlands of eastern Africa belong to this type. It is also a place for experiments and even fundamental research and the groundbreaking genetic research. Homegardens are also subdivided into two basic types as city or urban, and the Kebele or rural homegardens (Barthel and Isendahl, 2013; Kitanyi, 2013).

2.2 The Concepts of Livelihood

A livelihood comprises the capabilities, assets (including both material and social resources) and activities required for a means of living (Table 1). It is the set of capability, assets, and activities that furnish the means for people to meet their basic needs and support their well-being. Livelihood is not simple phenomena for local people rather it is connected with the environment, economic, political and cultural processes to wider regional, national and global area. A livelihood is sustainable when it can cope with and recover from stress and shocks and maintain or enhance its capabilities and assets both now and in the future, while not undermining the natural resource base (Chambers and Conway, 1992; Schumacher, 2011).

The concept of livelihood is increasingly becoming central in the debate of rural development, poverty reduction, and natural resources management. Livelihood analysis has gone beyond the narrow definition and approach to poverty reduction. It had been narrow because it was focused on a certain aspect or implication of poverty such as low income and did not consider another vital aspect like shock and social factors. It is well recognized, that factors and conditions which constrain or enhance people ability to make a living needs emphasis around social, economic, and environmental aspects. In this regard, a livelihood concept is comprehensive and central. The livelihood framework helps in the analysis of a particular context (policy, history, agro-ecology, and socioeconomic situations), a mix of livelihood resources (capitals) result in the ability to follow what combination of livelihood strategies with what outcome. A livelihood is sustainable according to Ian Scoones ‘when it can cope up with and recover from stress and shocks maintain or enhance its capabilities and assets, while not undermining the natural resource base (Scoones, 1998) ‘

The objective of achieving sustainable livelihoods for everyone provides a focus for anticipating the 21st century through implications of policies and interventions that enhance capabilities, equity, and increase social sustainability for improving the livelihoods of the poor. Providing access to resource-based opportunities should be the minimum of state-provided social services and livelihood security of pro-poor intervention (Chambers and Conway, 1991).

Table 1: Assets or capitals of sustainable livelihoods

No.	Asset	Description
1	Natural assets	Represent natural resources such as land, water and wider environmental goods that are critical for the rural livelihoods;
2	Social assets	Refer to the institutions, relationships, and norms that shape the quality and quantity of social interaction;
3	Economic/financial assets	Denotes the financial resources that people use to achieve their livelihood objectives: incomes, profits, savings, and credits;
4	Human assets	Representing the skills, knowledge, experience, ability to work and good health that together enable people to pursue their livelihood strategies; and
5	Physical assets	Denotes asset Such as transport, shelter, road, market, adequate drainage facilities, electricity and telecommunications

Source: Adopted from (Morse *et al.*, 2009; Kaushal and Kala 2014).

2.3. Socioeconomic aspects of owners of homegarden

Mercer and Miller (1998), conducted a quantitative and qualitative analysis of published socioeconomic research papers and a survey of agroforestry socioeconomic researchers are used to evaluate the achievements over the past 14 years. Their study focused on the major advances, gaps in knowledge, and constraints for closing those knowledge gaps etc. They observed that both the scope and the quality of socioeconomic research are slowly improving. They suggested the priority areas for future research include theoretical and empirical analyses of agroforestry adoption decisions, improved economic analyses, and policy studies at local, national, and regional levels.

Kabir and Webb (2009), examined whether a household's socio-economic attributes had a quantitative and predictable relationship with homegardens. They analyzed the floral structure of randomly selected 402 homesteads of Southwestern Bangladesh. They reveal the importance of homegardens in job creation and women empowerment. Active participation of women in homegardening reduced gender inequalities in the family. However, increasing population density and the concomitant fragmentation of landholdings to homesteads may create an opportunity for homegarden promotion in Bangladesh.

John and Nair (1999), examined the socio-economic factors and constraints that affect farming in 400 homegardens of Southern Kerala, India. They found that the cattle (17.5%) and poultry (30.25%) raising as an important complementary enterprise. An average of 14-15 species and 397 plants per homestead was observed. These include coconut, rubber, spices, vegetable, timber, tuber crops, fruits, fuel trees, and fodder. Cultivation cost, labor availability, credit availability and technical information availability, availability of manures and fertilizers, availability of plant protection chemicals, marketing facilities, and storage facilities were considered as major constraints in the homegarden.

Puri and Nair (2004), evaluated benefits of various tangible and intangible benefits (social, cultural and economic benefits) of agroforestry but they didn't mention about the socioeconomic elements and their significance in the determination of success and failure of agroforestry. But some success tales such as wasteland reclamation and poplar-based agroforestry have shown that the technologies are widely adopted when their scientific principles are understood and socio-economic benefits are convincing.

2.4. Homegarden Contribution to households

Agroforestry homegardens plays a vital role in contributing to peoples livelihoods. Maroyi (2009) and Acheampong et al. (2011), reported that Agroforestry homegardens improve the family's nutritional status, health, and food security. Agroforestry homegardens, therefore, is part of a household livelihood strategy and has gained prominence as a natural asset through which sustainable use of resources, particularly for the livelihoods of the poor, may be achieved. Homestead gardening and Agroforestry systems provide an important contribution to sustainable agricultural production because of their potential to meet economic, social, ecological, and institutional conditions for sustainable livelihoods (Nair, 2006).

Homegarden plays an important role in sustainable livelihood needs of the household members. Brownrigg (1985), reported that in many parts of the world homegarden systems provide supplementary food, fuel, fodder and serve as a recovery area for the people such as homegardens in northeastern Brazil contributed to the sustainable use of natural resources by reducing pressure on the native vegetation ((Trinh *et al.*, 2003; Albuquerque *et al.*, 2005).

Tesfaye (2013) reported that supporting the potential of population densities of over 500 persons/ km² in the areas of southern Ethiopia and the rich species diversity shows its importance for simultaneous and combined biodiversity conservation, livelihood, and food security. Thus, agroforestry homegardens are used to produce all livelihood assets that generate and deliver multiple benefits for the livelihood of the rural people. Agricultural land as a natural asset is the primary means of enhancing and improving livelihoods for the overwhelming majority of the rural population.

2.4.1. Contribution of homegardens to household food security

Tynsong and Tiwari (2010), stated that the homegardens contribute a great deal to food supply especially for the people living in the rural areas because of the high production and diversity of cultivated edible species. Although the extent of household dependency on homegardens varies considerably, its contribution is quite significant towards the livelihood of the people because of low investment and easy accessibility. Homegardens function as ex-situ as well as in-situ conservation plots for plant genetic resources of the region. In the villages studied, 103 wild plant species were recorded from the homegardens which showed that homegardens are also a home to many wild plant species, thus they serve as a repository of wild plants.

In most tropical agroforestry homegardens, food production is the first function and role. One major aspect of the significant role of food production in homegardens is to hold up continuous production throughout the year (Kebebew *et al.*, 2011), reported that in Southern Ethiopia 88.8% of the surveyed households were food secured throughout the year. Homegardens also can solve the problem of land scarcity by using a small land the households have by integrating various components in the same piece of land hence food security and income

generation (Abebe, 2005).

The combination of crops with different production cycles and rhythms results in a relatively uninterrupted supply of food products. Depending upon the climate and other environmental characteristics, there may be peak and slack seasons for harvesting the various products, but generally, there is something to harvest daily from most homegardens. Additionally, these harvesting and maintenance operations require only a relatively small amount of labor from the members of the family. Hence homegardens are among the best solutions for household food security and income generation to smallholder farmers due to their diversity. This is especially in all areas of the tropics under pressure from increasing populations and unsystematic deforestation (Nair and Kumar, 2004; Kebebew *et al.*, 2011; Lulandala, 2011).

2.4.2. Homegardens to income generation

Homegardens can contribute to household income in several ways. Income from homegardens comes from selling cereal crops, fruits, vegetables, and other cash crops (e.g., lime, rambutan, jackfruits, durian, cloves, and coffee) to local brokers or merchants. In many cases, sales of products produced in homegardens significantly improve the family's financial status. In Indonesia and Nicaragua homegardens contributed 21.1% and 35% of their total income respectively. In South-West Bangladesh and North Eastern Bangladesh, an average of 15.9% and 11.8% of household income is derived from homegardens respectively. Hence generally, homegardens play a great role in income generation as compared with other sources as it uses multiple components that produce diverse products (Motiur *et al.*, 2006; Tynsong and Tiwari, 2010).

2.5 The Biosphere Reserve Concept

Biosphere Reserves (BRs) are "areas of terrestrial and coastal/marine ecosystems or a combination, which are internationally recognized within the framework of UNESCO's programme on MaB". The BR concept, as the pillar of MaB conservation work, was developed in 1974 to encourage the establishment of protected areas and also to address the need to balance conservation of biological and cultural diversity with economic and social development. UNESCO BRs are currently served as "living laboratories for sustainable development" and are "the only sites under the United Nations system that calls for conservation and sustainable development to proceed along mutually supportive paths" (UNESCO 2010; Coetzer *et al.* 2013).

The biosphere reserve is a unique kind of protected area registered by UNESCO BRs with three main functions that are interdependent and equally important: Conservation of genetic resources, species and ecosystems, scientific research and monitoring; and promoting sustainable development (Jerneck and Olsson, 2013). UNESCO BRs have three clearly defined zonations; (Core area, buffer zone, and transition zone). The "core area" is strictly protected in a legal sense. It is typically small in comparison to entire biosphere reserve; of all human activity typically only research is allowed there. The 'buffer' zone surrounds the core area, with some restrictions as well human activity in this area should be compatible with conservation goals. In the transition area, the focus is not restrictions, but the promotion of sustainable practices (Beery *et al.*, 2015).

YCFBR is one of the Ethiopian BRs that have been registered as UNESCO Man and Biosphere (MaB) reserves in June 2010. Parts of the YCFBR were declared a National Forest Priority Area and gene reserve in 1998, and the whole zone was declared a United Nations Educational, Scientific and Cultural Organization (UNESCO) biosphere reserve in 2010. It is one of the biodiversity hotspots in Ethiopia. The YCFBR covers 167,021 ha, with the most important landscapes being forest, agricultural land, wetland, and grazing land (Table 2).

Yayo forests belong to the eastern Afromontane type and identified as one of the 34 biodiversity hotspot areas in the world by Conservation International. YCFBR is one of the habitats for a diversity of *Coffea arabica* and hence is important for *in-situ* conservation of the genetic diversity of the natural coffee. Coffee alone contributes around 70% of households' income in the area (Gole *et al.*, 2009; Woldegeorgis and Wube, 2012; ECFE, 2016).

Table 2: Areas of Yayo Coffee Biosphere Reserve

YCFBR	Total Area (ha)	Biosphere Zones	Area (ha)	Area (%)
	167,021	Transitional	117,736	70.5
		Buffer zone	21,552	12.9
		Core zone	27,733	16.6

Source: Adopted from ECFE (Environment and Coffee Forest Forum, 2017).

3. MATERIALS AND METHOD

3.1 Description of the Study Area

3.1.1. Yayo coffee biosphere reserve (YCFBR)

The study area YCFBR is located in the Oromiya state, south-western Ethiopia, between 8°10'-8°39' N and 35°30'-36°4' E. The area was registered in 2011 by the UNESCO as the 'Yayo Coffee Forest Biosphere

Reserve' for the *in-situ* conservation of wild *Coffea arabica*. It covers about 167,021ha split into six *woreda*1, namely Algae Sachi, Bilo-Nopa, Chora, Doreni, Hurumu, and Yayo (Gole *et al.*, 2009). The area has a rolling topography where altitudes range from 1140 to 2562 m a.s.l., and is crossed by three major rivers, i.e., Geba, Dogi and Sese. The climate is hot and humid, and the mean annual temperature is around 20 °C oscillating between the average extremes of 12 °C and 29 °C. The area exhibits a uni-modal rainfall pattern with mean annual precipitation of 2100 mm, with high disparity from year to year, and ranging from 1400to 3000 mm (Gole *et al.*, 2008). Dominant soil groups include nitosols, acrisols, vertisols, and cambisols (Senbeta *et al.*, 2005).The reserve is managed in zones, so that smallholder farmers can still use forest resources sustainably. The core zone encompasses 27,733 ha of undisturbed natural forest; the buffer zone 21,552 ha of mostly semi-coffee forest, where restricted use of forest resources is allowed (Schmitt *et al.*, 2010). The research was conducted in the YCFBR areas (specifically in Hawayember, Sololo and Uta None kebeles of Chora district (Figure 1).

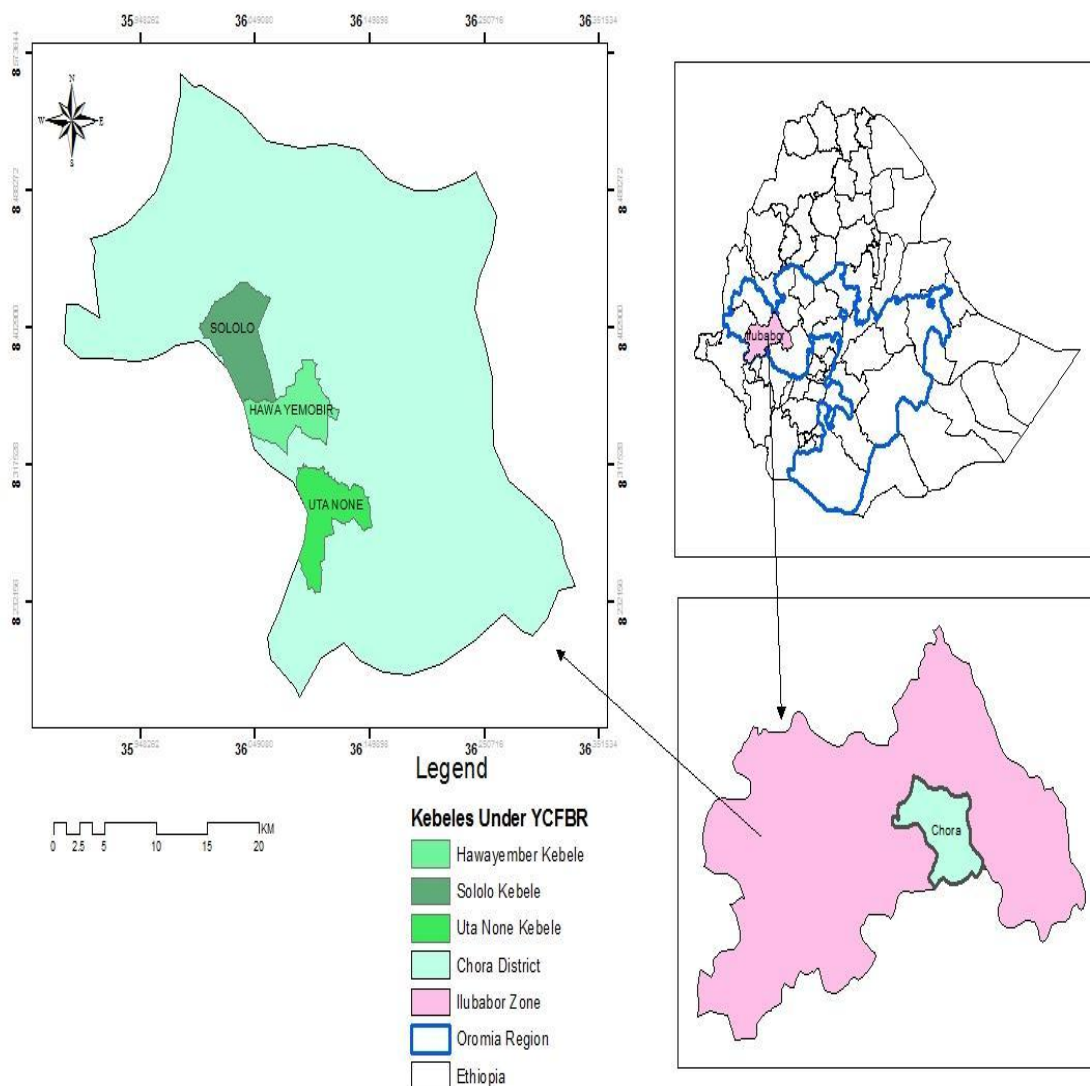


Figure 1 : Map of the study area

3.1.1.1. Population

In 2007, around 310,000 people lived in the six *woreda* (CSA, 2007). The Oromo ethnic group predominates and is considered indigenous. There are a significant number of Amhara, Tigreway and Kembata as they migrated from other parts of the country due to the government's forced resettlement program of 1984 (Kassa *et al.*, 2009). Orthodox christian, muslim, protestant and indigenous beliefs are evenly practiced (Tulu, 2010). Currently, the population of Yayo is booming due to the high birth rate, and the intense internal migration due mainly to the thriving infrastructural development (Tadesse, 2015), such as the construction of fertilizer and coal factories, a network of roads planned to ease the trade of coffee, and the forthcoming hydroelectric dam on the Geba River (Bacha, 2014).

3.1.1.2. Land use systems

The major land-use types are forest, agricultural land, wetland, and grazing land (Figure 2). Forests cover most of the area, and consist of four major variations, namely undisturbed natural forest, semi-forest coffee systems, fully managed forest for coffee production, and old secondary forests (Gole *et al.*, 2009).

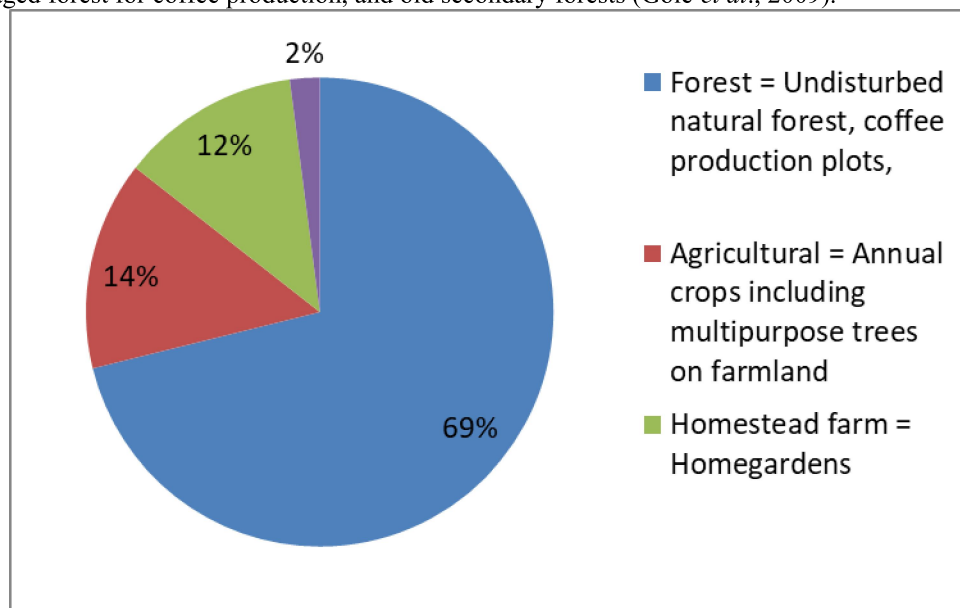


Figure 2: Major land-use type in YCFBR area (%) adapted from Assefa, (2010)

3.1.1.3. Transitional zone of YCFBR and households livelihood

The transition area is found adjacent to the buffer zone and it is composed of agricultural land, wetland, grassland, settlement area and fragments of forest land and covers area of 117,736 ha. It is the place of residence for all the human population in the biosphere reserve, the development organizations and local institutions. Around 154,300 permanent residents live in the transition areas of the Biosphere, including urban and rural settlements of whom the majority depend on agriculture for their livelihoods. Most income for the livelihood of the population of the area comes from the transition area (UNESCO 2010; Teketay *et al.*, 2010).

The main livelihood source of the Yayo households is coffee-based agriculture, which employs over 90% of the active labour of the area (Assefa, 2010). Most coffee plots are small, however it is estimated that more than 60% of the population depends on coffee production and coffee-related activities, such as collection, processing and marketing (Gole, 2003; Ilfata, 2008). Besides coffee and the other cash crop khat, smallholders produce annual crops, such as *Zea mays*, sorghum (*Sorghumbicolor*), *teff* (*Eragrostis teff*), and other cereals and pulses.

Farmers in the transitional zone own and cultivate land and are free to use it as they like. Many of them also own patches of private coffee forest in the transitional zone and have been assigned patches in the buffer zone. The agricultural landscape of the transition zone includes some of the semi-forest coffee production areas, garden coffee, small coffee plantations, cropland, and grazing land. Even though the area has abundant resources, which can support the local livelihood and the quality of important products like coffee, honey and spices, it has a large potential for improvement, mainly due to lack of improved production and processing technologies. The transition part of YCFBR has a lot of spices and herbs flora; among Korarima (*Aframomum korarima*) spice ranks first and other spices such as chilies, ginger, turmeric, coriander, etc. are grown widely (Etissa *et al.*, 2016).

The agricultural landscape of smallholder surrounding the forest area is also important for the conservation of cultivated many horticultural crop landraces. The smallholder farmers in the this area grow cereals, legumes, coffee, vegetables, fruits, root and tubers, spices and herbs and other crops together either as sole crop or in a combinations others in the homegardens with the shade trees (Tadesse *et al.*, 2009) as cited in (Etissa *et al.*, 2016).

YCFBR area is forest environment, its arabica species, and makes a meaningful contribution to the livelihoods of hundreds of smallholder farmers (Bharucha and Pretty, 2010). Also, according to Kuria *et al.* (2016), the farmers cultivate diverse crops in YCFBR areas. They do not solely rely on one cereal but many households cultivate a mix of two to four different staple items such as maize, sorghum, millet, wheat, barley and *teff* (*Eragrostis teff*).

In addition they grow different pulses (*beans, peas, and chickpeas*), root and tuber crops (potato, sweet potato, beetroot, carrot, anchote and enset (*Ensete venricosum*), vegetables (*hot/green pepper, tomato, pumpkin, Ethiopian kale, cabbage, Tarro, Abrango, onion and garlic*), fruits (*avocado, banana, mango, papaya, orange, lemon, and jackfruit*) and a variety of spices (*ginger, Ethiopian cardamom (Aframomum corrorima), and*

turmeric. The most important cash crops in the area are coffee and khat (*Catha edulis*); sugarcane and eucalyptus tree are also cultivated in the study area. Livestock and their products are also common commodities produced in the area. The main livestock includes: cows (milk production), bulls, sheep and goats, poultry and apiculture. Maize and coffee are the dominant commodities produced with the aim of consumption and market, respectively.

3.1.1.3.1 Homegardens in YCFBR

The traditional agroforestry systems in YCFBR in south-western Ethiopia are among the most widespread and best performing agroforestry practices, and support the livelihoods of the local population while maintaining environmental integrity (Assesfa, 2010; Sentra *et al.*, 2013). Homegardens of transitional zone of YCFBR encompass a mix of useful plants including staple crops like *Ensete ventricosum* and *Zea mays*, tuber and root crops, e.g., *anchote (Coccinia abyssinica)*, taro (*Colocasia antiquorum*), potato (*Solanum tuberosum*) and sweet potato (*Ipomoea batatas*), leafy and other vegetables, e.g., kale (*Brassica oleracea*) and hot pepper (*Capsicum frutescens*); exotic fruits, e.g., papaya (*Carica papaya*), mango (*Mangifera indica*) and avocado (*Persea americana*), and some pulse crops, e.g., haricot bean (*Phaseolus vulgaris*) and lima bean (*Phaseolus lunatus*) (Etissa *et al.*, 2016; Jemal *et al.*, 2018).

Species found in homegardens do not show a pre-determined spatial arrangement, with the exception of small plantations of *Catha edulis*. Rather, the location of individual plants and cohorts is random and conveniently determined by the farmer's needs. For instance, spices are planted close to the homestead, or shade-loving crops under fruit trees. In addition, species density is also variable depending on the household and market demand, and generally tends to increase based on the farmer's aim to introduce and test potential useful species gathered elsewhere (Jemal *et al.*, 2018).

3.2 Methods

3.2.1. Study site selection

The study sites (Kebeles, the smallest administrative unit in Ethiopia) and the district was selected purposefully. Three Kebeles (Hawayember, Sololo and Uta None) were selected for this study. The selection was based on their inclusion in YCFBR, and widespread practice of homegarden for the objective stated.

3.2.2. Sample size and sampling techniques

The sample size was determined using the method proposed by Yamane (1967).

$$n = \frac{N}{1 + N(e^2)} \dots \dots \dots 3(1)$$

Where n is the sample size, N is the population size, and e is the desired level of precision.

$$n = 865 / 1 + 865(0.14)^2 = \approx 48 \text{ Hawayember Kebele}$$

$$n = 381 / 1 + 381(0.14)^2 = \approx 45; \text{ Sololo Kebele}$$

$$N = 447 / 1 + 447(0.14)^2 = \approx 46; \text{ Sololo Kebele}$$

Accordingly, a total of 139 households were determined and selected by systematic random sampling method from 1693 households list (of the three Kebeles) for an interview (Table 3 and Figure 3). The resulting sampling distribution of the study site by Kebeles is shown as in Table 4 below.

Table 3: Total population and sample used for the study

Kebele	Total number of Households			Sample size per Kebele		
	Male	Female	Total	Random Interval	Random Start	Sample Taken
						Male Female Total
Hawayember	807	58	865	18	13	43 5 48
Sololo	333	48	381	8	2	44 1 45
Uta None	445	22	447	10	7	44 2 46
	1585	128	1693			131 8 139

HG=Homegerden

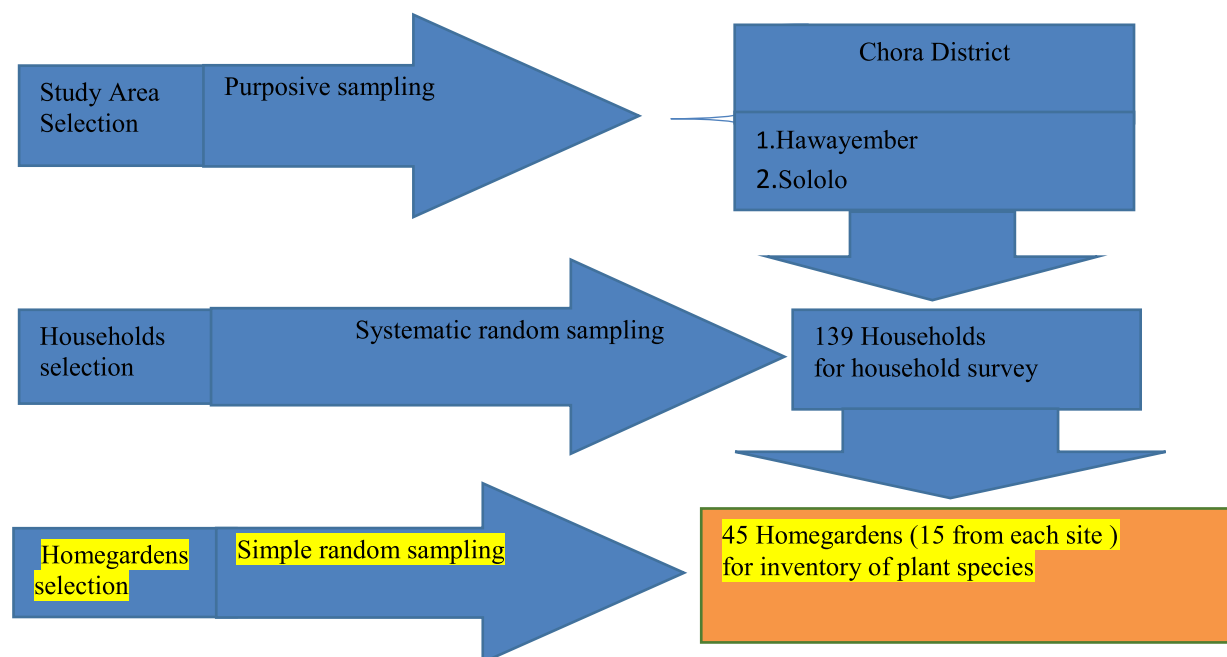


Figure 3: Schematic diagram of a sampling

3.2.3. Data collection methods

3.2.3.1. Household survey

Primary data were collected from the sample rural households using a semi-structured and structured questionnaire administered during October to December 2017. Prior to the actual administration of the general survey, the questionnaire was pre-tested, modified and refined. Data on homegarden contribution, with households demographic and socioeconomic (i.e. Age, family size, annual income, level of education, etc) were collected (Appendix 1-4). Household heads were interviewed to list their livelihood sources, products and their prices at the farm gate and/ or local market at the time of selling to determine both total incomes and that obtained from homegarden components (Appendix 1 and 4).

Note: The income determination in this study was based on the one year (2016/2017) yield and its prices estimation including both products consumed at home and sold in the market for income generation (i.e. those products around homestead were termed as homegardens and outside homestead as other sources) (Appendix 1 and 4).

In addition to the household survey, focus group discussions (FGDs) and key informant interviews (Table 4) and field observation were undertaken. These methods were used to confirm the information given by an individual farmer and to catch important issues that were not raised by respondent farmers. Questions were asked in a structured conversational format (Appendix 5 and Appendix 6); allowing us to gather consistent data across gardens, while also learning about qualitative aspects of homegardens through farmers' perspectives and insights (Coomes and Ban, 2004). Secondary data were also collected from published and unpublished sources including information on the study area.

Table 4: Summary and descriptions of instruments

No	Types of instruments	Target group	Number of target group representations	Types of sampling
1	Household survey	Selected household heads	139	Systematic random sampling
2	Key informants	Community leaders and experts, model farmers and members of the biosphere reserve management unit	15	Purposive sampling
3	FGD	Local community members	41	Purposive sampling

3.2.4. Data Analysis

Descriptive analysis through (percentage, frequency, mean, range, and standard deviation) and one way ANOVA were applied using IBM statistical package for social science SPSS version 20.0.

4. RESULTS AND DISCUSSION

4.1 Households characteristics

The average age of the respondents was 42.9 with a standard deviation of 7.23. The family size of the sampled households on average was six. The largest frequency in family size is seven family members per household, which was 27.8% of the sample households. The sampled household education level in the study area ranges from illiterate to complete secondary school. The total land size of each household mostly consists of the cropland, coffee plantation, and homegardens. The average farmland size was 1.6 hectare with the range of 0.5 to 3.5 hectare whereas about 56.5% of the households have farmland ranging from 1.5 to 2 hectare. Regarding the households annual income, the average household annual income is 31848.48 Birr. The size of homegarden in the study area ranges between 0.02 to 0.27 hectare, with the average of 0.14 hectare (Table 12), which is less than the mean homegarden size (0.185) reported by Linger (2014), for homegarden around Jabithenan District, Northwestern Ethiopia. About 29.3% homegarden area was 0.18 hectare, while about 85.8% was less than 0.2 hectare.

Table 12: Characteristics of sampled households, (n = 139)

Household characteristics	Measuring system	Observed range	Mean	SD
Age	Year	28-67	42.91	7.23
Total land size	Hectare	0.5-3.5	1.60	0.67
Homegarden land size	Hectare	0.02-0.27	0.14	0.07
Education	Year	0-10	3.5	2.78
Family size	Numbers	3-17	6.2	1.86
Annual income	Thousand	10-65	31535.96	10017.49

SD=Standard deviation

Source: Own data, Chora district, 2017,

4.1.1. Major benefits of homegarden for households

About 86.5% of the respondents agreed that homegarden provides high food products for their family. Whereas about 21.8% of the respondents agreed that homegarden used for high income generating and 47.4% of the respondents said that homegarden had a medium potential for income generating (Figure 4). These perceptions of the gardeners could probably imply that food crops in homegardens of the study area had a significant role to enhance nutritional and income status of the local people. Thus, along with the ecological benefits, homegardens provide potential food security to the householder. This result is agreed with Jemal *et al.* (2018), stating that homegarden, multistorey-coffee-system is mainly used to generate money and, for the majority of households, is the main, if not the only, source of cash. Most farmers use multipurpose-trees-on-farmlands to produce food, and homegarden is used for both a source of food and cash to supplement the other two practices. This result is agreed with Regassa (2016), reported that about 75% of the home gardeners explained that they conserve useful plant species for foods, around Hawassa, Ethiopia. Again, the result is also supported with the Mengistu and Fitamo (2016), in which they reported that diverse mixture of crops that are harvested at different times, and constant supply of food in a different form is available from homegardens.

The discussion held during the focus group discussion also supported that homegarden agroforestry used for a long period of food sustenance during the time of food shortage. They revealed that the canopy of the tree used as shade during high sunlight and warm weather. Although there is a shortage of land for homegarden, households get diverse products from such land as they cultivate it intensively. In general members of the group discussion household head respondents were agreed that homegarden practice contributes a lot and provide multiple benefits from a small unit of land (Figure 5). This result is in agreement with findings of Kassa *et al.* (2015), stated that the agroforestry practices contribute to the conservation of biodiversity, while providing multiple products and services, in Yem district southern Ethiopia.

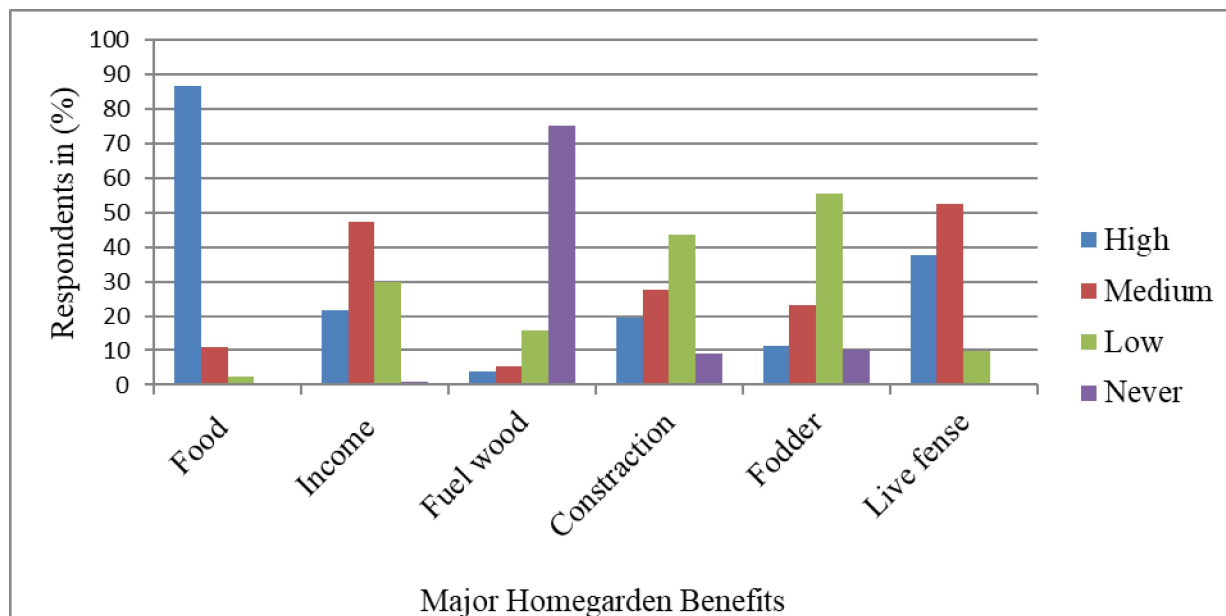


Figure 4: Major benefits of homegardens

4.1.2 Homegardens as a source of income

Homegarden annual income contribution for the households of the three Kebeles was not shown significant differences statistically, ($F_{136,2} = 0.281$; $p=0.755$). However, households in the study area generate income from different homegarden products. The homegardens contributions to household's annual income on average was about 13% of the total annual income (table 12 and Table 13), among which *Catha edulis* and *coffee arabica* homegardens produce share the main role, while the rest household income/economic contributors are from food source plants, such as fruit, spices, root and tubers, and vegetables in the practice (Figure 6).

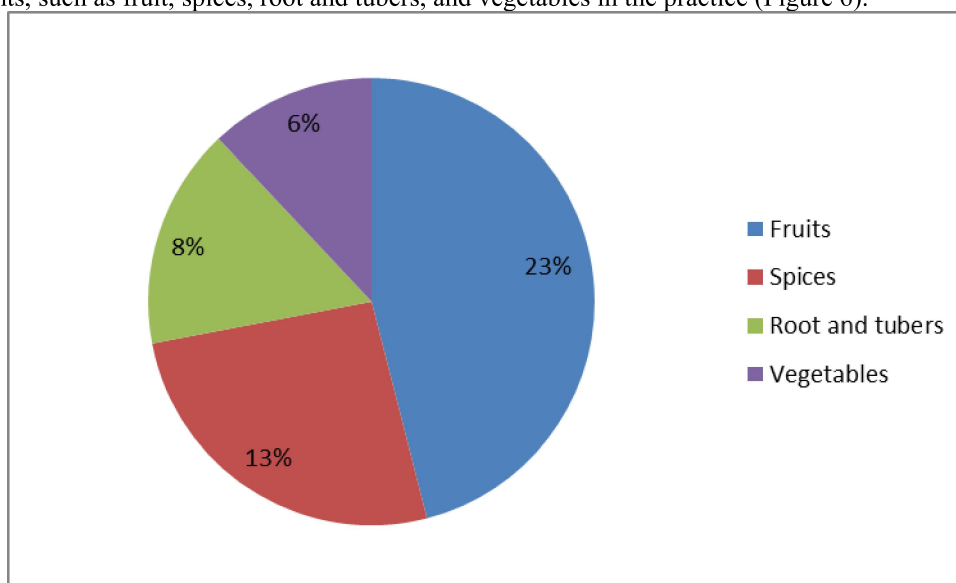


Figure 5: Income generating food source components of homegarden (of the total recorded species)

Concurrently, over 90% of the respondents reported that coffee (which is mainly from coffee plantation site) is their greatest household financial source (i.e. total household annual income). Similarly, the discussion held during the focus group discussion also implies that villagers cultivate and maintain plants in their homegardens mainly for household consumption and surplus vegetables and fruits were sold in the nearby market for monetary benefits. The most marketed fruits and vegetables *Persea americana*, *Mangifera indica*, *Musa sapientum*, *Lycopersicon esculentum*, *Brassica napus*, and *Brassica integrifolia*. Similar findings were obtained by Jemal *et al.* (2018), Coffee forest production is mainly practices used to generate money for the majority of households, where homegarden is used as both a source of food and cash income generation for local community around Yayo, southwest Ethiopia.

The above finding is in agreement with the findings of Nischalke *et al.* (2017), reported Coffee is an important part of the cultural identity and the most important livelihood source for households around YCFBR.

Similarly, the above finding is in agreement with the findings of Etissa *et al.* (2016), reported that many crops such as coffee, avocado, mango, banana, *Enset*, root and tubers, and many other crops grow in the sample homegardens of the households around YCFBR. The main structural arrangements in most homegardens are primarily coffee mixed with trees and shrubs, fruit trees or planted in strips, or planted as a boundary and fence, edges of plots and fields mainly for coffee shades, and live fence. From these trees including fruit trees farmers get food, fodder for their livestock, fuel wood and other wood products and other uses such as a windbreak and shades.

However, the above findings are slightly different from the findings of Regassa (2016), who reported that 35% household's annual income contribution from homegardens around Hawassa, Southern Ethiopia. The difference might be due to the livelihood sources and lifestyles of society living in the two areas (Hawassa city and those of Chora rural villages), and finding of Gebrehiwot (2017), in the same area, reported that over 50% of the Sidama community generate their household financial income mainly from coffee. Similarly, Mbow *et al.* (2014), stated that homegardens enhance smallholder's resilience by providing food for household consumption and to sell surplus food products to supply other needed items. Hence, this farming practice enhances and maintains human capital (health and education) for the rural community. It accomplishes this through continuous production and supply of food, nutrition, and financial income. According to Morse *et al.* (2009), livelihood outcomes include more stable income, increased human wellbeing, improved food security, and sustainability.

Table 2 : Annual incomes from homegarden

Level of income	Income in Ethiopian Birr per site		
	Cash income (Birr) 1\$ = 27Birr when the research conducted (the Year 2017)		
Level of income	Hawayember	Sololo	Uta None
Max income	17000.00 Birr	19700.00 Birr	23500.00 Birr
Min income	1200.00 Birr	900.00 Birr	1100.00 Birr
Average income	4095.65 Birr	4351.16.00 Birr	3797.73 Birr
Average annual income	4079.70 Birr		

Source: Household survey, Chora, 2017

4.2 Limitation of the Research

Even though this research was carefully prepared, I am still aware of its limitations and shortcomings. First of all, the research was conducted based on the data collected for three months, which is not enough for the researcher to assess enough information on the homegarden role. It would be better if it was done in a longer time. Second, the population of the experimental group is small, only one hundred thirty nine households might not represent the majority of the households in the biosphere reserve. Third, since the questionnaire designed to measure the households' annual income of one year. It might give useful information about the role of homegarden to local household livelihood; it seems not to provide enough evidence of the exact role played by homegarden.

4.3 Conclusions and Recommendation

4.3.1. Conclusions

Homegarden agroforestry practices in YCFBR plays a remarkable role in improving food and nutrition security for households residing in transitional (utilization zone) of the biosphere. The results of the study revealed that homegarden agroforestry practices in the present study area have been providing multiple benefits for the locals and playing significant contribution for the communities' livelihood in the area. The society mainly dependent on diverse plants of different uses in the system for food sources of the family. However, more of the plant species were exotic species in their origin and concentration on few species in the garden were observed. Cultivation of cash crop production particularly, *coffee arabica* and *Catha edulis* in homegarden agroforestry practices are attracting more attention of the farming households with the objective of maximizing their cash benefit and concurrently to escape from increased wildlife damage to food crop components in the garden. These situations are happening at the expense of species diversity and bringing a reduction in food provision for poor rural households. Thus, local people livelihood sustenance has been affected. Yet, clear capacity exists to make a homegarden contribution more effective towards of livelihood improvement.

4.3.2. Recommendations

Based on the findings of this study, the following recommendations are suggested:

- Attention should be given to make homegarden more effective in local people livelihood improvement.
- Promotion of homegardens should be included in the programmes of conservation agency and others concerned bodies to enhance the livelihoods of rural poor.
- Further study is recommended and needed to find available opportunities in supplying plant varieties of ecological and locals' needs.

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6.APPENDICES

Appendix 1: Households Interview Questionnaires

Jimma University

College Of Agriculture and Veterinary Medicine

Dear respondents: My name is Gemeda Terfassa, this is the research questionnaires to collect the research data from households in Chora for the objective of MSc thesis work to study “**The Role of Homegarden Agroforestry in Households Livelihoods at Yayo Coffee Forest Biosphere Reserve, Chora District, Southwestern Ethiopia**” this study is conducted is conducted within the NutriHAF Africa project In collaboration with ECFF. It is research for my Masters thesis. This is for generating information about the system in contribution in the area. I would like to assure you that the information that you are giving used only for this study and honestly your name will not be mentioned in the report. Thank you in advance!

Part I: Basic information

Name ----- Kebele ----- specific site ----- GPS coordinates of residence (coordinates):
 North: ___ East: ___ Altitude (m.a.s.l.): ___ Accuracy: ___ Gender -----

Part II: Information on households Socioeconomic Characteristics

Current....?

- 1 Age in year _____
- 2 Family size _____
- 3 Total land size in ha _____
- 4 Homegarden land size in ha _____
- 5 Education level completed in year _____
- 6 Total annual income _____

Appendix 2: Check list for total income calculation

Main Sources of household income		Major products				
		Maize	Sorghum	Millet	Others	
Cropland						
	Yields in Kg or kuntal/ha/year					
	Price					
Coffee from the forest (coffee plantation)		Coffee	Fuelwood	Contraction wood	Honey	Others
	Yield in Kg or kuntal/ha /year					
	Price					
Woodlot		Fuelwood	Contraction wood			Others
	Load/ha /year					
	Price					
Livestock		Present	Sold			
	Number					
	Price					
Business	Type	Trade				
	Income/ha /month					
Employment	Type	Wage	Others			
	Income/month					
Others	Type					
	Income/month					
Total income/year in Birr						

Appendix 3: Homegarden Household livelihoods contribution

- 1 What is your major source of income?
- 2 Which one of the following practice is your main source of household income? 1. Homegarden 2. Forest land 3. Farmland 4. if others specify _____
- 3 Why does your household maintain a homegarden? To: 1. spend time with my family 2. To produce food for my family 3. To generates additional income 4. For mental and physical relaxation 5. To beautify my home surrounding 6. Have no significant benefit 6. Others, Specify
- 4 Please, list common plants you have been growing in your homegarden with their main uses:

No.	Tree species	Plants primary use	Other Uses	Remark

9. Do you agree that the contribution of your garden products for family food and income generation is ____?

For family food	For income generation	Remark
High	High	
Medium	Medium	
Low	Low	
Never	Never	

10. Would you list your homegarden products with their major contribution?

Appendix 4: Check list for homegarden income calculation

Sources		Main products								
		Coffee	Chat	Fruits	Vegetable	Spice	Root & tuber	Fuelwood	Contraction wood	Others
Homegarden										
	Yield in Kg or kuntal/ha /year									
	Price									

13. What are the major benefits that you get from homegarden and how do you evaluate them as (1. High 2. Medium 3. Low 4. None)?

How do you evaluate the benefit that you get from homegarden?	Option	Remark
Food		
Income		
Construction		
Fodder		
Shade		
Fuelwood		
Life fence		

Thank You So Much for Your Cooperation

Respondent: sign _____

Appendix 5: Checklist for Focus Group Discussions (FGDs)

Introduction:

The Group Discussions is for the aim of the MSc thesis work to study "Contribution of Homegarden Agroforestry for Biodiversity Conservation and Local Livelihoods: The Case of Chora District, Southwestern Ethiopia" I would like to assure you that any ideas raised here are used only for this research. Your contribution has a vital role in the success of the study. Any of your opinions that will be included in this thesis report will not mention your name.

Thank you very much for your active participation essential ideas!

Instruction:

1. All members of the group should be equally participating.
2. Time allowed to one participation is ____minute in one turn.

3. All ideas raised here are equally important for the study.
4. There are no wrong ideas, feel free to react to the issues raised.
5. All participants should listen properly when one of the members his/her idea

Questions prepared for the discussion

1. Understanding the components, plant diversity in homegarden Agroforestry practices and its socioeconomic contribution, Please briefly tell us about your experience in
2. In what ways are you more aware of the importance of the homegarden in plant biodiversity conservation? And would you describe the conservation roles of homegarden?
3. What is the contribution of homegarden for local community livelihood in your area?
4. Would you explain please, the contribution of homegarden to the local community in both income generation and family food production terms?
5. What type of plants do people in your area more interested to conserve in their garden?, Why?
6. Do you think are there criteria for gardeners to preserve plants in their garden?
7. Would you mention plants or tree varieties commonly observed in your area homegardens? What do you think is the most probable reason for the plants to be common in the homegardens of the area?
8. For what purpose do people, in this area practice homegarden mostly?
9. What are the purposes of trees component in homegarden? _____
10. Where do people in this area get forest products for their construction materials or firewood at most?
11. Do you think that is homegarden in your area effective enough for plant biodiversity conservation? If not why?
12. What is the most important constraint/problems for homegarden practices inefficiency for plant conservation in your area?
13. What options do you suggest in bringing sustainable plant biodiversity conservation in the area?

Appendix 6: Key Informants Interview

1. Please briefly tell us about your experience homegarden management and its contributions to the plant biodiversity conservation.
2. What do you think about homegardens and their contributions to the plant biodiversity in your areas?
3. What type of trees and crops that are commonly being managed in homegardens of this area and why?
4. How do you describe the contribution of the homegarden practice to YCFBR and plant biodiversity conservation in your areas?
5. Do you think homegardens have a role in household food security and income generation ?
6. Describe the value of homegarden to: 1. Livelihood and socioeconomic of the locals 2. plant biodiversity conservation and YCFBR
7. What do you think is the best alternative practice that may compensate products from YCFBR for surrounding community in favor of sustaining biodiversity conservation practices in this area?
8. What are the main problems locals are facing in relation to the diversifying of homegarden components?