JIMMA UNIVERSITY
COLLEGE OF NATURAL SCIENCES DEPARTMENT OF BIOLOGY

AGROFORESTRY PRACTICES, BENEFITS AND CHALLENGES IN GIMBO DISTRICT, KAFA ZONE, SOUTHWESTERN ETHIOPIA

A THESIS SUBMITED TO JIMMA UNIVERSITY DEPARTMENT OF BIOLOGY IN PARTIAL FULFILMENT OF THE REQUIRMENTS FOR THE DEGREE OF MASTERS OF SCIENCE IN BIOLOGY

BY: ANDENET HAILU

MAIN ADVISOR: KITESSA H. (PROF)

CO-ADVISOR: TAMENE B.

OCTOBER, 2021

JIMMA, ETHIOPIA

JIMMA UNIVERSITY

COLLEGE OF NATURAL SCIENCE

DEPARTMENT OF BIOLOGY

ADVISORS'APPROVALSHEET

This is to certify that "Agroforestry Practices, Benefits and Challenges in Gimbo District Kafa Zone Southwestern Ethiopia" submitted in partial fulfillment of the requirements for the degree of Masters of Science in Biology, and has been carried out by Andenet Hailu under our supervision. Therefore, we recommend hence hereby can submit the thesis to the department.

Name of major advisor	Signature	Date

Name of co-advisor	Signature	Date

JIMMA UNIVERSITY

COLLEGE OF NATURAL SCIENCE

DEPARTMENT OF BIOLOGY

AGROFORESTRY PRACTICES, BENEFITS AND CHALLENGES IN GIMBO DISTRICT KAFA ZONE SOUTHWESTERN ETHIOPIA

By: ANDENET HAILU

EXAMINERS' APPROVAL SHEET

We, the undersigned, members of the Board of Examiners of the final open defense by Andenet Hailu have read and evaluated his thesis entitled "Agroforestry Practices, Benefits and Challenges in Gimbo District Kafa Zone Southwestern Ethiopia" and examined the candidate's oral presentation. This is, therefore, to certify that the thesis has been accepted in partial fulfillment of the requirements for the degree of Masters.

_____.	_____	_____
Name of the Chairperson	Signature	Date
_____ .	_____	_____
Name of Principal Advisor	Signature	Date
_____.	_____	_____
Name of Co-Advisor	Signature	Date
_____.	_____	_____
Name of Internal examiner	Signature	Date
_____.	_____	_____
Name of External examiner	Signature	Date

October, 2021
Jimma, Ethiopia

Declaration

I, the undersigned declared that this thesis is my original work and has not been presented for a masters degree in any other university, and that all sources of material used for this research have been dully acknowledged. I followed all ethical and technical principles in the preparation of data collection, analysis and completion of this thesis. All scholarly matter that is included in the thesis has been given recognition through citation. I affirm that have cited and referenced all sources used in these documents. Every serious effort has been made to avoid any plagiarism in the preparation of this thesis.

_____	_____	_____
Name of student	Signature	Date

Acknowledgments

First of all, I would like to express gratitude to my advisor Kitessa H. (Professor) and my co-advisor Tamene B. (Msc) for their continuous guidance, constructive comments, and useful suggestions they have given to me beginning from the preparation of the proposal until the completion of the study. I am also indebted to the Department of Biology Jimma University for the opportunity given for me to conduct this study in order to develop my study skill.

Moreover, my gratitude goes to all who provided generous support of material, advice, moral and others as well. To mention some of them: Eyayu Alemu, Ketsela Hailu and the participants in this study for the provision of honest and genuine information for this study as well as other family members for both their moral and material support .

Table of Contents

List of Tables

Page

List of Figures

List of Acronyms and Abbreviations

FDRE : Federal democratic republic of Ethiopia
FGD : Focus group discussion
FO : Food organization
HH : House holds
ICRAF : International center for research in agro-forestry
NGOs : Nongovernmental organizations
NTFPs : Non timber forest products
PASDEP: Plan accelerated for sustainable development to end poverty
SPSS : Statistical package for social science
SUPACKS : Sustainable poverty alleviation center in kefa sheka zone

Abstract

The major purpose of this study was to assess the practices, benefits and challenges of Agro-forestry in Gimbo district, Kafa zone. In order to achieve the objectives of the study, descriptive survey method was employed, because the major goal of this study was to describe the practices, benefits and challenges of agroforestry, as it exists at present. The study was conducted in three kebeles of Gimbo district that were selected purposively. Questionnaires, interviews and focus group discussions were used to collect data. The data gathered through questionnaire were analyzed using percentages, mean and standard deviation and the data collected through interview and focus group discussions were analyzed in statement form. The study depicted that: the major types of agro-forestry practices practiced by farmers of Gimbo district are home garden agro-forestry followed by shelterbelts; plantation-based cropping system; hedgerow intercropping; scattered trees in crop lands; boundary planting and live hedges; and woodlots for soil conservation. Vulnerability to food insecurity, access to forest product, access to credit, participating in own cash generating activity, species composition, density and structure of the forest, crop production, livestock production and product from NTFPs were improved after the introduction of Agro-forestry. Agro-forestry practices reduced deforestation, increased forest inventory, increased the right to use the forest products, encouraged alternative livelihood activities, created new market benefits for the participants, increased environmental awareness for the participants. Producers education level, small land plot size, clan-owned land renting system, absence of village land use plans, poor land use and management, lack of awareness by farmers of environmental benefits of trees and misconception about trees, lack of training or skills for product transformation, poor transport infrastructure, high wastage for perishable goods and a failure to reach quality grades, high cost of collecting tree products from the area, small number of markets, and lack of market information, lack of storage facilities and capital, and unstable prices and supplies, especially during the rainy season, were identifies as challenges of agro-forestry practices. Due to the challenges faced by farmers in marketing some of the agro-forestry produce, this study recommends establishment of additional interest groups to boost development of farm produce enterprises; and there is need to carry out further research on appropriate and affordable agro-forestry technology, which is also rewarding in the short run to resources poor farmers faced with seasonal flood and drought challenges.

***Key words**: Agro-forestry, Gimbo, Challenges, Benefits, Land use*

CHAPTER ONE

1. INTRODUCTION

1.1. Background of the study

Agro-forestry is a dynamic, ecologically based, natural resources management system that, through integration of trees on farms and agricultural landscapes, diversifies and sustains production for increased social, economic, and environmental benefits for all land users at all levels (World Agro-forestry Center, 2003). Agro-forestry can also be viewed as a strategy to overcome the lack of success in past tree planting by providing benefits for both food and tree production on the same unit of land, thus reducing competition for this scarce resource (Bishaw and Abdelkadir, 2003). Agroforestry practice in the tropics and sub-tropics is probably as old as agriculture itself (Atta-Krah *et al.* 2004, Kumar and Nair, 2004, McNeely and Schroth, 2006).

Agroforestry is a major component of Ethiopian farming systems and recently taken as one of the development objectives in PASDEP of national development policy of the country (Jama and Zeila, 2005; Teshome, 2006 and FDRE, 2003). In Ethiopia, the integration of trees and shrubs into agriculture emerged some 7000 years ago (Brandt, 1984; Edmond *et al*. 2000), and has developed during subsequent millennia into number of distinct indigenous agroforestry systems (Getahun, 1974; Kanshie, 2002).

Ethiopians forests are facing rapid deforestation and degradation of land resources. The increasing population has resulted in extensive forest clearing for agricultural use, overgrazing, and exploitation of existing forests for fuel wood, fodder, and construction materials. Forest areas of the country have been reduced from 40% a century ago to an estimated less than 3% today. The current rate of deforestation is estimated to be 160,000 to 200,000 ha per year. It is estimated that fertile topsoil is lost at a rate of one billion cubic meters per year, resulting in massive environmental degradation and constituting a serious threat to sustainable agriculture and forestry (Bishaw, 2001).

It is believed that most of the agro-forests in Ethiopia have evolved from forests and situated on high altitudes ranging from 1500-2300 m. Farmers built them by keeping upper storey trees and clearing the undergrowth to open up space for planting, coffee and other crops. Partial harvesting of the upper storey trees may also takes place to obtain wood and to create favorable growing

condition for the other crops. Most of the forests are used up and there is increasing shortage of land. In situation of shortage of forest land as most of the forests have already been converted, some farmers are observed to convert their plot of grazing land into multi-species complex systems (Abebe, 2005).

Agricultural producers, in particular the smallholder farmers of Ethiopia, are facing unprecedented challenges in the 21st century. The main economic activity is agriculture, a climate change sensitive or prone activity that employs about 80-85 percent of the total population. Subsistence farming practices are the main livelihood for most people living in developing region, which is characterized by degraded soils, small farm sizes, and low agriculture outputs (Bishaw *et al*., 2013). Ethiopian farmers continue to practice essentially the same farming methods with very little technical or management improvement for so long. The country has tried to implement agricultural-led development strategies, though success seems modest so far. In these areas where conditions for mono-crop agriculture are often harsh and unpredictable, trees and shrubs integrated into the agricultural system are vital assets of different products for farmers (Sunninchan, 2005). Agro-ecosystems and especially the diverse and vulnerable rain-fed systems need technologies, knowledge and practices that simultaneously increase their productivity, adaptation and resilience to climate change. Agroforestry, which is an ecologically based traditional farming practice, integrates trees into the farming systems to increase agricultural productivity and ameliorate soil fertility, control erosion, conserve biodiversity, and diversify income for households and communities, could be a potential option (Bishaw *et al*., 2013).

1.2. Statement of the problem

Agroforestry is an alternative and probably cheaper option for agricultural intensification and sustainability in Ethiopia. The impact of agroforestry on livelihoods improvement and environmental protection is being demonstrated in many regions in Ethiopia.

Enset (*Ensete ventricosum*) and Coffee based agroforestry systems are common in central, south-west and south Ethiopia including Kafa zone (Asfaw, 2003, Abebe, 2005, Tesemma, 2007). Coffee in agroforestry systems occurs in some parts of the kafa and is cultivated under the shade of remnant native trees, such as *Albizia gummifera* J.F. (Gmel.) C.A.Sm, *Acacia abyssinica* Hochst. ex Benth., *Millettia ferruginea* (Hochst.) Bak, *Ficus sur* Forssk, *Ficus vasta* Forssk. and

Cordia africana Lam. (Teketay and Tegineh 1991; Muleta *et al*., 2008). Farmers in kafa zone including Gimbo District retain *Cordia africana* and *Millettia ferruginea* for maintaining soil fertility in enset-coffee based agroforestry (Abebe 2005; Asfaw and Ågren 2007). Home garden agroforestry systems are also practiced in different parts of the area (Asfaw 2002; Mengesha 2010, Fentahun and Hager 2010; Debessa 2011; Haileselasie *et al*., 2012). However, the attention given to the ecosystem services provided by agroforestry in both these strategies is limited. There is also a lack of scientific knowledge about the function and structure of these systems, and their exact extent.

Agroforestry practices in Gimbo district were variable with regard to species composition, management practices as well as the prevailing biophysical and socioeconomic environment. Some studies have described the enset-coffee agroforestry home gardens of kafa zone, Southwestern Ethiopia, but a detailed analysis of their diversity, benefits and challenges is still missing. Therefore, the present study was to assess the practices, benefits and challenges of Agro- forestry in Gimbo district, Kafa zone. Only when this vital information is available, constraints and options for their improvement can be proposed. Moreover, as land-use is not static but changes over time, also the main factors causing these changes should be identified and their effect quantified before recommendations regarding improvements can be made.

1.3. Objectives of the Study

1.3.1. General Objective

The overall objective of this study was to assess the practices, benefits and challenges of Agro-forestry in Gimbo district, Kafa zone.

1.3.2. Specific Objectives

The specific objectives of this study were to:-

1. Determine the major agroforestry practices farmers have been practicing in Gimbo district.
2. Assess the benefits of agroforestry to the local community of the study area.
3. Identify the major challenges confronting the practices of agroforestry in the study area.

1.4. Research questions

1. What are the major types of agroforestry practices performed in Gimbo district?
2. What are the benefits of agroforestry to the local community of the study area?

3. What are the major challenges confronting in the practice of agroforestry in the study area?

1.5. Significance of the study

The expected study provided one-step towards a better understanding and documenting of the practice, benefits and challenges of Agro-forestry in Gimbo district, Kafa zone. The results of the study offered ample evidence to forest managers and the government as to the need to re-orient and focus their attention to agroforestry practice of the area specifically and the country in general for reducing rural poverty, forest degradation and livelihood diversification. The recommendations made the Forestry Commission and the government to take up the potential in the agroforestry system and production as a challenge to compliment the revenue generation and boost employment in the rural communities. The study may also help in clarifying and giving sufficient information for someone who wants to study in the same area.

1.6. Delimitation of the Study

The study was undertaken in Kafa Zone. In particular, Gimbo district was the principal location of the study site. Thematically, the paper was attempted to assess the practice, benefits and challenges of Agro-forestry in Gimbo district, Kafa zone, SNNPRS. The study was delimited to Gimbo district because the researcher had interested in filling the gap of absence of written document related to the issue in the area and to make the study more manageable in terms of time and space.

CHAPTER TWO

2. REVIEW OF RELATED LITERATURE

2.1. Concepts and definition of Agroforestry

Agro-forestry is a new name for an old set of land-use practices. It is an integrated approach to solving land-use problems by allowing farmers to produce food, fiber, fodder, and fuel simultaneously from the same unit of land. A common characteristic feature of all forms of Agro-forestry is that a tree component is deliberately grown or retained in an agricultural setting. Various definitions for the term Agro-forestry have been given through the years since its advent as a scientific approach to land-use problems in the early 1980s. The best and probably official definition is the one that is commonly used by the World Agro-forestry Center: "Agro-forestry is a collective name for land use systems and technologies where woody perennials (trees, shrubs, palms, bamboos etc.) are deliberately used on the same land management units as agricultural crops and/or animals, in some form of spatial arrangement or temporal sequence. In Agro-forestry system there are both ecological and economical interactions between different components (Badege and Abdu, 2003).

Agro-forestry is a science and art of producing trees, crops and animals in combination. It shouldn't be seen merely as an arrangement of trees and crops or particular combination of certain species but there must be a tree component deliberately grown or retained in the land-use system and there must be significant interaction, positive and/ or negative, between the woody and non-woody components of the system as an approach to land use that seeks to meet the specific needs of the community or individuals (soil fertility, fodder, fuel, construction, wood, food, etc). Generally Agro-forestry is a practical, low-cost alternative for food production as well as environmental protection. However, the benefits from Agro-forestry will only be realized through a combination of the right tree species with the right crops in the right spatial arrangements with the right management practices (Tsegaye and Worku, 2012).

Agroforestry is a land management system that combines perennials (including trees, shrubs and palms) with annual agricultural crops and/or livestock to increase total production while providing economic, social and environmental benefits. The goal is to reduce risk and increase total productivity in an agricultural system while simultaneously providing regular income and

increased cash flow. By integrating trees, perennials and/or livestock into a conventional agricultural system, agroforestry promotes the efficient use of sunlight, moisture, plant nutrients and other ecological services (Annie *et al*., 2016).

2.2. Benefits of Agroforestry

Agro-forestry combines production and service roles. Nair (1993);cited in (Tsegaye and Worku, 2012) indicated that the combination of several types of products which are both subsistence and income generating, helps farmers to meet their basic needs and minimizes the risk of the production system's total failure. Generally, Agro-forestry has the potential to solve many land-use problems. Some of the benefits that Agro-forestry offers are: soil-fertility improvement, provision of wood products (fuel wood, poles, timber, fruits, medicines, etc.), improved beekeeping, control of erosion, stabilizing of river and stream banks (i.e. prevention of siltation), improvement of water infiltration in to the soil, shrubs can act as live fences against livestock and human beings, trees and shrubs can contribute to better microclimate (shade, windbreak,) and provision of fodder, especially in the dry season.

2.2.1. Agroforestry benefits in food production

Solving the problems of food and nutritional security requires among other interventions a range of interconnected agricultural approaches, including improvements in staple crop productivity, the bio fortification of staples, and the cultivation of a wider range of edible plants that provide fruits, nuts, vegetables, etc., for more diverse diets (Frison *et al*. ,2011). Potential for the diversification of crop production lies in the great range of lesser-used indigenous foods found in forests and wooded lands that are often richer in micronutrients, fiber and protein than staple crops. Although such foods have traditionally been harvested from forests and woodlands, access to these resources is declining with deforestation and forest degradation (FAO, 2010). In this context, cultivation provides an alternative resource. Moreover, the yield and quality of production can be improved during cultivation if attention is given to genetic improvement and the adoption of efficient farm management methods, making planting an attractive option: for many wild trees, including indigenous fruits, a two-fold yield improvement or more is possible through genetic selection (Jamandass *et al*., 2013)

When bringing trees from the wild into cultivation it is essential to increase yields: if indigenous trees are perceived as relatively unproductive, agriculture in deforested areas is likely to be dominated by staple crops and agro-biodiversity will be reduced (Sunderland, 2011);cited in Jamandass *et al*.,2013) Some food-providing trees and palms, especially fruit-producing ones, have been managed by people in a transition from the wild to cultivation in farmland for millennia, resulting in complex agroforestry systems that contain many different foods; for other tree foods, the move to domestication is much more recent and is based on scientific inquiry (Torquebiau, 1984; Clement 2004); cited in Jamnadass *et al*., 2013). A combination of indigenous and exotic tree foods in agroforestry systems supports nutrition, the stability of production, and farmers' incomes.

A diversity of trees on farm land and neighboring natural forest fragments, where present, supports populations of pollinator species such as insects and birds that are essential for the production of many crops. Many fruit tree species that are important as human foods relay on insects pollinators for their production, while diverse farms that provide an alternative habitat for pollinator community can support the regeneration of food plants in neighboring forests (Garibaldi *et al*., 2013).

2.2.2. Soil fertility improvement and soil conservation

Land degradation and declining soil fertility create a major threat to agricultural productivity and affecting human welfare in most areas of Ethiopia. Particularly it is serious in regions where many soils lack plant nutrients and organic matter and top soil erodes by intense rainfall. Use of artificial fertilizers to replenish soil nutrients fails to provide adequate solution. Incorporation of trees in the farm can help in maintaining the nutrient pool and enhance soil fertility both under sequential and simultaneous Agro-forestry. Soil fertility can be improved or sustained by the addition of vegetative organic matter, i.e. decomposition of leafy biomass and roots. Further, integrating leguminous trees is common in Agro-forestry, which have ability of fix atmospheric nitrogen and contributes to better soil fertility. Nitrogen fixing tree, under Agro-forestry significantly increased nutrient pool, organic biomass, and activities of organisms in the soil. This would not only be beneficial to the soil, but would also be cheaper for resource-poor farmers and provide fodder or firewood (Tsegaye and Worku, 2012).

The other problem is erosion that causes reduction of crop yield due to loss of organic matter, associated nutrients and soil fertility. So, restoration and maintenance of fertility is essential. Root systems of woody perennials enable to adapt to steeply sloping sites that are unsuited to conventional cropping or grazing. Nitrogen fixing trees (legumes) in Agro-forestry have the capacity to grow in difficult sites subject to erosion and low soil fertility. They have also potential to restore degraded areas and control of soil erosion. Once established, they can create favorable conditions for the growth of other species. Additionally, tree legumes improve soil structure, which help to decrease erosion (Alao and shuabu, 2013)

Due to its long lived nature, trees and shrubs can remain throughout the year in the farmland and serve as better resources to control of erosion and soil conservation. They reduce the wind speed and runoff (through enhancing percolation of rain water in to the ground through ground litter). The tree root protects the soil from erosion and the litter serves as a buffer to direct rain drops and runoff and the tree crown reduces the wind speed and slows the direct force of the rain drops (Mathew and Sarah, 2016).

2.2.3. Fuel wood and energy

Over 80% of populations in rural areas of Ethiopia depend on fuel wood for their energy needs. Increased tree growing and better management of existing resources could provide for products such as fuel wood, poles, fruits and timber which have not only become scarce but increasingly expensive. Thus, such commodities could be produced both for subsistence and for cash. Scarcity of fuel wood may influence both the amount of food cooked and its type. Further, since fuel wood collection is women's work further away the source of fuel wood the greater their workload becomes. Consequently, they have less and less time and energy to spend on other activities such as caring for children or engaging in income-generating activities. Thus, the scarcity of fuel wood has a direct impact on the family's nutrition (Abera, 2016).

2.2.4. Carbon sequestration

Climate changes has been proved by scientific evidence and unequivocally accepted by the global community as a common issue of interest. Since the industrial revolution the burning of fossil fuels and the destruction of forests have caused the concentrations of heat trapping Green House Gases (GHGs) to increase significantly in our atmosphere at a speed and magnitude

greater than the natural fluctuation would dictate. If the concentrations of GHGs in the atmosphere continue to increase the average temperature at the earth's surface will increase by 1.8 to 4^0c by the end of the century. Thus the rapid increase in global surface temperature is mainly due to the rise in the amount of carbon dioxide in the atmosphere primarily due to anthropogenic.AS a result of change in global climate there has been wide spread and growing concern that has led to the extensive international discussion and negotiation. In seeking solutions for this the over whelming priority is to reduce emission of GHGs and increase the rate of carbon sequestration. The concern have led to efforts of reducing emissions of GHGs especially CO_2 and stored in forests soil and oceans .To slow down the concentration of GHGs in the atmosphere is to increase the amount of carbon removed by and stored in forests (Habtamu and Zerihun,2016).

Forests play an important role in the global carbon cycle because they store a large amount of carbon in vegetation biomass and soil. It also sinks CO_2 from the atmosphere. Conversion of especially high-biomass tropical forest to other land-uses like agriculture could lead to increased atmospheric CO_2 via biomass burning, increased soil respiration and decrease in CO_2 uptake by plants. So, this decrease in forest area reduces the carbon stock in the forest ecosystem. In the past three decades, Agro-forestry has become recognized as an integrated approach to sustainable land use because of its production and environmental benefits and it received attention as a strategy for biological carbon sequestration. The potential of Agro-forestry in sequestering carbon is based on the premise that the greater effectiveness of integrated systems in resource captures and use than single species. The density of carbon storage in Agro-forestry is low in comparison with forests; the woody biomass of Agro-forestry systems could provide a source of local fuel. Through providing fuel, Agro-forestry would reduce pressure on forests and at the same time, provide a substitute for fossil fuel (Mathew and Sarah, 2016).

2.2.5. Fodder

Grasses and cereal crop residues are the most important feed resources for livestock and which account for more than 70% of the dry matter in the animal feeds. But they are deficient in protein. On the other hand, there is an acute shortage of green fodder in many parts during the dry season. To overcome those problems, forages from leguminous trees (which mostly common in Agro-forestry) have a great potential to supply protein-rich fodder and play an important role

in the supplementary feeding of livestock during the dry season or in times of drought. A huge percentage of fodder trees are legumes and most of those are rich in protein and digestible. Farmers and pastoralists have long experience in feeding fodder trees and shrubs to their livestock to increase the benefits of the output gained from the animals, either by browsing or by cut and carry system. *Faidherbia albida, sesbania sesban, Chamaecytisus proliferus*, are a woody perennial which can provide fodder (Tsegaye and Worku, 2012).

2.3. Classification of Agroforestry systems

According to Badege and Abdu (2003), the most common systems of agroforestry classification and practice are: Structural basis: refers to the composition and the arrangement of the component, both spatial and temporal, Functional basis: Which refers to the main function or the role of the components especially woody components as for soil conservation, soil fertility and improvement, Socioeconomic basis: refers to intensity or scales of management and goals of the system and Ecological basis: Which refers to the environmental and the ecological suitability of systems. These can be separate sets of agroforestry systems for arid and semi-arid lands of or for humid and sub humid tropics.

All agroforestry systems are characterized by three basic components namely, the woody Perennials (trees/shrubs), the herbaceous plants (crops, pasture species), and the animals. Based on these three basic components, agroforestry systems can also be classified for all practical purposes according to their component composition. These are: Agro-silvicultural systems, Silvopastural systems, and Agro-silvopastural systems.

2.3.1. Agrosilvicultural system

In this system agronomic crops combined with trees/shrubs on the same unit of land for better sustained production of annual crops fodder and wood .In any one agroforestry system, there can be more than one agroforestry practice .An agroforestry system is identified by certain types of practice, that takes as a whole, form of dominant land use system in a particular locality characterized by environment, plant species and arrangement, management and social and economic functions. Although an agroforestry practice is a distinctive arrangement of component in space and time, when the combination are arranged in time sequence, such practice is called

taungya practice. The combination can be arranged in space, such as hedgerow mixed intercropping practice (Badege and Abdu, 2003).

2.3.2. Silvipastural systems

Silvopasture is a system in which forests are managed for timber production along with domesticated animals being raised on the same plot of land .This system utilizes several agronomic principles such as fertilization, native pasture grasses, and rotational grazing systems with short grazing periods that maximize plant growth and harvest while avoiding damage to the tree crop.Silvopasture is a highly intensive agroforestry method that requires grazing and timber management that can involve tree pruning, grazing, haying, fertilization and more. There are several benefits of silvopasture, which have led to its increased use. Silvopasture systems reduce economic risk by producing multiple crops and products, create shorter timber rotations (due to forage fertilization), enhance tree growth (due to the ability of grazing animals to control competition for moisture, nutrients and sunlight), provide a cooler environment for livestock and allow for control of weeds and brush without herbicide applications. It can also create high value timber products (resulting from pruning and tree management) that lead to higher diversification of income for farmers and increased income benefits . While considerable scientific research depicting beneficial animal/tree interactions has been conducted, the issue of soil compaction and animal/soil interactions in silvopasture has not been scientifically evaluated to a great extent. This system can be practiced on both range and forest lands for the production of both feed and woody materials and could also be practiced on sloping ground by growing grasses and trees/shrubs together for soil conservation purposes (Annie et al., 2016).

2.3.3. Agrosilvopasture systems

This is an agroforestry practice by which food, pasture and tree/shrubs crops are combined on the same unit of land for the production of grass and browse feed, biomass for fuel wood and green manure and food for human consumption. This system is practiced when the farmer needs all the benefits that would be obtained from silvopasture and agro silviculture systems from a unit of land. Usually such system is practiced on cultivated lands and is also practiced when crop land is constrained by slope and threatened by erosion. This system is promised in high land humid tropics (Mathukia *et al*., 2016).

The above definition and discussions of agroforestry systems and practices encompasses many well-known land-use systems long practiced in the Ethiopian highlands. Thus, it is apparent that agroforestry is only a new word for an old practice: it is based on forestry, agriculture, animal husbandry, land resource management, and other disciplines that all form the systematic background of land use. Furthermore, it encompasses an awareness of interactions between humans and the environment and between demand and available resources in a given area. Although science can improve agroforestry practices, an important aspect of the problem of Ethiopia is to mobilize and implement what is already known (Aklilu and Mikrewongel, 2016).

2.4. Agroforestry Practices

2.4.1. Improved Fallows

One method in which resource-poor farmers combats soil infertility is by leaving degraded land without cultivation. This abandoned land is referred to as 'fallow', and it is an option for improving soil fertility and it has been practiced for many generations. Improved fallow is defined as enrichment of a natural fallow with leguminous trees or shrubs planted at high density to improve soil fertility. The primary aim of improved fallow is promotion of food security through increased soil productivity. The improved fallow technology involves deliberate planting or sowing of nitrogen-fixing leguminous tree or shrub species. This technology has potential to restore soil fertility more rapidly than the traditional fallows and, hence, allow shortening of the fallow period. This practice has a potential to cut down fertilizer costs (Badege and Abdu, 2003)

2.4.2. Hedgerow inter-cropping

This form of agroforestry is practiced in many parts of Ethiopia. The sorghum/maize and Chat (*Catha edulis*) hedgerow intercropping in the Hararghe Highlands of eastern Ethiopia is one such example. The shrub chat is a stimulant cash crop that generates cash for the farmer. Although the soil regenerative properties of the system are not obvious, it has undoubtedly helped in the soil conservation of the hilly landscapes of Hararghe. Another form of hedgerow intercropping that has recently been introduced and has been widely tested in the scientific community is alley cropping. Experiments with alley cropping have been done at the International Livestock Research Institute (ILRI), Ethiopian Forest Research Center, and Haromaya University of Agriculture, among others. Alley cropping is an agroforestry technology suited to humid and sub-humid tropics and entails the growing of food crops between hedgerows of planted shrubs

and trees, preferably leguminous species. The hedges are pruned periodically during the crops' growth to provide biomass and enhance soil nutrient status. There is great potential for use of the system in Ethiopia, particularly to improve soil and water conservation in the hilly and mountain ranges for which Ethiopia is known (Destaw, 2010).

2.4.3. Scattered Trees on Cropland

This practice involves the growing of individual trees and shrubs in wide spaces in the farmland, while field crops are grown in the understory. The practice of growing trees dispersed on cropland may be based on protection and careful management of naturally regenerated trees, and it also involves planting new trees. Dispersed trees grown in farmlands characterize a large part of the Ethiopian agricultural landscape and it is an age-old practice. Some good examples of this practice include *Cordia africana* intercropping with maize in Bako and western Ethiopia; *Faidherbia albida*-based agroforestry in the Hararghe Highlands and Bishoftu area; scattered *Croton macrostachys* trees into the cropland at Finote-selam in West Gojam Zone, *Acacia nilotica*, *Ehretia cymosa*, *Cordia africana* and *Croton macrostachys* in the farmland in North shoa and South Wollo zones, (Mehari,2012)and the Gedeo indigenous agroforestry system (Gadisa,2016) which all share the characteristics of Weyna-dega and Dega agro climatic zones.

2.4.4. Live Fences

Live fences are barriers of closely spaced trees or shrubs to protect crops or structures against livestock and human interference. It may be established all around the farm, but it is commonly established around the homesteads and gardens. It is commonly practiced in Ethiopia. Live fences can be combined with other trees for production of wood and fruits. They can be made of single or multiple densely planted rows. Alternatively, one row of living fence posts can be planted widely spaced, with wire, sticks or dead branches between the interests in agroforestry is stimulated trees (Tsegaye and Worku, 2012).

2.5. Challenges for promoting Agroforestry practices

2.5.1. Policy Constraints

Policy plays an important role in distinguishing countries and regions that have benefited from agroforestry from those that have not. According to Place *et al.*, (2012) there are three key policy areas in which constraints need to be overcome in order for agroforestry benefits to be distributed more widely. First, farmers need land and tree tenure. If these factors are absent or

farmer involvement in tree-planting and management can be limited; but if those factors are assured, greater interest in agroforestry practice is stimulated. Land tenure rights are particularly important for agroforestry compared with other agricultural practices because of the relatively long period that may be required to realize benefits. Sometimes current policies on ownership have perverse effects, for example when regulations designed to control the harvesting, cutting or sale of tree products from forests are applied to farmland and limit the ability to use planted trees as substitutes for a wild resource.

Second, policies that determine how farmers obtain seeds, seedlings and clones of a wide range of tree species suitable for their various planting requirements are crucial (Lilleso *et al*., 2011). Current policies often slow the adoption of agroforestry, for example, by discriminating against small-scale entrepreneurial seed and seedling suppliers by providing NGOs and government extension services with funds to give free tree seed to farmers.

Third, the current policy environment often does not recognize agroforestry as an attractive investment area in agriculture. For example, governments often subsidies the provision of artificial fertilizers to enhance staple crop yields, which discourages the adoption of improved fallow technologies that could ultimately increase staple crop production more cost effectively and sustainably. Another problem is the lack of attention given to tree products and services in data collection and therefore there is a lack of information on the value of agroforestry trees in supporting food and nutritional security (FAO, 2013).

In addition to the above problems there is no citification standards for most of the tree based products and their derivatives, lack of adequate and research and extension capacity, lack of focus on agroforestry in Ethiopian Universities, farmers have poor access to tree seed and germplasm, the current government provides little support to farmers and who want to add value to their tree based products stakeholders involved in supporting tree based enterprise have been poorly coordinated (ICRAF,2015).

2.5.2. Constraints in Delivering Tree Products to Markets

Markets for many tree products are poorly structured and coordinated (Jonathan *et al*., 2014). This results in low and unstable returns to farmers and high prices for buyers of tree foods, which limits their consumption. Problems often cited by producers include the absence of a collective

bargaining system, poor transport infrastructure, and the involvement of multiple intermediaries in the supply chain, all of which act to reduce farm prices (Jamnadass *et al*., 2011). For perishable goods such as fruit, the result is also high wastage along the supply chain and a failure to reach quality grades. Prevailing low returns mean that farmers struggle to afford inputs to improve their suboptimal farm management practices. Traders also face many problems such as poor roads, corrupt officials and the high cost of collecting tree products from geographically. The market information systems in Ethiopia often do not include information about tree products, prices and marketing benefits (ICRAF, 2015).

2.5.3. Under investment in Research

There has been under investment in the development of new tree lines, cultivars, etc., that have high yields and provide quality products under smallholder production conditions. Until recently, scientists mostly ignored the great potential for the improvement of indigenous fruit trees.For many indigenous food trees only limited information is available on nutritional value, which can be expected to differ significantly even within species (Stadlmayr *et al*., 2013).

CHAPTER THREE

3. METHODOLOGY

3.1 Description of the study area

The study was carried out in Gimbo district, southwest Ethiopia. Gimbo district is one of the ten districts of the Kaffa Zone, southwest Ethiopia. The District is found within the geographical location of 7^0 23'North latitude – 7^0 49'N latitude and 36^0 00'East – 36^0 47'E, latitude and has a total land area of 832.5 km^2. Bonga is the administrative center of the Kaffa Zone and is found 440 km southwest of Addis Ababa. Uffa town is the central town of Gimbo district, which is found 18 km from the zone's capital, Bonga.

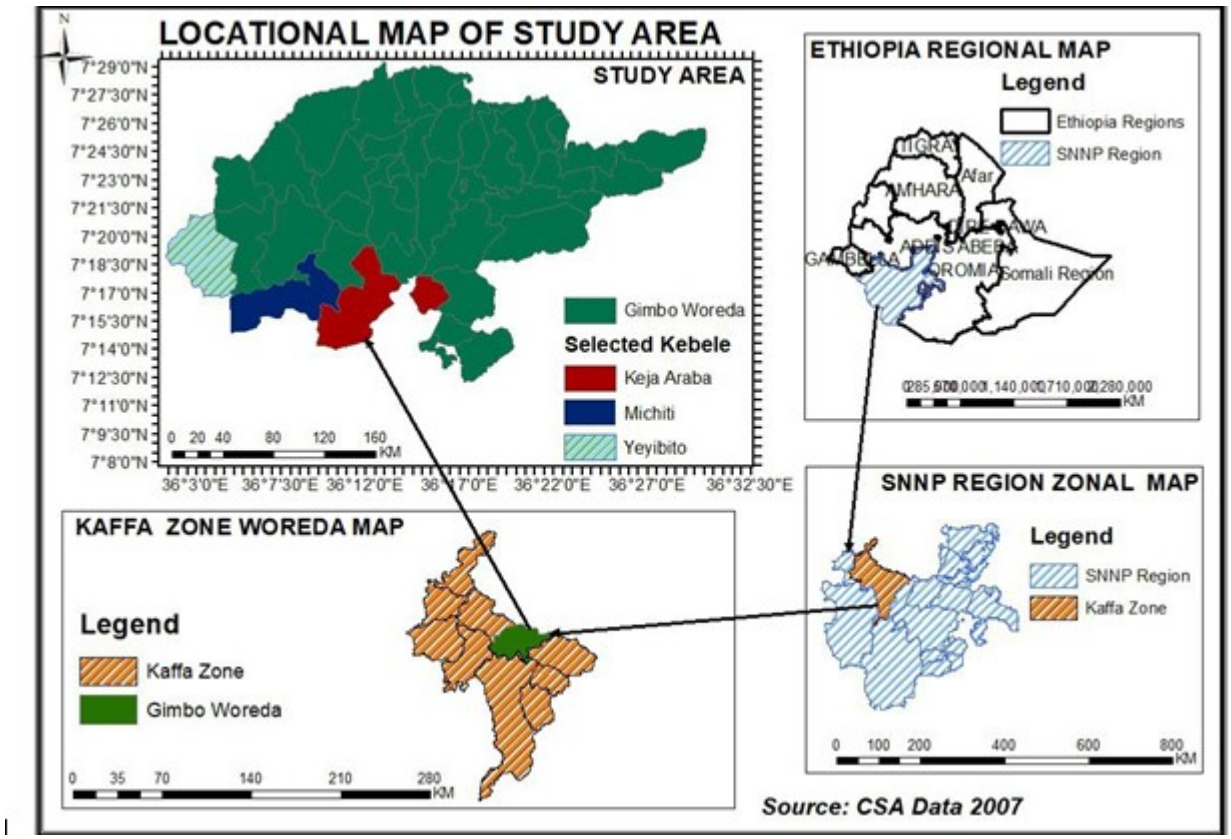

Figure1: Map of the study area (Source, CSA data, 2007)

Gimbo district has 85% of its area as highland and 15% low land. From the total area 16.98% has an altitudinal range of 2500-3500 m a.s.l, 68.12% found b/n 1500-2500 and 14.91% is within altitudinal range of 500-1500 m a.s.l. (SUPACK, 2004). The area has rugged and mountainous topography (Abayneh Derero 2003). and has gentle and flat landscape towards the Gojeb River. The geology of Gimbo district comprises (Eocene-Oligocene) (MoWR, 1996a; cited in Abayneh

Derero *et al.*, 2003). Moreover, the dominant soil unit comprises chromic luvisol, very deep dark reddish over dark reddish brown clay loam over clays (Abayneh Derero *et al.*, 2003). Nitosols, regosols and cambisols are among the different soil taxonomic groups of the study area (Feyera Senbeta, 2006).

Gimbo district has a mean annual temperature ranging between 15.1 and 22.5 ^{0}C with elevation ranging from 500 to 2500 m above sea level.

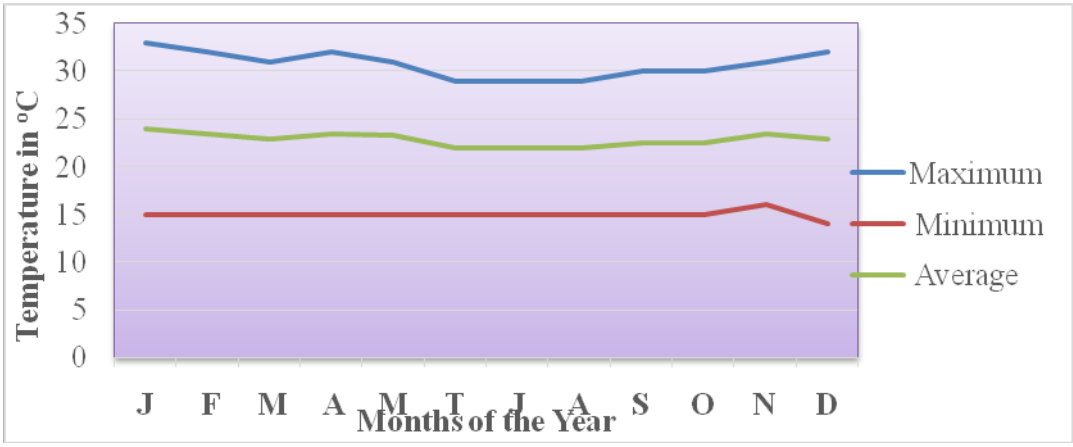

Figure 2: Temperature of Gimbo District

Gimbo district has long rainy season from March to November, the wettest season being May and June. The mean annual temperature of the district measured at Bonga town is 19.5 C^{0} EWNHS, (1997)

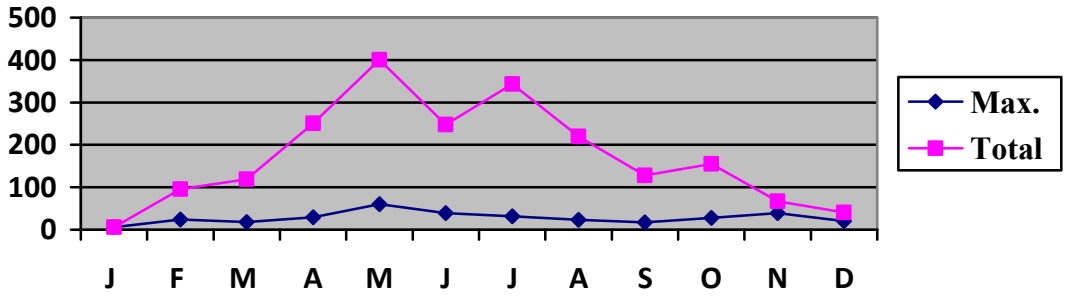

Figure 3: Rainfall of Gimbo District

The people in the study area are largely speakers of the language Keficho. These Keficho speaking people have social groupings sometimes considered as tribes. Also in the area, there are Oromo, Amhara, Tigre, Kembata and Hadiya ethnic populations. The resource use pattern

observed today has multicultural dimensions because this mix of people of different culture and knowledge backgrounds brings different patterns in to play.

Table 1: Population and Household Estimates of Gimbo district

Number of kebeles	Number of people			Number of households
35	Male	Female	Total	12806
	60309	60865	121174	

(***Source***: Kafa zone Finance and economy office, 2018)

Gimbo forest is part of Bonga forest and Kafa forest are classified in the vegetation of Ethiopia referred to as moist evergreen montane forests. The forests are located within altitudinal range of 1100-2700 ma.s.l. The forests in this area are normally the richest in species (Friis *et al*., 1982).

Table 2: Gimbo district land use/cover (ha)

Land use types	Land area(ha)
Built up area	674
Cultivated land Intensively	35,034
Moderately	1,348
Tea plantation	2,617
Montane forest Undisturbed	23,009
Disturbed	8,357
Highly disturbed	3,162
Wood land Dense shrub/bush	902
Savanna	0
Plantation eucalypti	1,259
Juniper	912
Coffee investment area	406
Grassland Open	1,893
Wooded	327
Wetland Perennial	4,511
Seasonal	2,776

(***Source***: SUPAKS, 2004)

According to the recent inventory carried out by the Institute of Biodiversity Conservation and Research through the GTZ-supported Forest Genetic Resources Conservation Project, Bonga forest is characterized by three distinct vegetation types (Taye Bekele, 2003). These vegetation types are:

Upland Rainforest Vegetation- This vegetation occurs at altitudes between 1500-2200 m a.s.l. and characterized by big tree species such as *Olea welwitschii*, *Schefflera abyssinica*, *Euphorbia ampliphylla*, *Croton macrostachyus*, *Albizia schimperiana*, *Prunus africana*, *Syzygium guineense* and *Polyscias fulva*. It also contains common smaller trees and shrubs such as *Millettia ferruginea*, *Teclia nobillis*, *Dracaena steudneri*, *D. afromontana*, *Galiniera saxifraga* and *Coffea arabica*. Ground herbs include false cardamom (*Afromomum corrorima*).

Upland Humid Forest Vegetation- This vegetation occurs at altitudes between 2450 -2800 m a.s.l and characterized by tree and shrub species such as *Hagenia abyssinica*, *Ilexmitis*, *Myrsine melanophloeos* (*Rapania melanophloeos*), *Maesa lanceolata* and *Bersama abyssinica.*

Arundinaria /Bamboo Thicket- This vegetation occurs at altitudes between 2400-3050 m a.s.l and characterized by bamboo thicket either in pure stands or may exist in mixture with trees, including *H. abyssinica*, *M. melanophloeos*, and *Hypericum revolutum*.

3.2. Research Design

In this study, descriptive survey research design was employed. Because the major goal of this study was to describe the practices, benefits and challenges of agroforestry, as it exists at present, it is also relevant to gather detailed information concerning status of the practices, benefits and challenges of agroforestry. Moreover, descriptive research design made possible the prediction of the future based on findings on prevailing conditions.

3.3. Sampling technique and Sample Size

In order to collect primary data, the researcher used three different sample sizes with different sampling procedures. In all cases, sample sizes were determined by considering financial, time and resource constraints. In the first stage: based on most availability of agroforestry practice, the researcher selected three kebeles (Yeyebitto, Michitti and Qeja araba) purposively out of 35 kebeles of Gimbo districts.

In the second stage the researcher took a total sample size of 317 households from three sample kebeles in general. The sample size was determined by using formula following Yamane (1967) formula by considering an estimate of 95% expected significant and giving any particular outcome to be within 5% of marginal error and 95% confidence interval of certainty (alpha=0.05).

Based on this assumption, the actual sample size for this study is computed as:-

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

Where n = sample size

N = Total size of households, and

e = acceptance level of error.

n = 1526/1+ 1526 (0.0025) = 1526/ 4.815 = 317

Therefore, n = 317 is the minimum sample size of household members for reliable results. Finally, by using proportional allocation method the researcher decided to take sample members from three kebele households. These sample members were drawn for data collection using simple random sampling method.

n = 317

n_1 (Yeyebitto) = $n*N_1/N = 317*450/1526=93$

n_2(Michitti) = $n*N_2/N = 317*528/1526 =110$

n_3(Qeja araba) = $n*N_3/N = 317*548/1526 =114$

Table 3: Proposed number of sample households of sample kebele

Kebeles	**No of house holds**	**No of sample**
Yeyebitto	450	93
Michitti	528	110
Qeja araba	548	114
Total	**1526**	**317**

Finally, for additional information from the total 9 Development agents and 1 the district's Agricultural office and forestry department head, all of them were selected to become the sample of the study by census sampling method.

3.4. Methods of Data Collection

3.4.1. Data Source

In order to achieve the intended objectives, the data for this study were collected from both primary and secondary data sources. For gathering primary data investigator employed questionnaires, interviews, and focus group discussions. In addition in each kebele commonly available trees and shrubs in the agroforestry system were recorded from the farmlands or home gardens of the interview farmers. The researcher also assessed secondary data from different

published and unpublished data sources such as books, journals, electronic media, research reports, official statics and reports. The secondary data were consisted of data on the population, characteristics of the study area as well as general concepts on agroforestry practices on different places across the globe. For gathering primary data researcher employed questionnaires, interviews and focus group discussion.

3.4.2. Questionnaires

With regard to questionnaires, there were two types of questionnaires (both open and close ended) which were used and administered to selected households living in sample kebeles in order to look the practice, benefits and challenges of agroforestry in the study area. These questionnaires were first prepared in English but later it translated in to Kafinonoo (local language) for making it easily understandable to the respondents. After preparation, around 30 questionnaires were randomly distributed as pre-test in order to correct unclear and misleading questions. Then all questioners were brought to the respondents.

3.4.3. Interview

Moreover, primary data was also gathered with the help of semi structured interviews with development agricultural workers and the district's agriculture and forestry department head. The interview was aimed at capturing information on agroforestry practices found in the area and their benefits for rural households in the study area.

3.4.4. Focus group discussions

Focused group discussions were conducted in three selected kebeles with participants being selected among farmers who have been practicing agroforestry within the area. Eight farmers from each of the three locations were assessed and invited for the group discussions. The discussions were revolved around farmers' practices, benefits and challenges of agroforestry in the study area. The aims of these discussions were to triangulate information from the interview schedules and questionnaire survey.

3.4.5. Document analysis

On the other hand, secondary data were extracted from different sources including published and unpublished materials from different bodies.

3.5. Method of Data Analysis

Statistical Package for Social Science (SPSS) was used to analyze quantitative data. Qualitative information's collected through verbal discussion and open ended questionnaires were broken

down into smaller meaningful themes and analyzed to bring statistical meaning. This helped in ascertaining attitude of the respondents. Prior to data analysis using SPSS, coding was first done to summarize information based on formulated ecosystem service variables. Descriptive statistics were computed using the Statistical Packages for Social Sciences (SPSS).

CHAPTER FOUR

4. RESULT AND DISCUSSIONS

4.1. Results

4.1.1. Demographic characteristics

Table 4: Demographic characteristics of Respondents
The table below summarizes the demographic characteristics of respondents.

Items	Variables	Responses	
		Number	**Percent**
Sex	Male	168	53%
	Female	149	47%
	Total	**317**	**100%**
Age	< 30 Years	26	8.20%
	31 -40 Years	42	13.25%
	41 – 50 Years	130	41.01%
	>50 Years	119	37.54%
	Total	**317**	**100%**
Education level	No formal education	105	33.1%
	Grade 1-4	125	39.4%
	Grade 5- 8	50	15.8%
	Grade 9 – 12	37	11.7%
	Total	**317**	**100%**
Religion	Orthodox	161	50.8%
	Protestant	89	28.1%
	Catholic	23	7.3%
	Muslim	44	13.9%
	Total	**317**	**100%**
Marital status	Single	16	5.0%
	Married	254	80.1%
	Divorced	28	8.8%
	Widow /Widower	19	6.0%
	Total	**317**	**100%**
No. of years lived in the area	11-15 years	12	3.8%
	> 15 years	305	96.2%
	Total	**317**	**100%**
Family size	<5 persons	75	23.7%
	5-10 persons	212	66.9%
	>10 persons	30	9.5%
	Total	**317**	**100%**

Source: Own survey, 2019

4.1.2. Major types of Agro-forestry Practices in Gimbo District

Table 5: Types of Agro-forestry Practices

Types of Agro-forestry	Rating of Respondents		Mean	SD	p-value
	1.Yes	2.No			
Scattered trees in crop lands	238	79	1.25	.433	.024
Home garden agro-forestry	310	7	1.02	147	.008
Hedgerow intercropping	273	44	1.14	.346	.019
Riparian zone vegetation	39	278	1.88	.329	.018
Enclosures and natural regeneration of species in woodlands and pasture	126	191	1.60	.490	.028
Plantation –based cropping system	291	26	1.08	.275	.015
Shelterbelts and windbreaks	300	17	1.05	.226	.013
Boundary planting and live hedges	233	84	1.26	.442	.025
Woodlots for soil conservation	128	135	1.43	.495	.028
Industrial plantations with crops	112	205	1.65	.479	.027

Source: Questionnaire Survey, 2019

The above table revealed the respondents agreement on the types of agro-forestry practices in their villages. From the analysis it is possible to say that home garden agro-forestry; Shelterbelts and windbreaks; Plantation-based cropping system; Hedgerow intercropping; scattered trees in crop lands; Boundary Planting and live hedges; and Woodlots were the major types of agro-forestry practices in Gimbo district.

4.1.3. Benefits of Agro-forestry to the Local Community of the Study Area

Table 6: Respondents Agreement towards Agro-forestry benefits

Item	Respondents	Respondents (N=317)		Mean	SD	p-value
		Frequency	Percent			
Do you agree Agro-forestry practice benefited you and others?	1.Yes	315	99.4%	1.01	0.79	0.04
	2.No	2	o.6%			
	Total	317	100%			

Source: Own survey, 2019

The above table revealed the respondents agreement on whether they benefited from agro-forestry practices or not. As indicated in the table, the majority were agreed that agro-forestry practices benefited them and others with a mean value of 1.01 and standard deviation of 0.79.

From this it is possible to understand that agro-forestry practices were benefited farmers of Gimbo District.

Table 7: Conditions of the society after the introduction of Agro-forestry

1. Improved 2. Remained the same 3. Worsened 4. Don't know

The table below reveals the conditions of the society around the forest area after the introduction of Agro-forestry.

Variables	Rating of respondents				Mean	SD	p-value
	1	2	3	4			
Households' income level	291	19	5	2	1.11	.410	023
Vulnerability to food insecurity	279	26	9	3	1.17	.504	.028
Access to forest product	282	33	1	1	1.12	.362	.036
Access to credit	268	30	11	8	1.24	.636	.036
Participating in own cash generating activity	231	43	22	21	1.47	.888	.050
Species composition, density and structure of the forest	293	24	0	0	1.08	.265	,015
Crop production	255	42	10	10	1.29	.678	.038
Livestock production	274	34	9	0	1.16	.441	.025
Product from NTFPs	247	70	0	0	1.22	.415	.023

Source: Questionnaire survey, 2019

The study also revealed that before the introduction of agro-forestry households in and around Gimbo forest depended mainly on forest products, crop farming and, to a limited extent on livestock. However, with the adoption of agro-forestry, major income sources of participant households shifted from the predominantly forest based before agro-forestry to agriculture based after agro-forestry (FDGs).

Table 8: Benefits from Agro-forestry Practices

5 = Strongly agree, 4 = agree, 3 = neutral, 2 = disagree, 1 = strongly disagree

The table below indicates the responses of respondents related with benefits of agro-forestry in the study area. Some of the strong and major benefits that were identified by respondents in the study area include:

Benefits	N	Min	Max	Mean	SD	p-value
Introduced deforestation	317	1	5	3.73	1.346	.1220
There was increment of forest inventory	317	1	5	3.48	1.299	.116
Increased the right to use the forest product	317	1	5	3.14	1.176	.105
Empowered women and marginalized groups	317	1	5	3.13	1.276	.114
Created more employment opportunity for participants	317	1	5	2.86	1.378	.123
Encouraged alternative livelihood activities	317	1	5	3.54	1.132	.101
Created new market benefits for the participants	317	1	5	3.65	1.159	.104
Increased environmental awareness for the participants	317	1	5	3.78	1.229	.110
Reduced conflict over forest resource use	317	1	5	4.11	.977	.087
High demand for tree products, including wood, fodder and other non timber forest products.	317	1	5	3.79	1.050	.094

Source: Questionnaire survey, 2019

Likewise, FGDs participants disclosed that they are using wild coffee, spices, honey and so on for their subsistence, construction materials for their houses and fence as well as woods for agricultural tools. Furthermore, the same things were mentioned during the key informant interviews as agro-forestry members are gaining economic benefits in terms of timber and non-timber forest products. This indicates that agro-forestry strategy has enabled the communities to have the legal rights to supplement their livelihood from the forest resources.

With regarding to empowerment of women and marginalized groups, the majority of respondents was strongly agreed and agreed that agro-forestry as strategy has empowered women and marginalized groups with a mean value and standard deviation of 3.13 and 1.276. This indicates that empowering women and marginalized groups is one of the benefits of agro-forestry in the study area. Moreover, during FGDs and key informant interview participants revealed that agro-forestry as a strategy treats all social groups equally and it gives equal chance for all social groups without discrimination. Therefore, as seen from the response analysis, and triangulation of different data sources, it is possible to say that agro-forestry as strategy has empowered women and marginalized groups in the study area.

As shown in the table, a substantial proportion of the respondents agreed that agro-forestry practices encouraged alternative livelihood activities. Similarly, a majority of them also expressed their agreement with it created more employment opportunities for participants. The

mean values of these items are 3.54 and 2.86 respectively. This tells us agro-forestry practices were high in encouraging alternative livelihoods but it was moderate in creating more employment opportunities for community of the study area.

The discussions with FGDs participants indicated that although some forest based livelihood activities are available, non-forest based livelihood activities were lacking. Nearly all of the participants reported the need for more non-forest based livelihood initiatives such as promotion of crop variety improvements, irrigation; poultry breed improvements, and sheep/goat fattening. Moreover, they stated the need for improved market benefits for non-timber forest products (e.g., honey and spices).

As the above table shows the majority of respondents agreed with the statement that says the practice increased environmental awareness for the participants. The mean value of 3.78 indicates that the agro-forestry practices were highly increased environmental awareness of the people of the study area. Access to market opportunities specifically for coffee, was also supported by a substantial proportion (65.1%) of them. The mean value of 3.65 tells us that agro-forestry practices were moderate in creating new market opportunities for the participants.

This result was further supported by focus group discussants that stated agro-forestry played a significant role in facilitating access to markets through creating linkages with other Coffee Farmers Cooperatives Union. According to participants, this access to marketing opportunities helped to empower the participants in terms of providing access to price information and awareness about improved forest coffee management practices, as well as the opportunity to share information with other communities.

As indicated in the above table, it is important to mention that most of the respondents agreed with the statement that agro-forestry reduced conflicts over forest resource uses. The mean value of 4.11 indicates that the agro-forestry practices were highly reduced conflicts over the forest use in the study area. During the interview session one respondent said, ‘Before the introduction of the agro-forestry, there was conflict between the forest department and local communities over the use of forest resources. However, the agro-forestry had reduced mistrust and antagonistic relations caused by protectionist conservation strategies’.

4.1.4. Challenges confronting in the practice of agro-forestry in the study area

4.4.4.1. Socio-cultural Constraints towards Agro-forestry

Table 9: Social and Economic Challenges of Agro-forestry Practices
5 = Strongly agree, 4 = agree, 3 = neutral, 2 = disagree, 1 = strongly disag

The table below indicates the socio-economic challenges of agro-forestry practices in the study area.

Challenges	N	Min	Max	Mean	SD	p-value
Producers education level	317	1	5	4.02	1.039	.093
Small land plot size (mainly in upland villages)	317	1	5	4.14	.587	.052
Clan-owned land renting system	317	1	5	3.89	.854	.076
Absence of village land use plans	317	1	5	4.16	.700	.063
Poor Land use and management	317	1	5	3.56	1.095	.098
Capacity and knowledge	317	1	5	4.10	.521	.047
Lack of awareness by farmers of environmental benefits of trees and misconception about trees e.g. fear of tree shade negatively affecting crops, and fruit trees attracting monkeys	317	1	5	4.38	.619	.055
Lack of awareness of existing forest legislation	317	1	5	4.02	.777	.070
Lack of knowledge of tree seedling management, pest and disease control, and adequate seeds and germplasm supply	317	1	5	4.21	.639	.057
Illegal encroachment from humans and animals, which may lead to low stock and hamper natural regeneration.	317	1	5	3.48	1.248	.112
Lack of training or skills for product transformation	317	1	5	3.62	1.030	.092
Traditional management practice	317	1	5	3.49	1.209	.108

Source: Questionnaire survey, 2019

Concerning Producers education level, the majority of respondents were strongly agreed and agreed that Producers education level is one of the major challenges of agro-forestry with a mean value and standard deviation of 4.02 and 1.039. This indicates that Producers education level is a challenge of agro-forestry practices in the study area. Besides, during focus group discussions (FGDs) participants revealed that Producers education level was one of the major challenges of agro-forestry practices in the of the study area. Likewise, similar ideas were reflected during the key informant interview of natural resource experts at kebele, District and zone levels, as producers education level is one of the causes for low productivity of agro-forestry practices.

This shows Producers education level is one of the driving forces to pressurize the effectiveness of agro-forestry practices of the area.

With regard to small land plot size, the majority of respondents were strongly agreed and agreed that small land plot size is one of the major challenges of agro-forestry practices with a mean value and standard deviation of 4.14 and .587. This indicates that small land plot size is a challenge of agro-forestry practices in the study area.

On the other hand, Clan-owned land renting system, Absence of village land use plans, Poor Land use and management, Capacity and knowledge, Lack of awareness by farmers of environmental benefits of trees and misconception about trees e.g. fear of tree shade negatively affecting crops, and fruit trees attracting monkeys, Lack of awareness of existing forest legislation, Lack of knowledge of tree seedling management, pest and disease control, and adequate seeds and germplasm supply, Illegal encroachment from humans and animals, which may lead to low stock and hamper natural regeneration, Lack of training or skills for product transformation and traditional management practice were rated as the major challenges of agro-forestry practices in the study area with mean values of 3.89, 4.16, 3.56, 4.10, 4.38, 4.02, 4.21, 3.48, 3.62 and 3.49 respectively.

During FGDs it is mentioned that family size and past participation in agro-forestry training were affecting the number of trees planted in agro-forestry. House hold (HH) with higher family sizes was planting more trees than less family sizes. This could be attributed with labor availability, and most of the age distribution per households in the watershed was found in productive age (age between 15 to 64 years). Higher family size would have better labor to plant trees because most of household members in this family size were in productive age. People found in this productive age were younger, eager to plant trees, able to provide better management for the planted trees, better in economic condition as most of them work an off farm activities. In addition to the agricultural activities, they have different hand works as a means of income generation, which help them to buy seedlings, and participate in different agro-forestry trainings that increase their knowledge about the importance of trees.

Similarly, people who participated in agro-forestry training planted more trees than who did not participate. This is related with level of knowledge i.e., different trainings given for local people would increase an understanding on agro-forestry component interaction and management, importance of woody species, and ways of increasing the survival rate of seedlings/saplings.

Training/lack of extension was also reported to drastically affect agro-forestry practices in the study area.

4.1.4.2. Market Constraints towards Agro-forestry

Table 10: Challenges of Agro-forestry Practices related with market

5 = Strongly agree, 4 = agree, 3 = neutral, 2 = disagree, 1 = strongly disagree

The table below indicates the market related challenges of agro-forestry practices in the study area.

Challenges	N	Min	Max	Mean	SD	p-value
Poorly structured and coordinated markets for many tree products	317	1	5	3.68	1.260	.113
Low and unstable returns to farmers and high prices for buyers of tree foods, which limits their consumption.	317	1	5	3.56	1.164	.104
Absence of a collective bargaining system,	317	1	5	3.87	1.370	.123
Poor transport infrastructure,	317	1	5	2.36	.942	.084
High wastage for perishable goods such as fruit along the supply chain and a failure to reach quality grades.	317	1	5	3.02	1.329	.119
High cost of collecting tree products from the area.	317	1	5	3.29	1.343	.120
Small number of markets, and lack of market information	317	1	5	3.58	1.357	.121
Lack of storage facilities	317	1	5	3.65	1.159	.104
Lack of capital and unstable prices and supplies, especially during the rainy season	317	1	5	3.88	1.211	.110

Source, Questionnaire survey, 2019

As indicated in the table, Poorly structured and coordinated markets for many tree products, Low and unstable returns to farmers and high prices for buyers of tree foods, which limits their consumption, Absence of a collective bargaining system, Poor transport infrastructure, High wastage for perishable goods such as fruit along the supply chain and a failure to reach quality grades, High cost of collecting tree products from the area, Small number of markets, and lack of market information, Lack of storage facilities and Lack of capital and unstable prices and supplies, especially during the rainy season are challenges of agro-forestry practices with mean values of 3.68, 3.56, 3.87, 2.36, 3.02, 3.29, 3.58, 3.65 and 3.88 respectively. From this it is possible to conclude that Poorly structured and coordinated markets for many tree products, Low

and unstable returns to farmers and high prices for buyers of tree foods, which limits their consumption, Absence of a collective bargaining system, Poor transport infrastructure, High wastage for perishable goods such as fruit along the supply chain and a failure to reach quality grades, High cost of collecting tree products from the area, Small number of markets, and lack of market information, Lack of storage facilities and Lack of capital and unstable prices and supplies, especially during the rainy season are challenges of agro-forestry practices in the study area.

4.1.4.3. Policy related Constraints towards Agro-forestry

Table 11: Policy related Challenges of Agro-forestry Practices

5 = Strongly agree, 4 = agree, 3 = neutral, 2 = disagree, 1 = strongly disagree

The table below indicates the policy related challenges of agro-forestry practices in the study area.

Challenges	N	Min	Max	Mean	SD	p-value
Poorly structured and coordinated markets for many tree products	317	1	5	3.68	1.260	.113
Low and unstable returns to farmers and high prices for buyers of tree foods, which limits their consumption.	317	1	5	3.56	1.164	.104
Absence of a collective bargaining system,	317	1	5	3.87	1.370	.123
Poor transport infrastructure,	317	1	5	2.36	.942	.084
High wastage for perishable goods such as fruit along the supply chain and a failure to reach quality grades.	317	1	5	3.02	1.329	.119
High cost of collecting tree products from the area.	317	1	5	3.29	1.343	.120
Small number of markets, and lack of market information	317	1	5	3.58	1.357	.121
Lack of storage facilities	317	1	5	3.65	1.159	.104
Lack of capital and unstable prices and supplies, especially during the rainy season	317	1	5	3.88	1.211	.110

Source: Questionnaire survey, 2019

As indicated in the table, Not recognizing agro-forestry as an attractive investment area in agriculture by the current policy environment, Absence of citification standards for most of the tree based products and their derivatives, Lack of adequate and research and extension capacity, Lack of focus on agro-forestry in Ethiopian Universities, Poor access of farmers to tree seeds , Poor coordination of Stakeholders involvement in supporting tree based enterprise, The high

state and central government taxes and Lack of sufficient trained human power and facilities were rated as challenges of agro-forestry practices with mean values of 4.00, 4.42, 4.15, 3.69, 3.67, 3.89, 3.90 and 3.78 respectively. From the above analysis it is possible to say that Not recognizing agro-forestry as an attractive investment area in agriculture by the current policy environment, Absence of citification standards for most of the tree based products and their derivatives, Lack of adequate and research and extension capacity, Lack of focus on agro-forestry in Ethiopian Universities, Poor access of farmers to tree seeds , Poor coordination of Stakeholders involvement in supporting tree based enterprise, The high state and central government taxes and Lack of sufficient trained human power and facilities were the challenges of agro-forestry practices in the study area.

4.2. Discussions

The study was assessed the types of agro-forestry practiced in the study area. The finding on the assessment of types of agro-forestry practices revealed that most of the study population was agreed that home garden agro-forestry ranked first followed by Shelterbelts and windbreaks; Plantation-based cropping system; Hedgerow intercropping; scattered trees in crop lands; Boundary Planting and live hedges; and Woodlots for soil conservation. From the analysis it is possible to say that home garden agro-forestry; Shelterbelts and windbreaks; Plantation-based cropping system; Hedgerow intercropping; scattered trees in crop lands; Boundary Planting and live hedges; and Woodlots for soil conservation were the major types of agro-forestry practices in Gimbo district.

Concerning the Benefits of Agro-forestry to the Local Community of the Study Area, the result revealed that the majority of respondents were agreed that agro-forestry practices benefited them and others. As indicated in the result the majority of respondents were agreed that households income levels, vulnerability to food insecurity, access to forest product, access to credit, Participating in own cash generating activity, species composition, density and structure of the Forest, Crop production, Livestock production and Product from NTFPs were improved after the introduction of Agro-forestry. The study revealed that before the introduction of agro-forestry households in and around Gimbo forest depended mainly on forest products, crop farming and, to a limited extent on livestock. However, with the adoption of agro-forestry, major income sources of participant households shifted from the predominantly forest based before agro-forestry to agriculture based after agro-forestry (FDGs).

The ability of households to produce enough to feed their family throughout the year was identified by key informants as the major indicator of the change in food security status of households in the study area. The majority of the respondents reported reduction in vulnerability to food insecurity following the introduction of agro-forestry. Two-thirds of the respondents indicated that, before agro-forestry, they were facing serious food shortages during the months of May and June. This figure decreased after the introduction of agro-forestry.

Major reasons attributed to the change were the introduction and promotion of non-forest-based livelihood activities and the accompanying training received that increased production and income levels. The majority of the respondents reported that they had not gained any technical training and agricultural inputs support from any source before the introduction of agro-forestry, while the remaining asserted that they have had received technical assistance.

These observations indicate the success of agro-forestry in redirecting the income sources of the local community from destructive forest use to sustainable forest production system or other complementary activities. Such redirection and improvement of income sources have ultimately achieved better food security as was confirmed by respondents. A similar study conducted in Bangladesh, reported significant poverty reduction among participants in Agro-forestry (Safa 2004). Studies in Gujarat, Andhra Pradesh, Haryana, Madhya Pradesh and West Bengal in India recorded improvements in the form of increased income to members of community institutions, from non-timber forest products (Prasad 1999). A study in Adaba Dodolla, Ethiopia also found improvement in the livelihoods of participant households (Terefe 2002).

The result also indicated that, agroforestry reduced forest deforestation in the area. This indicates that reducing deforestation is one of the benefits of agro-forestry in the study area. Respondents also explained that, agro-forestry provided them with the opportunity to manage the forest jointly with the forest department, which could in turn lead to develop our sense of ownership over the forest and reduced deforestation. A similar study by Mustalahti (2009) in Tanzania found a strong feeling of ownership over the forest resources following the implementation of agro-forestry. This implies that transferring resource management power to the grassroots level community with clearly defined rights and responsibilities can create sense of ownership.

In line with this finding, the study conducted by Tolera *et al.* (2015) indicated that due to the implementation of agro-forestry strategy, it has created sense of ownership and motivated the

community to protect the forest. Similarly, this approach is in agreement with bottom-up decision-making neo-populist theory of biodiversity conservation (Bio *et al.,* 1995). Therefore, as seen from the response analysis and triangulation of different data sources, it is possible to say that agro-forestry practices decreased deforestation in the study area.

Regarding the agro-forestry increased forest inventory, the majority of respondents believed that there were increment of forest inventory after the introduction of agro-forestry in the study area.

The mean value of response is 3.48. This indicates that agro-forestry strategy increased forest inventory in the study area. Likewise, during FGDs and key informant interview participants revealed that agro-forestry practices created increment of forest inventory. This implies that the strategy has created increment of forest inventory.

With regarding to increasing the right to use the forest product for the community, which era being gained by the communities, the result indicated that the majority of participants believed that due to agro-forestry strategy the right to use the forest product for the community was increased. This indicates that agro-forestry strategy has enabled the communities to have the legal rights to supplement their livelihood from the forest resources. In consistent with this finding, the study conducted by Winberg (2011) showed that agro-forestry is suggested as a potential to improve in addressing two of the Millennium Development Goals ie., eradicating extreme poverty and hunger; and ensuring environmental sustainability. Thus, as seen from the response analysis and triangulation of different data sources, it is possible to conclude that agro-forestry strategy has enabled the forest adjacent communities the rights to have the timber and non-timber forest products in the study area.

With regarding to empowerment of women and marginalized groups, the majority of respondents was strongly agreed and agreed that agro-forestry as strategy has empowered women and marginalized groups. This indicates that empowering women and marginalized groups is one of the benefits of agro-forestry in the study area. Moreover, during FGDs and key informant interview participants revealed that agro-forestry as a strategy treats all social groups equally and it gives equal chance for all social groups without discrimination. In line with this finding, the study conducted in Bonga agro-forestry practices by Gobeze *et al.* (2009) exemplified that agro-forestry strategy empowered local people as it enabled them to organize themselves and enhance their participation in decision making regarding the management of the forest resources. Similarly, the finding of this study is also in line with the biodiversity conservation theory of

Neo-populist (Populist). Alike the study conducted by Toler *et al.* (2015) showed that since agro-forestry is empowering and economically exciting to communities, it tenders key benefits for promoting biodiversity conservation of forests in a sustainable way. Therefore, as seen from the response analysis, and triangulation of different data sources, it is possible to say that agro-forestry as strategy has empowered women and marginalized groups in the study area.

Regarding Challenges confronting in the practice of agro-forestry in the study area,

The result indicates the socio-economic challenges of agro-forestry practices in the study area. Concerning Producers education level, the majority of respondents were strongly agreed and agreed that Producers education level is one of the major challenges of agro-forestry. This indicates that Producers education level is a challenge of agro-forestry practices in the study area. Besides, during focus group discussions (FGDs) participants revealed that Producers education level was one of the major challenges of agro-forestry practices in the of the study area. Likewise, similar ideas were reflected during the key informant interview of natural resource experts at kebele, District and zone levels, as producers education level is one of the causes for low productivity of agro-forestry practices. This shows Producers education level is one of the driving forces to pressurize the effectiveness of agro-forestry practices of the area.

On the other hand, Clan-owned land renting system, Absence of village land use plans, Poor Land use and management, Capacity and knowledge, Lack of awareness by farmers of environmental benefits of trees and misconception about trees e.g. fear of tree shade negatively affecting crops, and fruit trees attracting monkeys, Lack of awareness of existing forest legislation, Lack of knowledge of tree seedling management, pest and disease control, and adequate seeds and germplasm supply, Illegal encroachment from humans and animals, which may lead to low stock and hamper natural regeneration, Lack of training or skills for product transformation and traditional management practice were rated as the major challenges of agro-forestry practices in the study area.

During FGDs it is mentioned that family size and past participation in agro-forestry training were affecting the number of trees planted in agro-forestry. House hold (HH) with higher family sizes was planting more trees than less family sizes. This could be attributed with labor availability, and most of the age distribution per households in the watershed was found in productive age (age between 15 to 64 years). Higher family size would have better labor to plant trees because most of household members in this family size were in productive age. People found in this

productive age were younger, eager to plant trees, able to provide better management for the planted trees, better in economic condition as most of them work an off farm activities. In addition to the agricultural activities, they have different hand works as a means of income generation, which help them to buy seedlings, and participate in different agro-forestry trainings that increase their knowledge about the importance of trees.

Similarly, people who participated in agro-forestry training planted more trees than who did not participate. This is related with level of knowledge i.e., different trainings given for local people would increase an understanding on agro-forestry component interaction and management, importance of woody species, and ways of increasing the survival rate of seedlings/saplings. Training/lack of extension was also reported to drastically affect agro-forestry practices in the study area.

The result also indicates that Poorly structured and coordinated markets for many tree products, Low and unstable returns to farmers and high prices for buyers of tree foods, which limits their consumption, Absence of a collective bargaining system, Poor transport infrastructure, High wastage for perishable goods such as fruit along the supply chain and a failure to reach quality grades, High cost of collecting tree products from the area, Small number of markets, and lack of market information, Lack of storage facilities and Lack of capital and unstable prices and supplies, especially during the rainy season are challenges of agro-forestry practices. From this it is possible to conclude that Poorly structured and coordinated markets for many tree products, Low and unstable returns to farmers and high prices for buyers of tree foods, which limits their consumption, Absence of a collective bargaining system, Poor transport infrastructure, High wastage for perishable goods such as fruit along the supply chain and a failure to reach quality grades, High cost of collecting tree products from the area, Small number of markets, and lack of market information, Lack of storage facilities and Lack of capital and unstable prices and supplies, especially during the rainy season are challenges of agro-forestry practices in the study area.

Regarding the policy related challenges of agro-forestry practices in the study area, the result showed that Not recognizing agro-forestry as an attractive investment area in agriculture by the current policy environment, Absence of citification standards for most of the tree based products and their derivatives, Lack of adequate and research and extension capacity, Lack of focus on agro-forestry in Ethiopian Universities, Poor access of farmers to tree seeds , Poor coordination

of Stakeholders involvement in supporting tree based enterprise, The high state and central government taxes and Lack of sufficient trained human power and facilities were rated as challenges of agro-forestry practices. From the above analysis it is possible to say that Not recognizing agro-forestry as an attractive investment area in agriculture by the current policy environment, Absence of citification standards for most of the tree based products and their derivatives, Lack of adequate and research and extension capacity, Lack of focus on agro-forestry in Ethiopian Universities, Poor access of farmers to tree seeds , Poor coordination of Stakeholders involvement in supporting tree based enterprise, The high state and central government taxes and Lack of sufficient trained human power and facilities were the challenges of agro-forestry practices in the study area.

Challenges and barriers to agro-forestry were discussed during the FGDs, and they could be grouped in three main categories land tenure system, land use and management, and capacity building and knowledge. Slash and burn is preferred by farmers as it is not time and labor consuming, and helps to control weed and pest. Thus, alternatives need to be provided to help address the issues of time availability, labor demand, and weed and pest management, in association with awareness on the impacts of slash and burn agriculture on climate change and environment conservation in general. These results demonstrate that capacity development and awareness building is central to the expansion of agro-forestry in the project area, and that the promotion of alternatives to slash and burn is a high priority. More importantly however, they highlighted the challenges related to improving the land tenure system in which a considerable proportion of farmers today rent clan-owned lands on a seasonal/annual basis. In most cases, land owners rented out the most unproductive land, and farmers believed that if the land owners noticed an improvement in production they would claim back the land. Moreover, changes in land use practices on rented lands were allowed only in regard to annual crops, not for perennial crops and long cycle crops. Within such a land tenure system, planting trees raises several issues on tree and tree products ownership, land renting agreements and, more generally, on the social organization and power structures in the project area.

CHAPTER FIVE

5. CONCLUSSION AND RECOMMENDATIONS

This chapter deals with the conclusions of the major findings of the study, and recommendations.

5.1. Conclusion

The main objective of the study was to assess the practices, benefits and challenges of Agro-forestry in Gimbo district, Kafa zone. In line with this, the study has raised the following questions related with the objectives of the study:

1. What are the major types of agro-forestry practices performed in Gimbo district?
2. What are the benefits of agro-forestry to the local community of the study area?
3. What are the major challenges confronting in the practice of agro-forestry in the study area?

A survey study with quantitative and qualitative research approach was employed in this study. The related literature was reviewed and documented. In order to get answers for the above basic questions, the study was carried out in three kebeles of Gimbo district that were selected by random sampling techniques to the study. The study incorporated a total of 317 sample respondents. From the total of 317 questionnaires distributed to respondents all of them (100%) were filled and returned to the researcher. In addition, to supplement the information gathered through questionnaire, interviews and focus group discussions were undertaken with three selected kebeles with participants being selected among farmers who have been practicing agroforestry within the area on the practices, benefits and challenges of Agro-forestry and document analysis was also used as supplementary information. Finally, the data were carefully collected, coded, and presented for analysis. In the study, different data analysis tools such as frequency, percentage, mean values and standard deviation were used. Therefore, based on the finding of the study the following conclusions were made.

The major types of agro-forestry practices practiced by farmers of Gimbo district are home garden agro-forestry followed by Shelterbelts and windbreaks; Plantation-based cropping system; Hedgerow intercropping; Scattered trees in crop lands; Boundary Planting and live hedges; and Woodlots for soil conservation.

The finding of this study revealed that vulnerability to food insecurity, access to forest product, access to credit, Participating in own cash generating activity, species composition, density and structure of the Forest, Crop production, Livestock production and Product from NTFPs were improved after the introduction of Agro-forestry.

The major benefits of agro-forestry practices that were identified by the study include: Agro-forestry reduced deforestation, increased forest inventory, Increased the right to use the forest product, Empowered women and marginalized groups, Created more employment opportunities for participants, Encouraged alternative livelihood activities, Created new market benefits for the participants, Increased environmental awareness for the participants, Reduced conflicts over forest resource use High demand for tree products, including wood, fodder and other non timber forest products.

Producers education level, Small land plot size (mainly in upland villages), Clan-owned land renting system, Absence of village land use plans, Poor Land use and management, Capacity and knowledge, Lack of awareness by farmers of environmental benefits of trees and misconception about trees e.g. fear of tree shade negatively affecting crops, and fruit trees attracting monkeys, Lack of awareness of existing forest legislation, Lack of knowledge of tree seedling management, pest and disease control, and adequate seeds and germplasm supply, Illegal encroachment from humans and animals, which may lead to low stock and hamper natural regeneration, Lack of training or skills for product transformation and traditional management practice were identified by the participants of the study.

Poorly structured and coordinated markets for many tree products, Low and unstable returns to farmers and high prices for buyers of tree foods, which limits their consumption, Absence of a collective bargaining system, Poor transport infrastructure, High wastage for perishable goods such as fruit along the supply chain and a failure to reach quality grades, High cost of collecting tree products from the area, Small number of markets, and lack of market information, Lack of storage facilities and Lack of capital and unstable prices and supplies, especially during the rainy season are challenges of agro-forestry practices.

Not recognizing agro-forestry as an attractive investment area in agriculture by the current policy environment, Absence of citification standards for most of the tree based products and their derivatives, Lack of adequate and research and extension capacity, Lack of focus on agro-

forestry in Ethiopian Universities, Poor access of farmers to tree seeds , Poor coordination of Stakeholders involvement in supporting tree based enterprise, The high state and central government taxes and Lack of sufficient trained human power and facilities were rated as challenges of agro-forestry practices.

5.2. Recommendations

Based on the results and conclusions drawn, the following recommendations are made:

- There is need for intensification of farmers exchange visits since significant proportions of the successful farmers' were found to be influenced by their colleague.
- Due to the challenges faced by farmers in marketing some of the agro-forestry produce, this study recommends establishment of additional interest groups to boost development of farm produce enterprises.
- In view of challenges faced by governmental, non-governmental and community based institutions fronting natural resource management in Gimbo, there is need for capacity assessment of the existing institutions. The overall objective of such an assessment shall be to aid recommend appropriate intervention strategies for institutions development.
- There is need to encourage resource poor farmers to diversify their farming practices and progressively combine short and long-term production practices to enhance their social and economic well being.
- There is need for mutual collaboration amongst key actors in environmental conservation within Gimbo district. This is necessary to optimize the scarce human and environmental resources within the district since much of this has been misused through duplication of efforts.
- NGOs, which are currently working in the Zone with forest management, should be encouraged to be revising their management scheme packaging best agro-forestry practices, plantation forestry, suitable soil and water conservation practices, alternative source of energy and income generating activities for the communities.
- Alike, strengthening the local rule of law for accountability and transparency, participatory planning and decision making, and effectiveness and efficiency should be done continuously mainly by Public service, Justice and Administrative Offices.

- Likewise, Environmental Protection and Forest Office should abide by the binding rules signed with the agro-forestry projects in carrying out the regular monitoring and evaluation, giving technical support, awareness creation, and the Justice Sectors in providing legal assistance for forest users against encroachers and offenders, and building the managerial capacity of the agro-forestry practitioners.
- The international organizations, which are engaged in forestry program and climate change, as stakeholders should motivate the forest dependent communities through environmental service payment.
- There is need to ensure economic benefits to the communities through value addition chain and encourage sustainable utilization of natural resources.
- Finally, there is need to carry out further research on appropriate, and affordable agro-forestry technology, which is also rewarding in the short run to resources poor farmers faced with seasonal flood and drought challenges.

REFERENCES

Abaynesh Deraro (2003). Maintenance of genetic diversity in cordial Africana lam, a declining forest tree species in Ethiopia.

Abebe Tesfaye (2005). Diversity in home garden agroforestry systems in Southern Ethiopia. PhD thesis Wageningen University, Wageningen.

Abera Assefa (2016). The Implication of Wood-Burning Stove Efficiency for Environment, Health and CO2 emissions in the Jogo-gudedo Watershed, Ethiopia. *Academic Research Journal of Agricultural Science and Research* 4 (4): 154-163.

Aklilu Bajigo and Mikrewongel Tadesse (2016). The Effect of Agroforestry Practices and Elevation Gradients on Soil Chemical Properties in Gununo Watershed, Ethiopia: *International Journal of Environmental & Agriculture Research,* 2(1): 1-6

Alao, J. S. and Shuaibu, R. B. (2013). Agroforestry practices and concepts in sustainable land use systems in Nigeria: *Journal of Horticulture and Forestr*y, 5(10): 156-159.

Annie S., Matt F., Jim B., Steve B., Jeff H. Kathryn F. Harry G. (2016). An introduction to integrated agricultural land management system. Dovetail partners, pp.1-16

Asfaw Zemede (2002). Homegardens in Ethiopia: some observations and generalizations. In: Home gardens and in-situ conservation of plant genetic resources in farming systems. Watson, J.W. & Eyzagurre, P. B., (Eds.). Proceedings of the 2nd international home gardens workshop, 17-19 July 2001. Witzenhausen, Federal Republic of Germany.

Asfaw Zemede (2003). Tree species diversity, topsoil conditions and arbuscular mycorrhizal association in the Sidama traditional agroforestry land use, Southern Ethiopia. PhD Dissertation, Swedish University of Agricultural Sciences.

Asfaw Zemede and Ågren, G.I. (2007). Farmers' local knowledge and topsoil properties of agroforestry practices in Sidama, southern Ethiopia. Agroforestry Systems 71:35−48.

Att-Krah, K., Kindt, R., Skilton, J.N. and Amaral, W. (2004). Managing biological and genetic diversity in tropical agroforestry. Agroforestry Systems 61:183−194.

Bekele Azene (2007) Profitable Agroforestry innovation for Eastern Africa: Experience from 10 agroclimatic zones of Ethiopia, India, Kenya, Tanzania and Uganda, worldagroforestry center, p. 353.

Bishaw Badege (2001). Deforestation and land degradation in the Ethiopian highlands: A strategy for physical recovery. Northeast African studies.

Bishaw Badege and Abdelkadir Abdu (2003). Agroforestry and Community Forestry for Rehabilitation of Degraded Watersheds on the Ethiopian Highlands. Wondo Genet College of Forestry Debub University Awassa, Ethiopia International Symposium on Contemporary Development Issues in Ethiopia, July 11-12, 2003, Addis Ababa, Ethiopia.

Bishaw Badege., Neufeldt, H., Mowo, J., Abdelkadir, Abdu., Muriuki, J., Dalle, G., Assefa, T., Guillozet, K., Kassa, H., Dawson, I.K., Luedeling, E. & Mbow, C.(2013). Farmers' strategies for adapting to and mitigating climate variability and change through Agro-forestry in Ethiopia and Kenya. In: Davis, C.M., Bernart, B. & Dmitriev, A. (Eds.). Forestry Communications Group, Oregon State University, Corvallis, Oregon.

Brandt, A.S. (1984). New perspective on the origins of food production in Ethiopia. In: Clark, J.D. & Brandt, A. (Eds.). From hunters to farmers: the case and consequence of food production in Africa. p. 173−190.

Debessa, S.T. (2011). Study of useful plants Gedeo homegardens Ethiopia in and around Gate Uduma gardens in Kochere Wereda of Gedeo Zone, Ethiopia: an ethnobotanical approach. M.Sc. thesis Addis Ababa University, Ethiopia. P. 144.

Destaw Mequaninnt (2010). Assessment of Forestry and Agroforestry Extension Package Implementation Trends in Amhara Region, the Case of Farta District, South Gondar Zone. An MA Thesispresented to school of graduate studies of Addis Ababa University.94pp

Edmond, N., Yakam-Simen, F., Tadesse, K.K. & Romeij, P. (2000). Gedeo Zone Mapping Project. Phase 2. Final Report. Treemail, Heelsum, the Netherlands, Privateers N.V. and the Agricultural Bureau for Gedeo Zone. http://www.treemail.nl/download. Accessed 24 March 2009.

El Tayeb MS (2008). Factors Affecting Adoption of Agroforestry Farming System as a Mean for Sustainable Agricultural Development and Environment Conservation in Arid Areas of Northern Kordofan State, Sudan. Saudi Journal of Biological Sciences, 15: 137-145.

FAO (2010). Global forest resource assessment 2010. FAO forestry paper No.163 Rome.

FAO (2013). Advancing Agroforestry on the Policy Agenda: A guide for decision-makers, Agroforestry Working Paper no. 1. Food and Agriculture Organization of the United Nations. FAO, Rome. 37 pp.

FDRE (Government of the federal democratic republic of Ethiopia) (2003) Rural development policy and strategies. Ministry of Finance and Economic Development Economic Policy and Planning Department. Addis Ababa.

Fentahun Mulugeta and Hager, H. (2010). Integration of indigenous wild woody perennial edible fruit bearing species in the agricultural landscapes of Amhara region, Ethiopia. Agroforestry Systems 78:79–95.

Feyera Senbeta (2006). Biodiversity and ecology of Afromontane rainforests with wild Coffea arabica L. populations in Ethiopia. Bonn, ZEF.

Gadisa Chimdesa (2016). Historical Perspectives and Present Scenarios of Watershed Management in Ethiopia. *International Journal of Natural Resource Ecology and Management*. 1(3): 115-127.

Garibaldi L A, Steffan-Dewenter I, Winfree R, Aizen M A, Bommarco R, Cunningham S A , (2013). Wild pollinators enhance fruit set of crops regardless of honey bee abundance. *Science* 339:1608–1611.

Gebreegziabher Zenebe, Mekonnen Alemu, Kassie M, Köhlin G (2010) Household Tree Planting in Tigrai, Northern Ethiopia: Tree Species, Purpores, and Determinants. Environment for development, January, 2010.

Getahun Amare (1974). The role of wild plants in the native diet of Ethiopians. Agro-ecosystems 1:45−56.

Gustavo SG, Fonseca AB da, Harvey CA, Gascon C, Vasconcelos HL, (2004). Agroforestry and Biodiversity Conservation in Tropical Landscapes. Island Press, USA, pp. 537.

Habtamu Assaye and Zerihun Asrat (2016). Carbon Storage and Climate Change Mitigation Potential of the Forests of the Simien Mountains National Park, Ethiopia, *Agriculture, Forestry and Fisheries* 5(2): 8-17

Haileselasie, T.H. & Hiwot, M.T.G. (2012). Agroforestry practices and flora composition in backyards in Hiwane, Hintalo Wejerat of Tigray, Northern Ethiopia. International Journal of Biodiversity and Conservation 4(7):294–303.

ICRAF (2015). Harnessing Agroforestry in Ethiopia and strengthen food security, policy brief No. 30, 2015.

Jama B. and Zeila A. (2005). Agroforestry in the drylands of eastern Africa: a call to action. ICRAF Working Paper – no. 1. Nairobi: World Agroforestry Centre.

Jama, B., Eyasu, E., and Kebadire, C., (2006). Role of in Improving Food Security and Natural resources Management in the Dryland; A Regional Overview. Journal of the Dryland 1 (2): 206-211, 2006

Jamnadass R, Place F, Torquebiau E, Malézieux E, Iiyama M, Sileshi GW,Kehlenbeck K, Masters E, McMullin S, Weber JC, Dawson IK.(2013). Agroforestry, food and nutritional security. ICRAF Working Paper No. 170. Nairobi, World Agroforestry Centre.

Jamnadass, R.H., Dawson, I.K., Franzel, S., Leakey, R.R.B., Mithöfer, D., Akinnifesi, F.K. (2011). Improving livelihoods and nutrition in sub-Saharan Africa through the promotion of indigenous and exotic fruit production in smallholders' agroforestry systems. *International Forest Review*, 13: 338–354.

Jonathan N., Rob C. and Somphanh S.(2014). Forest Transitions and Rural Livelihoods: Multiple Pathways of Smallholder Teak Expansion in Northern Laos, *Land* 3:482-503.

Kanshie, T.K. (2002). Five thousand years of sustainability? A case study on Gedeo land use (Southern Ethiopia). PhD Dissertation, Wageningen Agricultural University

Kumar, B. and Nair R., (2004). The enigma of tropical home gardens. Agroforest. Syst., 61: 135–152.

Lilleso, J. Graudal, L., Moestrup, S., Kjær, E.D., Kindt, R. & Mbora, A. (2011). Innovation input supply systems in small holders' agroforestry: seed source, supply chains and support systems. *Agroforestry systems*, 83:347-359

Mathew H. and Sarah T.(2016). Agroforestry—the Next Step in Sustainable and Resilient Agriculture: *Sustainability* 8: 574-589.

Mathukia Rk, Sagarka Bk, Panara D. (2016). Fodder Production through Agroforestry: A Boon for Profitable DairyFarming. *Innovare Journal of Agricultural. Science* 4(2):13-19).

McNeely, J.A. & Schroth, G. (2006). Agroforestry and biodiversity conservation- traditional practices, present dynamics, and lessons for the future. Biodiversity and Conservation 15:549−554.

Mehari Alebachew (2012). Traditional Agroforestry practices, benefits , threats and research needs in the highlands of Oromia, Central Ethiopia: *International Research Journal of Agricultural Science and Soil Science* 2(5): 194-206.

Mengesha B. (2010). Alternative technologies for sustainable agricultural production and agroecosystem conservation in Arsi highlands, south-eastern Ethiopia. PhD thesis. Addis Ababa University, Ethiopia. p. 198.

Miller RP, Nair PKR (2006) Indigenous agroforestry systems in Amazonia from prehistory to today. Agroforestry systems, 66: 151-164.

Ministry of Agriculture and Rural Development of Ethiopia (MoARDE). (2005). Agroforestry extension package for Pastoral community (Amharic version). Addis Ababa Ethiopia.

Muleta D., Assefa, F. and Nemomissa, S. (2008). Distribution of arbuscular mycorrhizal fungi spores in soils of smallholder agroforestry and monocultural coffee systems in southeastern Ethiopia. Biology and Fertility of Soils 44:653−659.

Place, F., Ajayi, O.C., Torquebiau, E., Detlefsen, G., Gauthier, M. & Buttoud, G. (2012). Improved policies for facilitating the adoption of agroforestry. InM. Kaonga, ed. *Agroforestry for biodiversity and ecosystem services: science and practice*, pp. 113–128. Rijeka, InTech.

Sunninchan (2005). A review of best practices for selected bio diversity-based value chains that promote pro-poor conservation in the horn of Africa.

SUPAK/Kaffa Zone Agricultural and Natural Resource Desk (2004). Forest Resource Distribution: Methodology, Forest Coffee Distribution, Plantation Forest Distribution. A consultancy paper. Bonga/Kafa

Taye B, Wirtu O. (2003). Marketing study of NTFPs in South Western Ethiopia. Southwest Ethiopia: NTFP Research and Development.

Teketay Demel and Tegineh Assefa (1991) Shade tree of coffee in Hararge, Eastern Ethiopia. Int tree crop J7: 17-27

Teketay Demel (2004). Forestry research in Ethiopia: Past, present and future. *In*: Balcha G, Yeshitela K, Bekele T (eds), *Proceedings of a National Conferenceon Forest Resources of Ethiopia: Status, Challenges and Benefits (27−29 November 2002)*. Addis Ababa: IBC and GTZ, pp. 1−39.

Teshome Amidissa (2006) Agriculture, Growth and Poverty Reduction in Ethiopia: Policy Processes around the New PRSP (PASDEP). A paper for the Future Agricultures Consortium workshop, Institute of Development Studies.

Tessema Ch. (1970). The culture of coffee in Ethiopia. Agroforestry Today 9: 19-21

Tsegaye G. and Worku B. (2012). Enhancing communities' adaptive capacity to climate change in drought prone hot spots of the Blue Nile basin in Ethiopia: Training manual on planting indigenous tree species for forest restoration; and Agroforestry system and practice for extension workers at Kabe water shed wereilu, South Wollo, Ethiopia.53pp.

World Agroforestry Centre (2003). Agroforestry for improved livelihoods and Natural resources conservation. An Agroforestry Policy Brief. Kenya, Nairobi.

Yemane T. (1967). Statistics: An Introductory Analysis. 2nd ED. And New York: Harper and Row.

APPENDIX

JIMMA UNIVERSITY
DEPARTMENT OF BIOLOGY

Questionnaire

Introduction

Dear respondents;

The questionnaires are developed by a post graduate student in Jimma University for partial fulfillment of the award of M.A Degree in Biology. The purpose of these questionnaires is to collect data for the study entitled with 'AGROFORESTRY PRACTICE BENEFIT AND CHALLENGES IN GIMBO DISTRICT KAFA ZONE SOUTH WESTERN ETHIOPIA'. Your answers will be used only for research purpose. So I am kindly requesting you to give your genuine responses.

Thank you in advance!

General instruction;

- ✓ Don't write your name
- ✓ Put 'X' mark on the space provided for close ended and write your suggestions for open ended questions in the space provided.

Part –I: Socio-Economic characteristics of respondents

1. Name of kebele …….
2. Sex: Male □ Female □
3. Age: Less than 30 years □ 31-40 years □ 41-50 years □ Above 51 years □
4. Marital status: Single □ Married □ Divorced □ Widow/ Widower □
5. Educational back ground: No formal education □ Adult education □ Grade 1-4 □ Grade 5-8 □ Grade 9-12 □ Certificate □ Diploma and Above □
6. Religion: Orthodox □ Protestant □ Catholic □ Muslim □ If any Others, Please specify _____
7. How long have you lived in this kebele? Less than 5 years □ 5-10 years□ 11-15 years □ Above 15 □
8. Family size: Less than 5 people □ 5-10 people□ > 10 people□

Part –II: Questions related with the basic research questions

I. The major types of agroforestry practices performed in Gimbo District

No.	Types of Agroforestry	Responses	
		Yes	No
1.	Scattered trees in crop lands		
2.	Home garden agroforestry		
3.	Hedgerow intercropping		
4.	Riparian zone vegetation		
5.	Enclosures and natural regeneration of species in woodlands and pasture		
6.	Plantation-based cropping system		
7.	Shelterbelts and windbreaks		
8.	Boundary Planting and live hedges		
9.	Woodlots for soil conservation		
10	Industrial plantations with crops		

11. If any other types of Agroforestry practices in your locality please, list them

_____
_____
_____
_____
_____

II. The benefits of agroforestry to the local community of the study area

1. Do you agree Agroforestry practices benefited you and others?

   A. Yes B. No C. Don't know

2. What is the condition of Households' income levels after the implementation of Agroforestry?

   A. Improved B. Remained the same C. Worsened D. Don't Sure

3. What is the condition of Vulnerability to food insecurity after the implementation of Agroforestry?

   1. Improved B. Remained the same C. Worsened D. Don't Sure

4. What is the condition of Access to forest product after the implementation of Agroforestry?

   A. Improved B. Remained the same C. Worsened D. Don't Sure

5. What is the condition of Participating in own cash generating activity after the implementation of Agroforestry?

   A. Improved B. Remained the same C. Worsened D. Don't Sure

6. What is the condition of Access to credit after the implementation of Agroforestry?

   A. Improved B. Remained the same C. Worsened D. Don't Sure

7. What is the condition of Crop production after the implementation of Agroforestry?

   12. Improved B. Remained the same C. Worsened D. Don't Sure

8. What is the condition of Livestock production after the implementation of Agroforestry?

   A. Improved B. Remained the same C. Worsened D. Don't Sure

9. What is the condition of Product from NTFPs after the implementation of Agroforestry?

   A. Improved B. Remained the same C. Worsened D. Don't Sure

10. What is the condition of Species composition, density and structure of the Forest of the area after the implementation of Agroforestry?

    A. Improved B. Remained the same C. Worsened D. Don't Sure

Benefits related to adoption of agroforestry practice

5 = Strongly agree, 4 = Agree, 3 = Neutral, 2 = Disagree, 1 = Strongly disagree

No	Benefits	Response				
		5	4	3	2	1
1.	It reduced deforestation					
2.	There was increment of forest inventory					
3.	Have the right to use the forest product					
4.	Limit farm land expansion					
5.	Limit using for grazing land for livestock					
6.	It gives extra work					
7.	Promoted sustainable utilization of forest resources					
8.	Empowered women and marginalized groups					
9.	Created more employment opportunities for participants					
10.	Encouraged alternative livelihood activities					
11.	Promoted equitable distribution of resources and benefits among all social groups					
12.	Created new market opportunities for the participants					
13.	Increased environmental awareness for the participants					
14.	Reduced conflicts over forest resource use					
15.	High demand for tree products, including wood, fodder and other non timber forest products.					
16.	Recent improvements in land tenure security for farmers will encourage them to invest in strategies such as agroforestry that pay off.					

If any other benefits related with Agroforestry practices in your locality please, list them

_____

_____

_____

III. The major challenges confronting in the practice of agroforestry in the study area

5 = Strongly agree, 4 = Agree, 3 = Neutral, 2 = Disagree, 1 = Strongly disagree

No	Challenges	Response				
		5	4	3	2	1
I.	**Social and Economic Factors**					
	Producers education level					
2.	Small land plot size (mainly in upland villages)					
3.	Clan-owned land renting system					
4.	Absence of village land use plans					
5.	Poor Land use and management					
6.	Capacity and knowledge					
7.	Lack of awareness by farmers of environmental benefits of trees and misconception about trees e.g. fear of tree shade negatively affecting crops, and fruit trees attracting monkeys					
8.	Lack of awareness of existing forest legislation					
9.	Lack of knowledge of tree seedling management, pest and disease control, and adequate seeds and germplasm supply					
10.	Illegal encroachment from humans and animals, which may lead to low stock and hamper natural regeneration.					
11.	Lack of training or skills for product transformation					
12.	traditional management practice					
II	**Constraints in Delivering Tree Products to Markets**					
	Poorly structured and coordinated markets for many tree products					
2.	Low and unstable returns to farmers and high prices for buyers of tree foods, which limits their consumption.					
3.	Absence of a collective bargaining system,					
4.	Poor transport infrastructure,					
5.	The involvement of multiple intermediaries in the supply chain,					
6.	High wastage for perishable goods such as fruit along the supply chain and a failure to reach quality grades.					
7.	High cost of collecting tree products from the area.					
8.	Small number of markets, and lack of market information					
9.	Lack of storage facilities					
10.	lack of capital and unstable prices and supplies, especially during the rainy season					
III	**Policy Constraints**					
	Not recognizing agroforestry as an attractive investment area in agriculture by the current policy environment.					
2.	Absence of citification standards for most of the tree based products and their derivatives,					
3.	Lack of adequate and research and extension capacity,					
4.	Lack of focus on agroforestry in Ethiopian Universities,					
5.	Poor access of farmers to tree seeds					

6.	Poor coordination of Stakeholders involvement in supporting tree-based enterprise					
7.	The high state and central government taxes					
8.	Lack of sufficient trained human power and facilities					

1. If any other challenges related with Agroforestry practices in your locality please, list them

_____
_____
_____
_____
_____
_____

2. What do you suggest to overcome the challenges faced in the agroforestry practices of the study area?

_____
_____
_____
_____
_____
_____