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Assessment of Traditional Agro Forestry Practices, Socio-Economic Benefits, and Constraints in Zegie Peninsula, North Western Ethiopia

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DEPARTMENT OF NATURAL RESOURCES MANAGEMENT

GRADUATE PROGRAM

M.SC. IN AGROFORESTRY

ASSESSMENT OF TRADITIONAL AGRO FORESTRY PRACTICES, SOCIO-ECONOMIC BENEFITS, AND CONSTRAINTS IN ZEGIE PENINSULA, NORTH WESTERN ETHIOPIA

MSc Thesis

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A THESIS SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE (M.Sc.) IN AGROFORESTRY

Main Advisor: Demamu Mesfin (PhD)

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Bahir Dar, Ethiopia

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DECLARATION

This is to certify that the thesis prepared by Melkamu Getie (ID No BDU1301396), entitled: "Assessment of Traditional Agroforestry Practices,socio-economic benefits and Constraints in Zegie Peninsula North Western Ethiopia," and submitted in partial fulfillment of the requirements for the Degree of Master of Science in Agroforestry complies with the regulation of the University and meets the accepted standards with respect to originality and quality.The matter embodied in this project work has not been submitted earlier for award of any degree or diploma to the best of our knowledge and belief.

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THESIS APPROVAL SHEET

I hereby certify that I have supervised, read, and evaluated this thesis/dissertation titled "Assessment of Traditional Agroforestry Practices, Socio-economic benefits and Constraints in Zegie Peninsula North Western Ethiopia" by Mister Melkamu Getie Ayenew prepared under my guidance. I recommend the thesis/dissertation be submitted for oral defense.

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Name of Advisor	Signature	Date

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THESIS APPROVAL SHEET

As member of the Board of Examiners of the Master of Sciences (M.Sc.) thesis open defense examination, we have read and evaluated this thesis prepared by Mr, Melkamu Getie Ayenew entitled Assessment of Traditional Agroforestry Practices, Socio-economic benefits and Constraints in Zegie Peninsula North Western Ethiopia. We hereby certify that, the thesis is accepted for fulfilling the requirements for the award of the degree of Master of Sciences (M.Sc.) in AGROFORESTRY

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ABBREVIATIONS/ACRONYMS

AF	Agroforestry
AFs	Agroforestry systems
AFTs	Agroforestry technologies
BCAAD	Bahirdar city Administration Agricultural department
CBAF	Coffee based Agroforestry
Das	Development Agents
ETB	Ethiopian Birr
FAO	Food and Agriculture Organization
FGD	Focus Group Discussion
FHH	Female-headed household
GDP	Gross Domestic Product
HHs	Households
ICRAF	International Centre for Research in Agroforestry
IFAD	International Fund for Agricultural Development
KII	Key informant interviews
MCS	Multistory coffee system
MDG	Millennium Development Goals
MHH	Male-headed households
NRM	Natural Resource Management
RK	Rural kebele
SPSS	Statistical Package for Social Sciences
SSA	Sub-Saharan Africa

ABSTRACT

The introduction and promotion of agroforestry in Zegie peninsula would not be a new idea since farmers have been practicing the act of keeping trees together with food crops and/ or animals on their farms.The major purpose of this study, is to assess traditional agro forestry practice, socio ecomonic benefits, and constraints in purposively selected rural kebeles of Zegie peninsula.The study was based on a household survey conducted on 316 households and the data was gathered using a structured questionnaire.For the accomplishment of the study four focus group discussionswith model farmers,elders,land committee members,and female headed householdsand alsothree key informant interviews with kebele experts, forest conservation task force and watershed committee were held.The responses of sample households were analyzed using SPSS version 20, and the qualitative data were narrated and summarized accordingly.Multinomial logit model was employed to estimate the determinants of the choice of agroforestry practice by the households.The result indicates that eight agroforestry practicesexist in the study area namely;homegarden (99.7%),coffee based multistory AFPs (82.6%, live fence (44.6%), boundary planting (16.8%), scattered trees on crop lands (7.3%),wind breaks (2.5%), fodder bank (1.9%),and trees on pasture (1.3%).From the total respondents, 315(99.7%)had adoptedagroforestryand 1(0.3%)did not adopt and involved small businesses/weaving. Some of the benefits were fuelwood (96.2%), diversify'incomes (86.4%), medicine (80.7%), soil nutrient improvement (76.9%), honey production (68.4%), and food supply (61.4%).The major constraints of agroforestry practices identified by households were diseases and pests (99.4%), scarcity of land (71.5%), lack of marketing access (67.7%),lack of credit facilities (50.9%), and water shortage (46.8%), inorderofmagnitude.Resultsofthemultinomial logistic regression modelshowedthat six variables significantlyaffected the choice of agroforestrypractices by households.Size of farm land,family size,capital,gender,watersource,credit and price of marketinghad an influence on their decision to choice of plant/not to plant trees.In generaldiseases and Pests that attack seedlings and even killed them before they matured. For further agroforestry enhancement, diseases, pests, droughts resistance, andimproved species should be required. Moreover appropriate policy and credit facilities should be established.

Keywords: *Traditional agroforestry, benefits, constraints, farmer'spreference, zegie peninsula*

Table of Contents

LIST OF TABLES

LIST OF FIGURE

List of appendix

CHAPTER 1. INTRODUCTION

1.1 Background and Justification

In developing countries especially Africa, rapid population growth, environmental degradation and decline in per capita food production are the main problems. Consequently, the need for intensification of agricultural production coupled with population growth forces poor farmers to expand their cultivation to hilly and marginal areas. This aggravates the degradation of natural resource (Kang BT &Akinnifesib FK (2000). At the beginning of the twentieth century around 35% of Ethiopia's land was covered by trees but recent research indicates that the forest cover is now less than 15.11% (FAO, 2020).As indicated by FAO (2010) forest resource of the country has declined from 15.1 million hectare in 1990 to 12.2 million in 2010 due to population growth, increasing demand for agricultural land, increasing fuel wood demand (Alemu Mekonnen &Abebe Damte, 2011), land use competition, land tenure problem (Richard CJ (2006), Bishaw Badege (2001), USAID (2008), uncontrolled grazing, lack of awareness, illegal logging, urban expansion, weak policy and legal framework (Simon, Counsel 2009) has led to a continuing decline of forest area (FAO, 2007).
Deforestation is a serious problem in developing countries; (Hosonuma *et al*., 2012; Weatherly-Singh and Gupta 2015). Use of forests excessively in Ethiopian has led to soil erosion, reduction of agricultural products, loss of habitats, reduction of streams volume, ecological and genetic resources degradation and change in local climatic situation, significantly contributing to climate change (Vignola et al. 2015). (Phiri *et al*., 2004;Van der Werf *et al*., 2009). About 17 % of global CO_2 emission comes from deforestation (IPCC, 2007).

One possible solution to reduce high dependency on the forest is finding other alternatives to produce wood products for fuel and construction materials outside the natural forest, provision of services and products (Mulugeta Sisay &Kindu Mekonnen, 2013). Several attempts have been made to minimize the loss of forest resources and to increase the forest cover, among which forest conservation through expansion of agroforestry system is the major one and the government has put efforts to conserve the forest resources of the country through designing forest policy. According toFAO (2013) Agroforestry system is an ancient

practice and the farmer also more recognized it. It is also a form of sustainable land use systems that combine tree with crop or animal husbandry simultaneously and sequentially.

The traditional agroforestry system practiced in different parts of rural Ethiopia reported to have a multitude of purpose (Mesele Negash*et al*., 2011).Even though Agricultural land in Ethiopia is estimated to cover 52.62 million ha (46% of the total area) (Brown *et al*., 2012 and Bishaw Badege *et al*., 2013), the area of agroforestry system is not well documented.According to some estimates based on satellite imagery for the base year 2006, it was around 2.32 million ha (Brown *et al*., 2012),andthe figure did not include scattered trees on crop and grazing lands.

As Azene Bekele (2007) identified that nine types of agroforestry practice were practiced in various parts of Ethiopia providing diverse ecological and socioeconomic services. Alley cropping, home gardens, fodder tree planting, living fences, farm boundary, road side plantation, trees on contour bunds, and gully planting as age-old AFPs in Ethiopia. Home gardens are the most popular agroforestry practice in most parts of Ethiopia (Agize *et al*., 2013).

Diverse agro-ecological nature of Ethiopia favors various combinations of trees and shrubs with annual and perennial crops. Thus, the existing AFPs in few pocket areas may have significant contribution to expand these practices to larger areas with similar physical and socio economic settings. Contributions of Agroforestry tie the concept of sustainable development through the provision of multiple goods and services (Smith *et al*., 2012). The contribution was classified as economic (Walker, 2013), ecological, and social (Mbow *et al*., 2014) perspectives.

The benefit simultaneously addresses the objective of sustainable development and makes it an attractive land use practice in both developing and developed countries.In the context of economic contribution, agroforestry contributed 29% to agriculture's gross domestic product (GDP) in developing countries (World Bank, 2008) and it creates job (Ajijur *et al*., 2017 and Herren *et al*., 2012)to biodiversity conservation (Wilson and Lovell, 2016) by maintaining the forest resources and considered as the best alternative to combat land degradation (Minang *et al*., 2011, Naire, 2014), reduced greenhouse gas emissions (Burgess and Rosati, 2018), enhancing water retention (Kumar *et al*., 2015).Agroforestry also provides good opportunities

to women (Kiptot and Franzel, 2012) and reduce gender inequalities related to natural resource access (Wekesa *et al*., 2018).

Although AFPs have multiple benefits, there are various determinant factors for the implementation and expansion of AFPs,such ashousehold wealth status (Predo & Francisco 2012), high opportunity cost and labour availability (Alemu Mekonnen & Abebe Damte, 2011), lack of market infrastructure and the absence of processing techniques to add value to AFPs (Garrity, D. P 2004), insecure land tenure policies (Msuya *et al*.,2006), diseases and pests (Kofi,A.F., *et al.*,2003**),**lack of water**(**Taimoor *et al.*,2017) are major limiting factors for the implementation and expansion of intensive agroforestry in different parts of region.

Despite the crucial benefits of agroforestry in reducing deforestation, conserving biodiversity, tackling environmental problems and improving livelihoods of farmers through provision of timber and non-timber tree products, assessment of major challenges for the implementation and expansion of AFPs in different agro-ecological areas has been given less attention in Ethiopia.

Therefore in this study the assessment focus on identify the existed agroforestry practice,benefits,and related challenges to the implementedagroforestry practice in the study area.This is because people who are living in the study area gives emphasis agroforestry practice. As a result most of the study areas arecovered by agro forestry practices this indicates the perception towards agroforestry practice is better but a lot of constraints facing to farmers.Hence, theintention for undertaking this study to improve the productivity of existing systems and develops new agroforestry practice in the study area.

1.2 Statement of the Problem

Agroforestry is a sustainable land- scape practiced by more than 1.2 billion people worldwide derives their livelihoods from agro forestry systems (Dawson *et al*., 2013).The population is continuously growing and causing serious environmental problems particularly in developing countries like Ethiopia. As the population continues to grow, the gaps between supply and demand for agricultural land continues to expand, increase land degradation, and decrease in agricultural productivity. Such situation is leading to severe land use conflict between the crop production and other type of land uses such as forest and agroforestry, fuelwood collection, timber production, and need in construction materials continue to put pressure on the limited forest resources (Abebaw Zeleke, 2008).This would cause further clearance of forestland, and consequently environmental degradation.

As a result, a number of interventions were breakthrough by rural communities to solve such domestic problems and enhance their access to alternative income generation activities. The adoption and development of agroforestry practice is one of these measures to enhance food and nutritional security, improve human health and environmental sustainability.Even though agroforestry research were made Since 1970s (Garrity, 2006), the selection of suitable agroforestry practice by rural household was at early stage/traditional method and remained low production, the existing farming system and traditional knowledge is the starting point for development and scale up of different agroforestry practices (ICRAF, 2006; Christiaensen *et al.*, 2011).

Most development interventions in the past failed due to lack of giving adequate attention to traditional knowledge (Miller and Nair, 2006). In Ethiopia, information on traditional agroforestry practices is generated from limited studies (Abebe Seifu, 20002; Mehari Alebachew, 2012; Abrham Abiyu.,*et al*2015), since most of the researchers are more specific in terms of site (Muruts, 2018), constraints and socioeconomic benefits (Zebene Asfaw, 2001; Abebaw Zeleke, 2006; Bishaw Badege and Abdu Abdelkadir, 2003).Hence, different traditional agroforestry practices in the Zegie peninsula, since there were not well studied and documented inclusively/ comprehensive (Identification of agroforestry practice, constraints and farmers tree and shrub preference). Besides to this the socio-ecomomic benefits of

traditional Agroforestry practice on local community is not very much organized and identified specifically in the area.

Therefore, comprehensive understanding of major traditional agroforestry practices in rural communities, and to what extent traditional agroforestry practices contributed to household income is quite important for the next successful selection and adoption of agroforestry practices. 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). Yet right tree /shrub species, right crops, right spatial arrangements with the right management practices study in Bahir Dar city administration, Zegie peninsula is still missing.

Asaresult, detailed data were not available to substantiate the claims and to scale up the practice within study area and from the study area to other similar areas. Without a formal study and hard facts and figures, theexisted agroforestry practice, constraints,and socio-economic benefits generated by the practice may remain unknown.Therefore, the livelihood socio-economic contribution assessment and other comprehensive study was required.

Therefore, assessing the magnitude of factor affecting agroforestry practices is very crucial to explore possible solution to maximize socio-economic benefit and reduce constraints of agroforestry practices implementation in the study area. Therefore, this study is intended to investigate the major traditional agroforestry practices, benefits and to identify major constraints related to traditional Agroforestry practices in Zegie Peninsula, North western, Ethiopia.

1.3 Objectives of the Study

1.3.1 General Objective

The aim of this study was to assess traditional agroforestry practices, constraints andsocio-economic benefits for promoting agroforestrypractices in Zegie Peninsula, North western Ethiopia.

1.3.2 Specific Objectives

The specific objectives of the study were to**:**

- Identifies major traditional agroforestry practices in the study area;
- Assess the most preferred tree and shrub species in each agroforestry type;
- Examine the socio-economic benefit of agroforestry practice to household income.
- Identify major constraints of agroforestry practices in the study area; and
- Identify the Factors that determine the rural households choice to participate in AFP

1.4 Research Questions

This thesis isfocuses on thefollowing question;

- What are the major traditional agroforestry practices in study area?
- What are the most preferred agroforestry tree and shrub speciesin each agroforestry type?
- What are the benefits of agroforestry practice to household's income?
- What are the constraints of agroforestry practice implementation in study area?

1.5 Significance of the study

The implementation of the agroforestry practice is embraced by several factors. The result generated in this studyis expected to benefit the stakeholders as follows. It will helps to understanding the factors affect the implementation of the agroforestry practice, and this will enhance their soico –economice benefits in order to improve agricultural productivity, food security and poverty reduction. This study was helps to create better understanding for the benefits of agroforestry practices to households' livelihood source. Additionally, finding of this study will be useful to provide basic information about existing agroforestry practices which is important to redirecting, improving and strengthening as well as introduce agroforestry practices for future. This turn contributes to the national policies and strategies that support sustainable management at farmland.

The other possible benefit of this study is useful in providing baseline information for the researcher and other scholars who concern further research on this issue and also the study provided adequate information for better understanding of traditional agroforestry practices in

zegie peninsula, similar districtsspecified in regions of the country and even beyond sub-Saharan countries at large.

1.6 Scope and Limitation of the Study

Spatially, the study was limited to Zegie Peninsula traditional agro forestry practice northern west high lands of Ethiopia.

1.7Operational Definition of the Key Terms

Agroforestry**:** refers to a sustainable land management practice that includes the deliberate integration of a woody component with an agricultural production in the lower storey (Santiago-Freijanes et al 2021).

Kebele**:** is the smallest administrative unit of Ethiopia.

Peninsula: a large mass of land projecting into a body of water.

Debo: Cooperation consists in working together.

Gott: Smallest unit of with in kebele.

1.8 Organization of the paper

The thesis is organized into five chapters. Chapter one presents the introduction, which focuses mainly on the background, statements of the problem, objectives, significance and scope of the study, definition of important terms. Chapter two provides review of related literature which describes some related concepts regarding to the agroforestry practices. Chapter three deals with a short description of the study area and the methods that were employed to generate and analysis data are presented in this unit.Chapter four presents the results and discussion of the study on the bases of the information gathered from sampled household respondents and purposively selected key informants and FGD.Finally, chapterfive deals with conclusions and recommendations drawn from the study toimprove agroforestry practice.

CHAPTER 2. LITERATURE REVIEW

2.1 Concept and definition of Agroforestry

Agroforestry defined as a deliberate integration of woody components with agricultural and pastoral operation on the same pieces of land in a spatial or temporal sequence in such a way that both ecological and economical interaction occurs between them (Kalinganire *et al.* 2008).Agroforestry is a symbiosis of trees growing, crop production and livestock rearing where each component is beneficial to each other,it may be a traditional and/or introduced (Bandyopadyay, 2001). These definitions imply that in an Agroforestry system: 1) there are two or more species of plants/animals at least one of which is woody perennial 2) there should be biological and economical interaction within the components 3) the cycle of an Agroforestry system is always more than one year (Mesele Negash, (2002).

Agroforestry is a sustainableland- scape practiced by more than 1.2 billion people worldwide derives their livelihoods from agro forestry systems (Dawson *et al*.,2013, Zomer *et al.,* 2009). It received high attention as a resource-efficient and environment-friendly land-use practice (Jose and Gordon, 2008). Agroforestry focuses on the role of trees in agricultural landscapes to achieve the economic, ecological, and social needs in today's world (Garrity,D. P 2004).From a natural science point of view, agroforestry values in terms of its ecosystem services: soil enrichment, biodiversity conservation, improvement in air and water quality, and carbon sequestration (Jose, 2009).Unlike other types of conservation practices where land is taken out of production, agroforestry is 'productive conservation' (Gold *et al*., 2004).

From an economic point of view, agroforestry systems have typical features: a) long planning horizons, b) irregular cost and revenue occurrences, and c) fixed tree components along with crop or livestock components (Godsey, 2008). Agroforestry systems are also playing an important role as part of the so-called "climate-smart" landscape that simultaneously embraces mitigation and adaptation policies and programs (Montagnini, 2017).Agroforestry, with its multiple environmental and economic benefits, can help the agriculture and forestry sectors find innovative solutions to present-day problems: including low profitability, environmental impacts, and negative publicperception (Baets *et al*., 2007).

2.2 Traditional agroforestry

Traditional agroforestry is variously referred to as indigenous agroforestry.Traditional agroforestry started in prehistoric times when hunters and gatherers deliberately or accidentally dispersed seeds of highly valued fruit trees in the vicinity of their campfires. These seeds later germinated and grew to produce fruits for food and were managed in mixture of naturally grown timber trees and other herbal plants (Udofia, 2010).

Traditional agroforestry system is most common among the rural community of Africa and other developing countries. It is one of sustainable eco-system; many centuries old, representing generation of farmers' experiences.There are numerous examples of traditional agroforestry practices involving combined production of trees and agricultural crops on the same pieces of land in many parts of Africa. This traditional agroforestry system has sustained people for generations, and contributed to improvements in food security, regional and national economies and environmental resilience (Eyasu Alias, 2002).There are also numerous types of traditional Agroforestry practices in different parts of the country in southern Ethiopia (Zebene Asfaw, 2003; Tesfaye Abebe, 2005) northern Ethiopia (Kindaye Gebrehiwot, 2004) and North eastern Ethiopia (Kindu Mekonnen,2001).

2.3 Distribution of Agroforestry

Globally, agroforestry is not a new practice since it has been used starting from ancient time by farmers throughout most of the world (Beatrice *et al.,* 2013; and Shehu *et al*., 2013).The agricultural lands in different parts of the world, has been used to integrated management system which are different from one location to other (Lakra *et al.,* 2008). This agroforestry practice contributes to rural livelihoods, improved socio-economic status and good ecosystem function in land use systems.

In Africa, agroforestry practice ensure provision of food production, suppress weeds, increase the amount of carbon in soil biodiversity and enhance the hydrological cycle whereas best solution to tackle issue related to soil erosion problem on agricultural land (Sharma *et al.,*2008). However soil fertility and agricultural yields has been declined for last 30 years through soilleaching and soil erosion. Thus, this results a gradual decease in yields per production in hectare, so the policy maker used agroforestry as solution to problem.

Agricultural land use and its challenges at present have been major concerns throughout sub-Saharan Africa.Farming in many parts Africa have no tradition to maximizing output of the production per hectare by integrating agroforestry practice rather than the concerned to reduce the risk of crop failure (Undurraga *et al.,* 2013).In fact that the importance of agroforestry practices so far has been descriptive at agricultural farm land, in studying the role of trees in traditional farming activity in many parts of country.

2.4 Agroforestry practices in Ethiopia

Agroforestry system is an ancient land use practice in Ethiopia, there is an abundant type of agroforestry practice in Ethiopia. For instancethree types of agroforestry practice such as pasture land, farm land and home garden in Northwestern Ethiopia as cited by Ketsela KH (2012). Also, coffee shade tree, scattered trees on farmland, home garden, woodlots, farm boundary and grazing lands are types of traditional agroforestry practices in Southern, Ethiopia(Tesfaye Abebe 2005),(Zebene Asfaw, and Agren, GI 2007).The enlargement of tree-based agroforestry land use practice under different landforms is the alternative method of increasing the efficiency of land because planting or maintaining of tree or shrub on farmland, roadsides, pasture land, and farm boundary use to minimize a shortage of wood products and improve the production ability of land simultaneously (Lalisa Duguma,and Herbert,2010). Woodlot of Eucalyptus is also the most agroforestry practice in Ethiopia, because it playing a vital role in improving the livelihood of the farmer (Lalisa Duguma, andHerbert, 2009), and (Zerihun Kebebew, 2010).

2.5 Major types of the agroforestry practice

The smallholder farmer plant tree for multi-purpose on their own farm lands, among the major use were fuel wood production, live fences, windbreaks, Shade, beautification, and preventing soil erosion among others (Rogers, 2007).More than hundred different agroforestry practices have been identified in tropical and temperate regions (Atangana *et al.,* 2013).Azene Bekele (2007) identified nine types of AFPs in various parts of Ethiopia providing diverse ecological and socioeconomic services.These agroforestry systems are primarily aimed at meeting household food needs Azene Bekele, (2007),Mesele Negash,(2013).

Major types of agroforestry practice were following:

Scattered trees on cropland

The practice of growing and maintenances of scattered trees on cropland has also supported the protection and management of selected matured trees already on the positioning (Mehari Alebachew, 2012).Trees provide fuel, building poles, fodder or gum and improve soil fertility, conserve soil moisture and improve the microclimate of the area. For example Acacia albida, Cordial africana and Croton macrostachys, the most common trees deliberately left on farm lands due to their multiple uses in different parts of the country. In most cases these trees are naturally regenerated trees that are left intentionally standing.

Trees on rangelands

This Silvopastoral activity involves the integration of the native tree species having inputs for cattle fodder values in rangelands those tree species can be used specially in the semi-arid and sub-humid parts of world. This tree species include like Cordial africana, Acacia Abyssinia, Ficus ovate and Sesbania play major role for animal by it shadow and fodder (Abonesh Tesfaye*et al,* 2014; Zalkuwi *et al;* 2013).

Boundary Planting

It involves planting multiple trees or fruit, shrubs and grasses in single or multiple lines for purpose of boundary planting and along buffering zone of the farms land ,to avoid conflict with neighboring farmers (Anjulo, 2016). The selection of tree species was considered based on theeconomic importance to household. Timber trees are good species for delineating boundary at farm land.

Live Fencing

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, and 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 trees. The use of live fences is a cheap method of fencing large areas because once the live fences become established they are permanent. Their establishment requires no expensive

materials to be purchased and they are easy to maintain. Living fences may also give produce, e.g. fruits. Native tree species to be promoted for this purpose will be: Accacia tortilis, Accacia bussei, Accacia seyal (KindeyaGebrehiwot, 2004).

Windbreaks / Shelterbelts.

Windbreaks or shelter breaks are defined as linear plantings of trees or shrubs.These are valued as shelter from harsh weather for habitats and livestock (Brandle *et al;* 2004, 2009). No matter where they are located, well-designed windbreaks provide economic returns and benefits to land owners. Field windbreaks are planted for protecting the fields, crops and orchards from wind, snow, etc. Windbreaks around farmsteads help to reduce fuel demand of family and provide protection to buildings.Reports of several studies regarding the effectiveness of windbreaks in wind reduction have been discussed by Sudmeyer and Scott, (2002),Brandle *et al;*(2004).

Home gardens

Home gardens is an old practice that involves the use of land close to the homestead involving a mix of annual crops and perennial crops in combination with trees and sometimes in association with domestic animals. In home gardens, trees, shrubs, vegetables and other herbaceous plants are grown in dense and random arrangement (Whitney *et al;*2018).It also defined as a small-scale farming level that used to meet basic need for poor (Rutatora, 2001).In fact that home garden agroforestry practices has less cost-intensive activity, because it requires fewer inputs and investment thus it is extremely important for resource-poor families that have limited access to production inputs.Based on farmers' preferences, many experiences and practices they inherited /adopted from their parents and the communit.It was possible to find in home gardens some species of trees and shrubs remnants of pre-existing forest, when it was converted to residential area (Mehari Alebachew, 2012).

Through home gardening women have developed proficiency related to plants and garden practices that helps them become better home and environment managers. Comparatively women have useful knowledge of numerous domestic needs than man. By their involvement in the production process, they are able to meet family needs more easily. But women

gardeners are inclined to produce food primarily for family consumption while focus on high value crops for marketing (Galhena *et al;* 2013).

Fodder Tree Systems

Protein banks are stands of trees or shrubs established within a farm or pasture area to serve as a supplementary source of protein-rich fodder for livestock (Sileshi Gezachew *et al.*, 2014). Livestock can also be allowed to graze directly on protein banks, but this can result in damage to the plants and wastage of fodder (Sumberg, 2002; Hamer *et al*; 2007; Bayala *et al*;2014a). Protein banks may also conserve soil on slopes, and if planted in strips along the contour they may serve as biological soil conservation measures.The trees provide shelter and shade for livestock and herdsmen and protect the animals from strong wind, and their branches can be lopped to provide feed for livestock during the dry season (Zewuge Teklehaimanot, 2004).

Multistory coffee systems

Multistory coffee systems (MCS) broadly refer to the semi-managed production of coffee under the canopy of scattered taller trees. This generally has positive side effects on the coffee stands with respect to microclimate amelioration, biodiversity, pest control, pollination, and water and soil conservation (Snoeck *et al.*, 2000; Rice, 2010; Alemu Mekonnen, 2015). According to the report of Omarsherif Mohammed In Yayu, southwestern Ethiopia depending on the management scale and origin of the stand, four variations of MCS exist, i.e., forest/wild coffee, semi-managed forest coffee, garden coffee and coffee plantation (Gole, 2003; Senbeta and Denich, 2006;Gole *et al., 2*008; Andent Dress, 2010). All of them involve at least two layers, i.e., coffee/shrub layer and shade tree layer.

2.6 Desirable Characteristics of Tree for Agroforestry

While selecting tree species for agroforestry systems, the following desirable characteristics should be taken into consideration. Though all desirable characters are not found in a single species, but their multiple uses are taken care of (yspuh&Solan F, 2012)**.**The desirable characters are (1)Tree species selected should not interfere with soil moisture (2) tree species should not compete for plant nutrients (3) tree species should not compete for sunlight(4) tree species should have high survival rate and easy establishment (5) tree species should have fast growing habit and easy management (6) tree species should have wider adaptability (7)tree

species should have high palatability as afodder(8)tree species should have shelter conferring and soil stabilization attributes(9)tree species should have capability to withstand management practices (10) tree species should have nutrient cycling and nitrogen fixation attribute (11)tree species should have thin bark(12)tree species should be free from chemical exudations (14)tree species should have easily decomposable leaves (15) tree species should have their multiple uses (16) tree species should have high yield potential. High yield potential is the most important criterion of selection of tree species for agroforestry systems as the main aim is to obtain overall more output per unit area. Care should be taken before collection of seeds and seedlings that they are being procured from reliable source.

2.7 Characteristics of Agricultural Crops for Agro forestry

(a) Agricultural crops should be short duration and quick growing (b) They should be at least partially tolerant to shade(**c)** Most of them should belong to Leguminosae family(d) They should respond well to high density tree planting(e) They should bear some adverse conditions, like water stress and/or excess of watering(f) Crops should return adequate organic matter to soil through their fallen leaves, root system, stumps, etc(g) Crops should appropriately be fitted in intensive or multiple cropping system (yspuh & Solan F,2012**).**

2.8 Benefits of agroforestry practices

1. improving water use efficiency

Agroforestry systems have the potential for improving water use efficiency by reducing the unproductive components of the water balance like run-off, soil evaporation and drainage (Turner & Ward, 2002).Trees with their comparatively deeper root system, improve groundwater quality by taking up the excess nutrients that have been leached below the rooting zone of agricultural crops.

2. Soil nutrient improvement

Soil fertility depletion in smallholder farms is the fundamental biophysical root cause of declining per-capita food production in Sub-Saharan Africa, including Ethiopia (Maithya *et al.*, 2006). On the other hand, it is also indicated that trees on farmlands have significant values for soil nutrient improvements either by preventing or mitigating soil erosion, in turn, reducing nutrient losses from the system (Breman,2001;BishawBadege,2001; Belayneh

Ayele,2010) or by increasing the total content of nutrients in the soil-plant system (Amare Haileslassie *et al.*,2005).

Out of the several benefits obtained from agroforestry systems in terms of soil fertility, soil nutrient cycling is the most predominant.In a soil-plant system, plant nutrients are in a state of continuous, dynamic transfer (Breman, 2001) and plants take up nutrients from the soil and use them for metabolic activities.In-turn, these nutrients are returned back to the soil either naturally as litter fall or through pruning and mulching in some agroforestry practices and through root litter Jose,(2009).Different studies on soil-plant-crop relations in AFPs showed that selected trees and shrubs improve soil fertility which results in boosting of crop yield, (Pre-Smith,2010).

Agroforestry practices have a potential to provide a valuable organic matter, which improve the nutrient and water holding capacity, increased cation exchange capacity, buffering of the soil against acidification as well as aluminium and iron toxicity (Breman, 2001). Studies in Ethiopia also showed AFPs have greater potential in improving soil nutrient status (Gindaba *et al.,* 2005; Belayneh Ayele, 2010; Lalisa Duguma *et al.,* 2010; Balay Manjur *et al.,* 2014) compared with conventional mono-cropping systems.Nutrient depletion studies also showed that higher amounts of soil nutrients are lost from conventional mono-cropping systems than agroforestry systems through crop and crop residual harvest (Amare Haileslassie *et al.,* 2006). Nutrient storage and cycling by woody species might have a positive influence on the understory and annual crop through litter fall and decomposition, which, in turn, increases soil nutrient supply for the understory. On the other hand, Belayneh Ayele,(2010) also indicated that the soil loss due to rill and inter-rill erosion is higher in open fields than agro forested fields.

3 Agroforestry for biodiversity conservation

Biodiversity conservation may not be a primary goal of agroforestry systems. Nevertheless, in some cases agroforestry systems do support as high as 50-80% of biodiversity of comparable natural systems and also act as buffers to parks and protected areas. Agroforestry is a system of complex and integrated approach, which provides opportunity to intermingle trees, crops, pastures and animals in a managed aspect and provides shelter for soil flora and fauna, birds,

insects and wildlife. Traditional agroforestry systems are best examples of agro-biodiversity conservation (Montagnini *et al.,* 2011

4. Agroforestry for Microclimate Amelioration

Agroforestry are having ability to improve microclimatic environment by lowering temperature, evapotranspiration, moisture reduction, and acting as a filter for providing buffer against direct sunlight.Microclimate amelioration is considered as one of the important role of trees in agroforestry systems to provide sustainability. In dry land and low rainfall areas, water availability to crops is paramount and seems to be the dividing factor between absolute crop failure and reasonable food production. (Lin,2010) has revealed on coffee based agroforestry systems mentioned that crops grown under heavy shade (60-80 %) were kept 2-3°C cooler during the hottest times of the day than crops under light shading (10- 30%) and lost 41% less water through soil evaporation and 32% less water through plant transpiration. The effect of extremely high temperature on some crops may be reduced through modifying the microclimate. According to (Steffan *et al.*,2007) the removal of shade trees increased soil surface temperature by about 4 °C and reduced relative air humidity at 2 m above ground by about 12%.

5. Carbon Sequestration Potential of Agroforestry

Agroforestry enhance the uptake of CO2 or reduce its emission and has the potential to remove a significant amount of CO2 from the atmosphere,if the trees are harvested, sequestered carbon is locked. Many researchers have proved that agroforestry system are promising land use system to increase aboveground and soil Carbon stock to mitigate greenhouse gas emissions(Verchot *et al.*,2006,Yadava *et al.*,2010 and Bright *et al*.,2012). The Carbon sequestration potential of tropical agroforestry system in recent studies is estimated between 12 and 228 Mg ha-1 with a mean value of 95 Mg ha-1 (Pandey, 2007). According to (Swaminathan,2012 and Dagar et al.,2016b) mentioned that agroforestry systems have the highest carbon sequestration potential among managed land use systems, followed by grazing management, forest management,and crop plant management in that order.

6. Sociocultural and Recreational Value

The indigenous and traditional systems have been appreciated for ecological principles and sustainability; but very little attention has been paid toward the recreational and cultural values of the systems. Wherever these systems are practiced, these are an important component of local cultural heritage. The indigenous bamboo + pine system and the rice + fish culture of the Apatani tribe of Arunachal Pradesh in India have earned the rare distinction as a UNESCO World Heritage Site for its extremely high productivity and the unique way of preserving the ecology (Tangjang and Nair, 2016).

7. Agroforestry for Fodder Production

Trees and shrubs often contribute substantial amount of leaf fodder in arid, semiarid and hill regions, during lean period through lopping/pruning of trees,popularly known as top feed. The leaf fodder yield depends on species, initial age, lopping intensity and interval as well as agro climatic conditions. Silvipastoral system is the most appropriate land use system for degraded lands. The top feeds are also considered very important in vegetation stabilization and sustained productivity of rangelands (Dhyani, 2003).They also play an important role as windbreaks and by providing shade for the grazing animal.

8. Honeybee production

Agroforestry systems are very suitable for apiculture, the care and management of honeybees for various products and/or for pollinating agronomic or tree crops. Hives can be introduced in existing forest systems (i.e. forest farming), or new plantings could be designed to favor bee forage (Hill and Buck, 2000). Fruit trees require bee pollination for effective fruit set. Other trees, as black locust (Robinia pseudoacacia), chestnut (Castanea sativa) and Tilia spp. are known to have flowers that produce nectar and pollen attractive to bees and can produce high quality honey (Hill and Buck, 2000). In silvopastoral and silvoarable agroforestry, planting bee forage in the tree line may favor honey production and provide additional income. Apart from honey, apiculture can produce valuable products as beeswax, propolis, royal jelly, bee venom (for therapeutic uses) and bee pollen.

9. Fuel wood supply

Production and use of fuel wood are important livelihood strategies in SSA where about 81% of the households (excluding South Africa) rely on wood fuel as their primary source of

energy (World Bank,2011). The main fuel wood in SSA is charcoal and firewood. Charcoal is mainly used in urban areas while firewood is used by rural households for cooking and heating and in cottage industries for brickworks, tea processing and tobacco curing (Ramadhani *et al.,* 2002; World Bank, 2011; Iiyama *et al.,*2014). The demand for charcoal and firewood is projected to increase (Global Environment Fund, 2013) in many countries in SSA, as they remain the most readily available sources of energy and the most affordable alternatives to kerosene, liquid petroleum gas and electricity (Iiyama *et al.,* 2014). More fuel wood must, therefore, be produced on agricultural land if the fuel wood demand is to be met on a sustainable basis (Ndayambaje and Mohren, 2011). Approximately 20% of fuel wood in Africa is produced in agroforestry systems (Sharma *et-al.,* 2016).Agroforestry fuel wood production can provide more sustainable alternatives compared to forest and woodlands sources (Iiyama *et al.,* 2014). For example, firewood from agroforestry is often harvested by selecting branches or collecting deadwood from trees.

10. Food Production

As a result of population increment throughout the world famine and starvation are knocking with speed (Olajidetaiwo*et al.,* 2010).Agroforestry enhances food and nutritional security by supporting crop production and through provision of edible tree and livestock products (Dewees *et al.,* 2011; Jamnadass *et al.,* 2013; Franzel *et al.,* 2014). Trees improve growth and yield of crops when the appropriate species are planted in optimum densities and appropriate pruning regimes are applied (Bayala *et al.,* 2015). Fruits and vegetables common in homegardens provide food security because they mature at various periods throughout the year.

2.9 Constraints to implement Agroforestry Practices

Although it is known that AF provides several benefits there are still factors which limit some farmers from adopting and practicing AF. The basic constraints affecting the agroforestry practices as follow.

1. Lack of farmers' knowledge

Unawareness and lack of education, technical skills, capital, technical assistance, and interest are the main hindrances in the adoption of agroforestry (Lambert and Ozioma, 2011) reported that with high level of awareness of agroforestry systems, there was likely to be high

adoption, since farmers were aware of a given system adoption. Mashinini *et al.* (2011) reported also that lack of adequate knowledge pertaining the type and amount of inputs to be used by farmers hindered farmers to produce more food. Lack of awareness and fragmented extension service affecting the expansion of agroforestry practice (Peter *et al.,* 2017).

2. Unsecure land tenure system

Unsecured or ambiguous land tenure, lack of land use management is common in developing countries, leads to confusion regarding land delineation and rights.If people do not have title to land, there is a perception that there is no point in finance in trees, which may take a long time for benefits to be accomplished. It is expected that farmers that feel secured (sure to inherit land they cultivate to their descendants) build the choice to take a position in future investment (Rioux, 2011; Holland *et al*., 2014; Kiyani *et al.,* 2017).Bakengesa et al. (2002) reported that insecurity on land tenure has resulted in low adoption of AFTs by farmers. Msuya *et al.* (2006) also noted that a fundamental challenge in dissemination and adoption of AF was lack of permanent land ownership. Generally, farmers fear to invest on the land which does not belong to them.

3. Lack of extension services

Extension services increase farmer's awareness of specific technical advice and increases rate of technical adoption. Extension workers, are not only for informing farmers to improve their lands and prepare a cropping pattern, but also motivate them to adopt modern agricultural practices according to their socioeconomic status (Mansoor Ahmad *et al*.,2007).It is against this condition that Lambert and Ozioma,(2011) reported that ineffective linkage between extension workers and farmers was responsible for low adoption of technology including AFTs.According to Orisakwe *et al*. (2011) poor extension delivery was the factor that limited adoption of AF in Imo state, Nigeria.However, inefficient government extension services contribute to continue low yields of production.

4. Food and Nutritional Insecurity

Agroforestry systems with agriculture crops, trees, and livestock farms generate wide range of social and environment benefits to 1.2 billion people for enhancing food production (Jamnadass *et al.,* 2013).Beckford *et al. (*2011) reported that food security is a condition

where all people, at all times, have physical and economic access to sufficient, safe, and nutritious food to meet their dietary needs and food preferences for an active and healthy life. Solving the problem 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).As well as directly providing edible products, agroforestry trees support food production by a range of other means, including by providing shade and support for crops that need it,supporting animal production,andimproving soil fertility. Agroforestry has an important role in increasing the yields of vegetables that, with fruit, provide varied and nutritionally balanced diets rather than calories alone (Susila *et al.,* 2012).

5. Losses of Perishable Agroforestry Products

Many agroforestry products have a very short shelf life, particularly fruits and vegetables, which are mostly collected and marketed by women. For perishable goods such as fruit, the result is also high wastage along the supply chain and a failure to reach quality grades. Ramathani,(2002) and Kadzere *et al.* (2006) reported that postharvest handling and transport are the major causes of losses of perishable agroforestry products.

6. Lack of access to market

Unreliable marketsof their produce lead them to sell their produces by farm gate prices. These resulted into low earnings and food insecurity (IFAD, 2012). For many tree products, markets are poorly structured and coordinated Roshetko *et al.* (2007). This results in low and unstable returns to farmers and high prices for buyers of tree foods, which limits their consumption. Marketing farm products, both agricultural and forestry produce are sometimes difficult for farmers. Distance from farm to market, transportation problem, bad road network, attitude of buyers trying to cheat the farmers, processing and storage problems are all marketing challenges facing farmers. It sometimes leads to waste of agricultural produce and consequently low income accrued to farmers who has laboured for long. This result is similar to the barriers to agroforestry development identified by (FAO, 2013).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). Traders additionally face several issues, like poor roads, corrupt officers, and also the high value of collection from geographically scattered producers.

7. Inadequate Capital

Inadequate access to capital and credit is usually considered as a serious constraint for increasing household production and financial gain to invest in additional economical land use. For any improvement of the farming practices, the essential public product funded by the state, like education, health care, agricultural research, and extension and also the maintenance of rural roads ought to be in place (Hazell *et al.,* 2007; Jones, 2015; Weil and Brady, 2016). It is believed that farmers with high income are likely to adopt new technologies than farmers with low income, because income increases farmer's ability to hire labour and meet cost associated with technologies (Casey, 2001).According to Ibrahim, *et al. (*2019), inaccessibility to soft loans either from the government or nongovernmental bodies and reduced standard of living of the farmers.

8. Unavailability of labour

Cultivation is often done with family labor and also the labor shortage is commonly a reason why agroforestry practices do not seem to be adopted (Angelsen and Kaimowitz, 2004; Weil and Brady, 2016). Most agroforestry innovations demand changes within the labor practices of the farming system into that they are introduced. Moreover, labor necessities are scrutinized by rural individualsbefore they decide whether or not agroforestryfollow. According to Ibrahim,*et al*.(2019) also unavailability of labour is aconstraint, whereby educated and well-to do individuals who needs hired labour to farm for large hectares of land are not able to get.

9. Shortage of Farm size

Even though the concept of agroforestry and its importance was well understood among the respondents, the size of the land available to the farmers, served as a limiting factor. Most of the farmers complained that their farm sizes were too small to allow for the integration of trees. Kofi*et al.*(2003) and Pattanayak *et al*. (2002**)** carried out the farm size increases,

agroforestry adoption as well increases. Maluki *et al*.,(2016**)** ;Orisakwe and Agomuo, (2011) farm size decreases the adoption as well declines Lambert and Ozioma ,(2011) reported that farm size was positively related to adoption rate of AFTs implying that as the farmers farm sizes increased they adopt more of agroforestry technologies. Kabwe, (2010) reported that when the farm size was large, it encouraged AF adoption.

10. Lack of seed and seedling

Tree planting activities are often constrained by limited access to planting materials, poor nursery skills and inappropriate technical information of tree planting (Gunasena and Rushetko, 2000).Ajayi, (2006) reported that one of the greatest constraints of some agroforestry technologies was lack of access to quality seeds. Unlike the seeds of annual crops in which established institutions exist to promote them and also private sector organizations have been engaged in their multiplication and distribution, there is little or no institutional structure to make the seeds of AF tree species available. Lack of seedlings serves as another constraint to the adoption of agroforestry. Farmers are therefore interested in the planting of trees on their farms but do not have access to seedlings. Generally, lack of planting materials is a limitation to adoption of agroforestry (Kwesiga *et al.*, 2003).

11. Occurrence of diseases and pests

The seasonal occurrence of plant and animal diseases is a threat to agroforestry. Kofi *et al***.**(2003**),** high incidence of pests and diseases could be caused by incidence of climate change and the associated problem of excessive rainfall and drought. This could result to poor yield, low quality/market value and poor return to households (Mabel, 2015).

12. Lack of credit facilities

Farmers in the study area indicated that credit facilities were not also available for expansion of their farm size as well as the purchase of other farm inputs. Credit is said to be a major concern both to project implementation and to farmers.Credit enables diversification of livelihoods and creates access to basic needs in times of income shortage from major livelihood activities (Destaw Berhanu, 2003).

13. Lack of access road

The transportation network linking the villages to the market centers, and lack of storage facilities impact of AF when introduced, as transport of produce would be a limiting factor. A lotof farm produce deteriorates during bumper harvest due to the aforementioned problems as well as the perishability nature of some produce Kofi*et al. (*2003).

14. Water Shortage

Lack of technical assistance, proper awareness, and water shortage were the major constraints faced by the farmers for planting trees on their farmlands. People have to be careful about the misuse of water and recycling of the used water has to be practiced at small scale level Taimoor *et al*. (2017).

15. Institutional Problem

Major barriers to promote agroforestry systems are the lack of support for such systems through public policies (BishawBadege*et al***.,** 2013). Agricultural price supports or credit granted for certain agricultural activities, but hardly ever for trees, are also discouraging agroforestry adoption (FAO, 2013).Though agroforestry involves various stakeholders and value chains across agriculture and forestry sectors, institutional mandates are often unclear and divided between agriculture and forestry ministries (Agroforestry Network, 2020). Experience indicates agroforestry is said to belong to many ministries theoretically; in practice, however, it belongs to none; which creates numerous legal, economic, and social barriers preventing the potential of agroforestry to be fully exploited (Dawson *et al.,* 2013).

16. Free-grazing

Traditional free-grazing systems have contributed to the steady degradation of land that has taken place in the highlands of Ethiopia for centuries (GrimaTaddese,2001), and has resulted in continuous decline in the availability of livestock feed and other.Free-grazing system did not only result in increased land degradation (Dereje Tegaye *et al.,* 2012), but also has limited the effectiveness of human endeavour in degraded areas through the physical destruction of soil and water conservation structures such as terraces, reforestation among others, ultimately causing a vicious circle of land degradation, livestock feed shortage and over all lower productivity of the livestock sector.

2.10 Conceptual framework

In this section the conceptual framework that guides the study was present by building a model of interest.The framework includes different factors supposed to affect the agroforestry practices. These were socio-economic factors (Plot size, income, labor force and market price of tree products), institutional factors (extension service, land tenure and tree ownership) was as psychological factor (perception to agroforestry practices) which indicated as positive or negative attitude toward agroforestry practices) and bio-physical factors were assumed to have positive influences on the farmer's perception to use agroforestry practices. In general, poorer bio-physical production conditions (e.g., slop of farm land or erosion) create a positive incentive to adopt agroforestry practices to alleviate negative environmental situations. Furthermore the frame works how the benefits of agroforestry practices to farmer like income, food, firewood and soil conservation etc. Another factor affect agroforestry practices were household's personal and demographic variables which are mostly associated with farmers' adoption behavior. From this category of variables, education and age were reviewed in this study. The conceptual framework of this study is presented below.

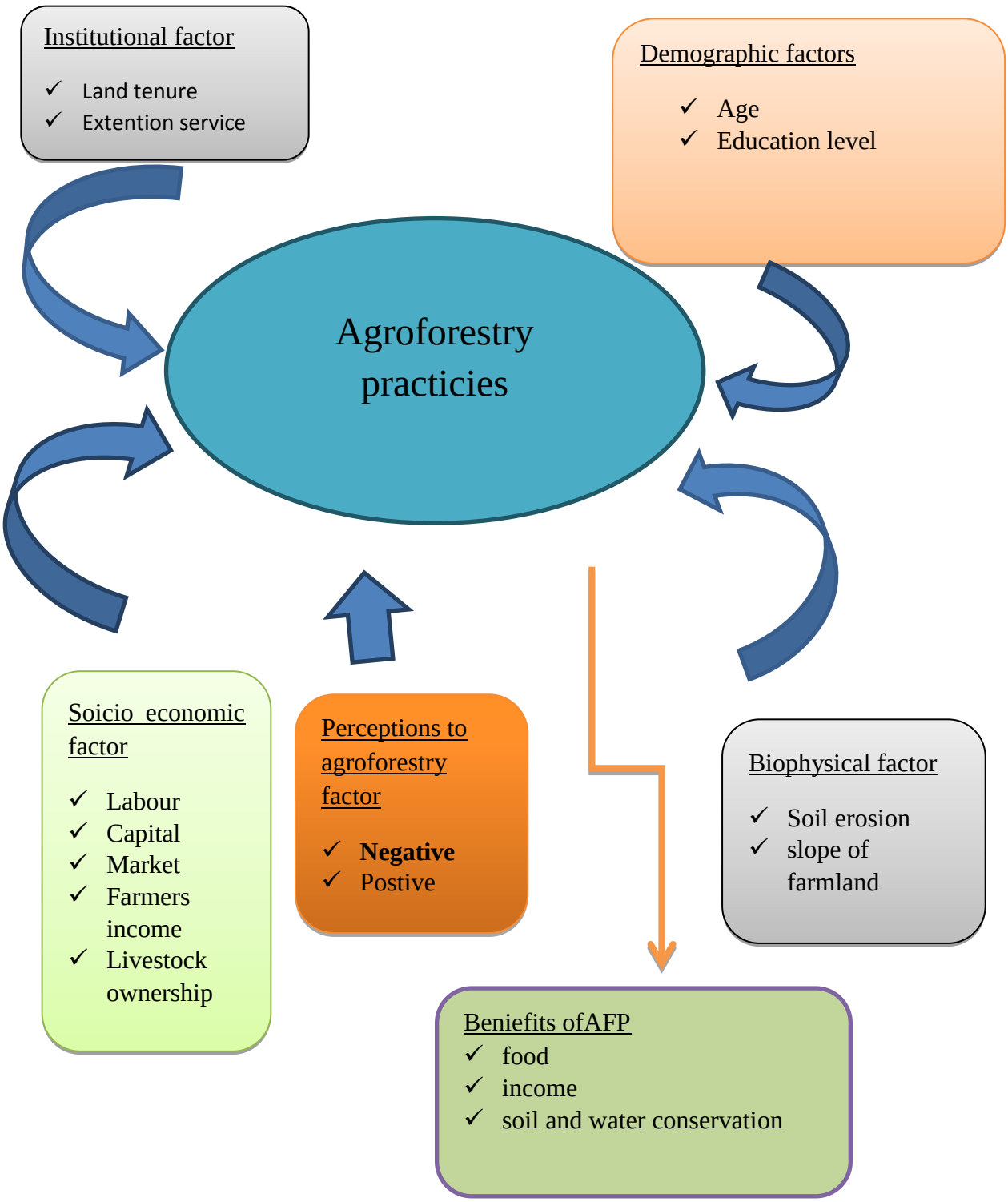


Figure 1Conceptual framework of the study

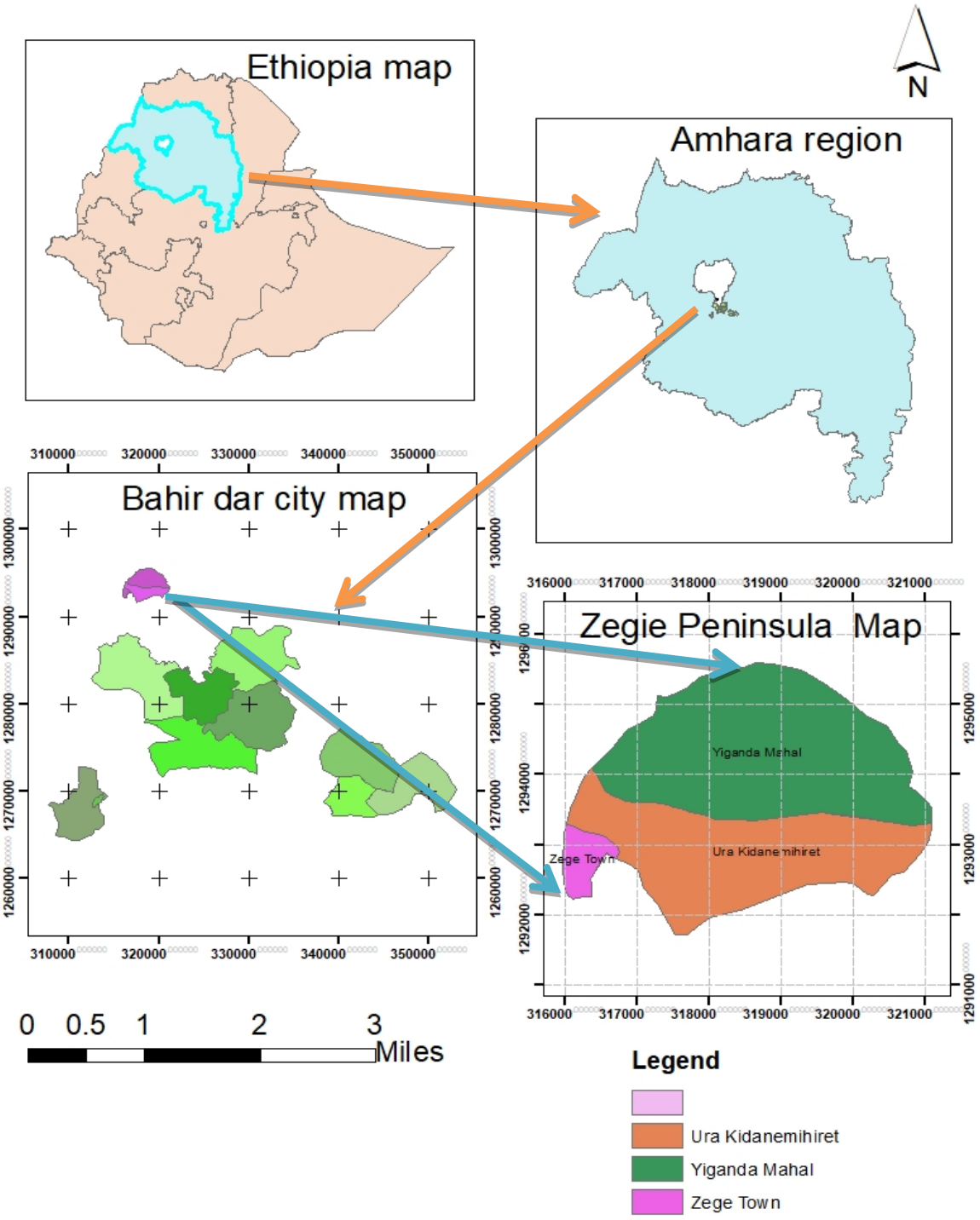
Source: Adopted from Alavalapati *et al.*(2005)

CHAPTER 3. MATERIALS AND METHODS

3.1 Description of the Study Area

3.1.1 Geographical location of the study area

The study was conducted in Zegie peninsula, Bahirdar city, Amhara national regional state, Ethiopia. It is located at 600 km northwest of Addis Ababa, and 28 km North West of Bahir Dar city. Geographically it is located between 11° 41' 57"N and 37° 20' 5"E (Figure 2). It is the largest peninsula along Lake Tana and the altitude ranges from 1770 m along the banks of the lake to 1990 masl at its summit called Ararat. It can be accessed both by land and water. The Peninsula includesZegie (Afaf), Ura and Yiganda Kebeles, (Yibelu Yitayih *et al.* (2021).



Source (Shape file, 2023)

Figure 2 Map of the study area

3.1.2 Climate

Zegie peninsulalies in the moist 'Woina Dega' agro-climatic zone and the mean minimum and maximum temperatures for 10 years (2008–2018) of meteorological data indicate 12.1 °C and 28.43 °C, respectively, with the average annual rainfall of 1726.07 mm (Yibelu Yitayih *et al*. 2021).

3.1.3 Soil types

The soils of Zege Peninsula are predominantly Nitosols followed by Luvisols, Vertisols and reddish or brownish ferrisols derived from volcanic parent material. Having pH values of the soil ranges from 5.05 to 6.07 (Getachew Deriba, 1993).

3.1.4 Land use

According to BCAAD, (2023), 73.8% of the whole peninsula was covered by dense forest trees and shrubs.

Table 1Land use land cover of the study area

NO	LULC	Area in ha
1	Cultivation	231
2	Grassland	106
3	Natural andplantation Forest	131.38
4	Wetland	54.306
5	Agroforestry	1428
6	Settlement	218.525
7	Shrubs	155.625
	Total	2324.836

Source, BCAAD, (2023)

3.1.5 Farming system

Livestock rearing and agricultural activity were prohibited in some parts of the area typically of Ura and Yiganda kebeles(TilahunTeclehaimanot and Mirutse Giday, 2007).Charcoal and

fuel wood collection is common practices of most of the inhabitants. The economy of Zeghie Peninsula revolves around coffee production (CARE Ethiopia, 2001).At present; most families cultivate (Rhamnus prinoides), (Citrus Limon), (Citrus medica), orange, bitter orange and sour orange (Citrus aurantium*),* papaya (Caracapapaya) and guava (Psidium guajava). Few, families also grow maize (Zea mays), mango (Mangifera indica), avocado (Perseaa mericana) and fishery (Getachew Gebeyehu and Afework Bekele, 2009). Most of the fruit crops in this area were introduced by CARE Ethiopia in the 1990s. In the absence of viable alternative economic activities, many residents of Zegie Peninsula have resorted to cut trees for sale and firewood. An estimated 90% of the firewood entering Bahir Dar town is from Zegie Peninsula (CARE Ethiopia, 2001). It was common to see boats carrying wood for sale to Bahir Dar city every day during the present study period.

3.1.6 Population

The peninsula has a total population of8754 having 3838 male and 4916 female, the proportions of female to male are 56.2% to 43.8% respectively. The peninsula has 1494 households of which 988 male and 506 female headed households,and the average population size in a house hold is expected as 5.8 (BCAAD,2022).

3.1.7 Wild animals

Wild animals such as grivet monkey, porcupine, jackal, bush pig, hyena, leopard, squirrel, hare and bushbuck are common in the peninsula (Getachew Gebeyehu and Afework Bekele, 2009).

3.1.8 Vegetation

The most dominant trees in Zegie Peninsula include Mimuscops kummel, Ficus sur, Strychanoss pinosa, Ficus vasta, Cordia africana, Capparis tomentosa, Prunus africana, Croton marcostachyu, Albiza gummifera, Jacaranda mimosifolia, Millettia ferruginae, Podocarpus gracilis, Ficus thonningii, Acacia busseai and Grewia ferruginea (Yibelu Yitayih *et al.* (2021).

3.2 Research Design

For the purpose of this study, mixed approach (quantitative and qualitative) research designs were used.Quantitative research refers to the numerical representation and manipulation of observations, used to describe and explain the phenomenon that such observation reflects (Berg, 2007). In other words, qualitative research was largely based on interpretive, holistic approach and aim to understand reality and meaning. It is a non-numerical examination and interpretation of observations for which the purpose was discovering underlying meanings and patterns of relationships (Berg, 2007).The mixed research designs minimize some of the limitations using single approaches which are complex physical phenomena are treated independently (Creswell, 2003). Generally, researcher believed that mixed research design (Munthali *et al.,* 2019) approach helps to substantiate or support the information collected using one instrument by another.

3.3 Selection of the Study Area

The researcher selected Zegie Peninsula as a research site using purposive sampling techniques from the total of eleven rural kebeles under Bahirdar city administrations because of the existence of different traditional agroforestry practices,the presence of different tree and shrub species,due to the prohibited of livestock rearing and agricultural activity in the area particularly Ura and Yiganda Kebele,presence ofdifferent limiting factors for implementation and expansion of agroforestry practice, few studieshas been conducted in the Peninsula concerning agroforestry practice, and familiarity with the rural kebeles and their people.

3.4 Sampling technique

Both purposive and simple random sampling techniques were employed in this study. The researcher used purposive technique to select key informants like agricultural development agents (DAs), Forest conservation task force,and watershed committee.Focus group discussion participants were purposively selected from different units of the community which include individuals with better acceptance at community levels likeElders, Model farmers,Female headed households, Land committee.In addition to this simple random sampling technique was employed to select sample respondents from the household of Zegie,Ura, andYiganda rural Kebele**.**Zegie rural kebele has 350 households, with this

252(72%) are male headed households and 84(28%) are female headed households,inUra kebele, from 539 households, 300(55.6%) are male headed and 239(44.4%) are female headed, similarlyin YigandaKebele, there are 605 households with 387(63.9%) are male headed and218 (30.1%) are female headed (BCAAD, 2022).

3.4.1 Sampling size

The sample size for this study was determined using the formula developed by (Yamane,T 1967) using 95% confidence level and with 5% level of error:

$$n = \frac{N}{1+N(e)^2}, \quad \text{----------Equ (3.1)}$$

Where,

n= required sample size.

N=population size.

e=desired level of precision (5%).

$$n = \frac{N}{1+N(e)^2} = \frac{1494}{1+1494(0.05)^2} = 315.5 = 316$$

The required sample households of each RK (n) were then calculated using the Formula: Cited by Bazezew Asfaw,(2018)

$$n_1 = \frac{n}{N} * N_1 \quad \text{---------- Equ (3.2)}$$

N= Total household

$n_{1=}$ eachrural kebele sample households

$N_{1=}$ each rural kebele households

n= Total household samples

$$n_1 = \frac{316}{1494} * 350 = 74.02 \approx 74 \text{ (Zegie kebele)}$$

$$n_2 = \frac{316}{1494} * 539 = 114.005 \approx 114 \text{ (Ura kebele)}$$

$$n_3 = \frac{316}{1494} * 605 = 127.96 \approx 128 \text{ (Yiganda kebele)}$$

Table 2 Population inhouseholds and sample size

Kebeles	Population in households		Total	Randomly selected sampled HH		
	Male-headed HHs	Female-headed HHs		MHH	FHH	Total
Zegie	301	49	350	59	15	74
Ura	300	239	539	74	40	114
Yiganda	387	218	605	75	53	128
Total	988	506	1494	208	108	316

Source: BCAAD, 2023

3.5 Data Collection Methods

Data were obtained from primary and secondary sources. Primary data were collected through questionnaire, Focus Group Discussion (FGD), Key informative interview (KII).Secondary data were gathered from different published and unpublished sources including books, journal articles, office reports, and internet.

3.5.1 Quantitative Data Collection

3.5.1.1.Household survey

Data was collected through structured questionnaire from individual HHs through face to face contact.The questionnaire was developed in English language and then translated to local language (Amharic). The data was generated from primary sources of household surveys. Primary data on household information about socio-economic and demographic characteristics of HHs; sex, age, family size, level of education, religion, marital status, land system and tenure security, type of livestock, land siz, institutional factors, types agroforestry practice,tree and shrubspecies of each agroforestry type,benefits and constraintsand also the major livelihood activity were collected from the sampled HHs.The data was collected using structured questionnaire.

The questionnaire was pre-tested using non-sampled households and necessary amendments were made, in conducting the interview enumeraters were selected carefully from Das/

development agents.As a result three development agents (natural resource experts) working each kebele, used as enumeraters and oriented on, the content of the questionnaire and procedures to be followed in the process of conducting the interview before commencing the work.Supervision was made by the researcher during data collection.

3.5.2 Qualitative Data Collection

So as to accomplish qualitative data collection, key informant interviews,and focus group discussions, were employed in the study area.

3.5.2.1.Key informant interviews

Key informants are individuals who are knowledgeable, open-minded, articulate, and cooperative for research interview purpose (Cole 2005; Neergaard 2007).A purposive sampling method will use to identify key informants based on their knowledge of the study area.The key informant interview was conducted with knowledgeable people from the community who have good knowledge about the area and the community. The purpose of key informant interviews is to collect an end to end information from a wide range of people.The three key informants in this study were (Watershed committee, forest conservation task force, and development agents) as well ashealth extension and land experts at kebele level. Key informant interview is carried out to triangulate the obtained information from the household interviews and anin-depth and detailed understanding of agro forestry. Hence, in this research, in total three key informants were used, and the discussion were moderated by the researcher by using a checklist (Table 3).

3.5.2.2.Focus Group Discussion

Focus group discussion is one of the most common qualitative research methods. According to (Lewis, 2015), the advantage of this method is that it allows the interaction with a range of information and allows the researcher to focus on group norms and dynamics around the issue being investigated, and the discussions weremoderated by the researcher using a checklist.The ideal size for a focus group discussion ranges from six to eight members (Lewis, 2015).Hence, for this study four focus group discussions were held, having seven members per group (Table3). Focus group discussion participants were purposively selected from different units of the community which include individuals with better acceptance at

community levels including (Model farmers, Elders, Land committeehead, andFemaleheadedhouseholds)whohad experience on the past and present trend of agroforestry practice.Some of the checklist were; identify the type of agroforestry, benefits, hindrance factors, major of tree and shrub for livestock fodders, main source of wood for fuel and construction, additional income generating off-farm activities, who learn agroforestry in the first time, common crops types and the major medicinal crops, herbs, root and tubers,and spice in the study area and other relevant questions for this study was collected.

Table 3Selected sample KII and FGD participants in the district

Position/profession	key informants				FGD Participants			
	Ura	Zegie	Yigand	TotalKII	Ura	Zegie	Yigand	Total FGD
Model farmers	-	-	-		3	3	3	9
Elders	-	-	-		3	3	3	9
Kebele-experts/Development agents	4	4	3	11	-			
Kebele-watershed committee head	1	1	1	3	-			
Forest-conservationtask force	2	2	3	7	_			
Kebele-land committeehead	-	-	-		1	1	1	3
Female-headed households	-	-	-		-	-	7	7
Total	7	7	7	21	7	7	14	28

Source: Household Survey, 2023

3.5.2.3.Field observation

Field observation carried out in the study sites to assess the existing situation of agroforestry systems and various tree species present on farmland, home gardens, multistory coffee system, live fences, boundary planting, scattered trees on cropland, wind breaks/shelter belts, fodder bank, trees on pasture. This was used to cross-check and enhances the reliability of information collected from selected HHs, key informant interview, and FGD. Besides, during field observation potential agro forestry practices was visited and photographs was also taken. According to (Obenget *et al*., 2014) field observation helps for the researcher to describe the existing agroforestry practices and comparing the reported\information with the actual occurrences in the study area

3.6 Methods of Data Analysis

3.6.1 Qualitative Data Analysis

Data obtained from key informant interviews, focus group discussions, were narrated and summarized accordingly. The information which was gathered using observation had been used to counter-check information provided by household respondents, key informant, and focus group participants.

3.6.2 Quantitative Data Analysis

Data were entered, coded, and cleaned using Microsoft Excel 2010 and then exported to SPSS, version 20, for further analysis.Quantitative data analysis involved both descriptive and inferential statistics (Multinomial logistic regression was used for factor affecting the choice of agroforestry practices).The analyzed data was presented and summarized using tables, and graphs.

3.6.2.1.Analysis of Factors Influencing Selection of various Agroforestry practices

Multinomial logit regression model was employed to analyze the underlying factors determining households' decisions on selection of various agroforestry practices.Multinomial logistic regression is used to predict categorical placement in or the probability of category membership on a dependent variable based on multiple independent variables. The

independent variables can be either dichotomous (i.e., binary) or continuous (*i.e*., interval or ratio in scale). Multinomial logistic regression is a simple extension of binary logistic regression that allows for more than two categories of the dependent or outcome variable.

Multinomial logistic model was employed to determine the factors that affect choice of agroforestry practice by households in the study area. According to Zeleke Dessie *et al.*, (2020)the model was preferred because it permits the analysis of decisions across more than two categories in the dependent variable. In this study the logistic formulation led to the estimation of the probability of making the choice of a particular agroforestry practice given the demographic and the socio economic characteristics of the households. Let there be dependent variable categories 1, 2..., Zwith 1 being the reference category. One regression is run for each category 2, 3... Zto predict the probability of *Y*i (the dependent variable for any observation *i*) being in that category. Then the probability of *Y*i being in category 1 is given by the adding-up constraint that the sum of the probabilities of *Y*i being in the various categories equals one and the same.The multinomial logistic regression model calculation for this study is given as:

$$P(Yi = Z) = \frac{exp(ZiXi)}{1+\sum_{i=2}^{Z} Exp(ZiXi)} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots Equ\ (3.3)$$

Where: Y = a random dependent variable taking on the values (1, 2, 3…, Z) for a positive integer Z and these include; Home garden, scattered trees on cropland, multistory, trees on boundary, and live fences. Xi= represents specific personal and socioeconomic characteristics of household.When using multinomial logistic regression model, the data were checked and tested for model specification of likelihood ratio, goodness of fit and multicollinearity tests.

Dependent Variables**:** The dependent variable were participation of household in various agroforestry practices (Home garden, scattered trees on cropland, multistory coffee system , trees on boundary, and live fences)Let Yi (z=1-5) denotes theprobability associated choice of agroforestry practice by rural household i with z=1 if the household practice home garden; z=2 if the household practice in scattered trees on cropland; z==3 if the household practice in multistory, y=4 if the household practice in boundary planting , and y=5 if the household practice in live fences.

Independent Variables**:** The independent variables of the study area were those variables hypothesized to have associations with choice of agroforestry practices

1. Variables explaining choice of agroforestry practices and Expected Hypotheses

Independent Variables**:** The independent variables of the study area were those variables hypothesized to have associations' agroforestry practices.Hence the following major explanatory variables were hypothesized in affecting the choice of agroforestry practices in the district.

Age of household heads (AgeHHH): The rural households mostly devote their time for livelihood improvements on agriculture. The older the household head, the more experience in farming. Moreover, older persons are more risk averters, and mostly they intensify and diversify their production activities. Where as young households would be more flexible for technology adoption and selection than older do. Therefore, it is hypothesized that, age of household head was positively or negatively influences the selection of agroforestry practices.

Sex of household head (SexHHH):In most cases the land management practices require more labor force. Hence, male headed households are expected to better undertake different land management practices, as better endowed with labor. In addition, women are commonly busy in household activities and their prime responsibility is usually child rearing.On behalf of this, females are more active nearby house activities than male and able to cope with home garden agroforestry practice than others. Hence it is hypothesized to have a positive or negative relation with the selection of agroforestry practices.

Farm land size (SizeFarm): Land holding size is an important factor to choice of agroforestry practices. Farmers who have large farms are less likely to choice agroforestry practices that require large land size as compared to those who have small landholding size because they have capabilities of accommodate and fallowing. Farmers with small land holding size might be obliged to choice agroforestry practices that require small land size for production. However the opposite might also be true. Farmers with small land holding size might not choice and select agroforestry practices depending on the size of land. The sign of selecting agroforestry would be either negative or positive relation.

Household size (HHSIZE): Since, agroforestry practices were labour intensive activity, meaning that families with less labour cannot afford to take up the technology.Large family size is normally associated with a higher labor endowment that will enable a household to

accomplish a various agricultural activities on time bases. In this study it is hypothesized to have a positive relation with the choice of agroforestry practices**.**

Annual income of household (Tincome): This refers to annual farm income obtained from sale of crop, fruits and other fixed assets in the home. Based on authors experience the amount of income left from consumption could be used for purchase of farm inputs. High income earned from the agricultural activities increases the farmers' financial capacity and increases the probability of investing in new agricultural technologies. In other way they could leave other practices due selection of best practices. Therefore, income expected to positively promote the selection of agroforestry practices or negatively inhibit other agroforestry practices.

Education of household head (EDUHHs): It refers to level of education attained by the household head at the time of survey. The level of education of the target group is one of the important factors preparing the individual to choice the best and short returned products of agroforestry practices. Then it is hypothesized to have a positive or negative correlation with selection and owning of agroforestry practices.

Access to credit (AccCredit): Agroforestry that requires high technology with multiple products requires relatively high initial investment cost than the others. Households who want to have multiple agroforestry products but do not have money at that time need some source of financing such as credit. Therefore having access to credit was supposed to have positive or negative influence on selection of agroforestry.

Price: The selling price of agroforestry products has a significant positive or negative association with the selection and owning of both multistory and boundary planting.

Water: Sufficiency and reliability of water sources (Suf&rewater)**:** Availability of sufficient and reliable water source was expected to positive or negative influence on selection of various agroforestry practices at household level in the penisula.

Animal: the number of livestock unit was positive or negative probability level to determine choice of household in participating agroforestry .The significant inverse relationship between livestock farming and the presence of agroforestry indicated that larger number of livestock

unit owned household heads were less likely to grow agroforestry and however the opposite might also be true

Land tenur**:** Security of tenure is the certainty that a person's right to land will be recognized by others and protected in case of specific challenges. If people do not have title to land, there is a perception that there is no point in finance in trees, which may take a long time for benefits to be accomplished. As aresult it was supposed to have positive or negative influence on selection of agroforestry.

Market: Distance to the market from household's home was expected to have a positive or negative influence on adoption of agroforestry. Having closer market was supposed to assist farmers to to sell products and increase their social interactions and shared information.

Table 4Variables explaining choice of agroforestry practices and Expected Hypotheses

Specification of variables	Type	Description	Expected sign
Sex (SexHHH)	Categorical	Sex of the household head: Female =1; male=0	±
Age (AgeHHH)	Continuous	Age of the head of household	±
Household size(HHSIZE)	Continuous	Number of household members	±
Education (EduHHH)	Continuous	Household head's educational level in years of schooling	±
Farmland size (SizeFarm)	Continuous	Household's total farmland owned in ha	±
Total income (Tincome)	Continuous	Total annual income of the household in Birr	±
Sufficiency and reliability ofwater source(Suf&rewater)	Categorical	Having sufficient and reliable water source for irrigation= 1;Otherwise = 0	±
Access to credit (AccCredit)	Categorical	Having access to credit=1; Otherwise=0	±
Price (affpric)	Categorical	Affordable price of agroforestry products=1; 0therwise=0	±
Access to market(AccMkt)	Categorical	Having access to market=1; Otherwise=0	±
Landtenur	Categorical	Secure land tenure=1; otherwise=0	±
Animal	Continuous	Number of animal =1; otherwise=0	±

Source: Extracted from Author's data (2022)

CHAPTER 4. RESULTS AND DISCUSSIONS

4.1 Demographic Characteristics of Households

4.1.1 Sex and Age Composition

Out of the total 316 respondents of the household survey in the study area, 208 (65.8%) were male and the remaining 108 (34.2 %) were female. This indicates that the proportion of males heads is significantly higher than that of females heads in thestudy area(Table 5).This is an indication that farming in the study area was highly dominated by male. This confirms the report of Adekunle (2009) that farming activities in Ondo State were mostly dominated by men, which could be an indication of labour intensive nature of farming practices.The age of the sample household heads ranged from 25 to 80 years old with an average of 52.2years, and also the age composition of the sample households showed that 0.9 %, 8.5 %, 14.9 %, 32.3%, 34.5% and 8.9 % within the age category of 18-25, 26-35, 36-45, 46-55, 56-65 and above 65 years respectively.

4.1.2 Marital Status of Respondents

The majority of the respondents 244(77.2%) were married,8(2.5%) were single, while 34(10.8%) and 30 (9.5%) were divorced and widowed respectively.

4.1.3 Household size

Out of the total 82(25.9%) of the respondent households had between 1 to 3 members, while 226 (71.5%) had between 4-8 members and the remaining 8 (2.5%) of households had above 9 members (Table 5). The household sizes of the sample households ranged from one to ten with an average size of 5persons. The result is in line with the national average household size 5.1 in rural area of Ethiopia (CSA and World Bank, 2013). Nwaru (2004) observed that large household size would help in reducing labour constraint in agricultural production.

4.1.4 Education level of sample households

Out of the total 316 respondents125 (39.1%) had engaged formal education, such as 95 (30.1%) having completed primary education,22 (7.0%) had completed secondary education;

6 (1.9%) had completed preparatory schooland the remaining 2(0.6%) attaining some College/ university degree).Whereas68(21.5%) undergo informal education,from this 50 (15.8%) adult educations (Can read and write only) and 18 (5.7%)attained church education.The remaining123(38.9%) of sample households were illiterate and couldn't read and write(Table 5).Education is an important characteristic that determines farmer's ability to communicate, acquire information and to adopt new technologies.The proportion of the literacy group implies that education level would favor to implement more than one type of agroforestry practices in the study area. Therefore, the farmer's education level has a positive relationship with AFP. This could be related with the awareness level of the farmers, as education is a key element in understanding new and modern agroforestry practices. Some reports supported the result USAID (2010) reported that the more educated a farmer is the more chances that the farmer would adopt innovations. This would help the farmers in understanding the concept of agroforestry.

4.1.5 Religions

The majority of respondents, 314 (99.4%), were Orthodox Christians, while 2(0.6%) were Muslims (Table 5).

Table 5Demographic Characteristics of households

Variables	Frequency (n=316)	Percentage (%)	Mean	Standard Deviation
Sex				
Male	208	65.8		
Female	108	34.2		
Age				
18-25	3	0.9		
26-35	27	8.5		
36-45	47	14.9	52.2	10.997
46-55	102	32.3		
56-65	109	34.5		
Above 65	28	8.9		
Marital status				
Single	8	2.5		
Married	244	77.2		
Divorced	34	10.8		
Widow	30	9.5		
Family size				
1-3	82	25.9		
4-8	226	71.5	5	1.947
>9	8	2.5		
Education level				
Illiterate	123	38.9		
Can read and write only	50	15.8		
Church education	18	5.7		
Elementary school (1- 8 grades)	95	30.1		
Secondary school (9- 10 grades	22	7.0		
Preparatory school	6	1.9		
College/ university	2	0.6		
Religion				
Orthodox	304	99.4		
Muslims	2	0.6		

Source: Household Survey, 2023

4.2 Socio-economic characteristics respondents

4.2.1 Occupation of the household's head

According to the survey's result showed that, 315(99.7%) respondentsinvolvedin agroforestry, whereas 1(0.3%) worked for small businesses /weaving (Table 6).

4.2.2 Additional income generating off-farm activities

Accordingto the results of the household survey, 247 (78.2%) respondents participated in various activities other than agroforestry.The result showed (Table 6)122 (49.4%),37 (15.0%),37 (15.0%), 18 (6.9 %), 12 (4.9%), 11(4.5%), and 11 (4.5%) of the respondents were participated in fish trap, petty/local trading, relatives remittance, security guard, local daily wage labor, selling local drinks, and church employers respectively.

While the remaining 68(21.5%) did not engage in any other form of revenue-generating activity other than agroforestry activities.In addation to off-farm activites,among the agroforestry prouducts fuel wood were commonly observed along the highways of the study areas and transport to bahirdar by boat in order to supplement households' food security.The result supported by similar finding that Fuel wood is also an important source of cash income for households located nearby the main roads and the market center(Zerfu Hailu 2002). Stacks of E. globulus fuel wood were commonly observed along the highways of the study areas (Zerfu, 2002). Many smallholder farmers mostly sell fuel wood during the rainy season in order to supplement households' food security

The focus group discussion revealed that household members engage in a variety of activities to support their livelihoods. Farming as their primary occupation andengage in additional activities including, fish trap, petty/local trading, selling local drinks, local daily wage labourand security guard.As aresult less land size owners are frequently engaged in off-farm activities /additional activities than large land size owners.Off- farm income source helps as a source of income outside of crop, livestock and tree products and supports the ideas of household interviews.

Table 6Socio-economic characteristics respondents

Variables	frequency (n=316)	Percentage (%)
Occupation of the household's head		
Farming	315	99.7
Small business	1	0.3
Additional income(off-farm)activities		
Yes	247	78.2
No	68	21.5
Sources do you use to supplement the deficiency		
Fish trap	122	49.4
Local daily wage labour	12	4.9
Petty/local trading	37	15.0
Security guard	17	6.9
Relatives Remittance	37	15.0
Selling local drinks	11	4.5
Church employer	11	4.5

Source: Household Survey, 2023

During focus group discussion,the main source of wood for fuel and constructionwere from their own planted trees and only small households buying from the surrounding area, wenjeta Kebele Bahirdar Zuria District. Particularly in zegie kebele farmers used Eucalyptus globulus species for construction purposes.

4.3 Farm size, Land tenure, Market, and Extension System

4.3.1 Farm size and Land tenure

All of 316 (100%) of the respondants had land in different size. From the total respondents171 (54.1%) had farm sizes of ≤ 0.5ha, 134 (42.4%) 0.6-2 ha, 8 (2.5%) 2.1-3ha, and 3(0.9%) greater than 3ha (Table 7). Based on this finding, majority of the respondents were engaged in subsistence farming which was mainly for household consumption and very

little for sale due to the small size of farmland (≤ 0.5 hectares). This explains why most of the rural farmers cannot make enough profit from their produce and therefore poor purchasing power to maintain a minimum standard of living.

The study result also showed that 119(37.7%) of the respondents acquired their farmlands through land inheritance from others, (Table7).Others acquired land through, lease/rent 3(0.9%), Bought /purchase 1(0.3%), given by government 75 (23.7%), family gift 95 (30.1%) While, 23(7.3%) of the respondents acquired their land through a combination of two (land inheritance and given by government). From the findings, farmland size is related to adoption rate of agroforestry; respondents having larger farm sizes are more likely to adopt different types of agroforestry practice than respondents having small farmland size.This agreed with Oyewole *et al.* (2015) from Ekiti State, Nigeria, Gebreegziabher zerihun et al. (2010) from Ethiopia who reported that large land size more participating in tree planting than smaller size of land (Table 7).

According to the respondents response, the result of land tenure security (Table 7) showed that, the majority of households 211 (66.8%) have been feelings about land tenure security.Whereas105 (33.2%) of the respondents did not have feelings.Concerning the reasons of loss of the land rights at federal as well as regional land office reveals that the rural land holder may loss or terminates his/her use right through absence of a farmer from the locality without the knowledge of his where about and without renting the land.Unsecured or ambiguous land tenure, lack of land use management is common in developing countries, leads to confusion regarding land delineation and rights.

Table 7 Farm size and Land Tenure security on agro-forestry

Variables	Frequency	Percent
Owner of land		
Yes	316	100
No	0	0
Size of farm land		
≤ 0.5ha	171	54.1
0.6-2 ha	134	42.4
2.1-3ha	8	2.5
>3ha	3	0.9
Method of land acquired		
Inheritance of land	119	37.7
Rent	3	0.9
Bought	1	0.3
Given by government	75	23.7
Gift from family	95	30.1
Both inheritance and given by government	23	7.3
Feeling of land tenure security		
Yes	211	66.8
No	105	33.2

Sources; household survey, (2023)

4.3.2 Market system

According to the respondent's response, the result of market system showed that 172 (54.4%) of them revealed that they were sell from local market (Table 8). Whereas 79 (25%) and 13 (4.1%) of households were sell from urban market and their farmland respectively. In addition 14 (4.4%) and 16 (5.1%) of households were sell from both urban and local market, andalso local and their farmland respectively.

The remaining 21 (6.7%) households were sell their agroforestry products from all market system (urban, local market and on farm) (Table 8).The satisfaction level of the respondents based on price of agroforestry products 123 (38.9%) and 192 (60.8%) of households wereagreedanddisagreed respectively.

Table 8Market system

Variables	Frequency	Percent
Selling place of AF products	315	99.7
Local Market	172	54.4
Urban Market	79	25
On farm	13	4.1
Both urban and local market	14	4.4
Both local and on farm	16	5.1
Urban, local market and On farm	21	6.7
Satisfaction on the price of AF products	315	99.7
Yes	123	38.9
No	192	60.8

Sources; household survey, (2023)

4.3.3 Extension system

4.3.3.1 Sources of agroforestry information

For information on agroforestry, farmers rely on a variety of sources. The farmers claimed that the primary information sources of agro forestry for educating farmers on agroforestry practices were inherited from family (77.2%),extension works (17.4%), own trial (3.2%),formal training (1.3%), personal advice (0.6%), andcommunity meeting (0.3%).Inherited from familywere the main sources of information for agroforestry in the study area. Out of the total respondents247 (78.2%) got training in how to practice agroforestry and the remaing 69 (21.8%) did not haveagroforestry training.From 247 (78.2%) trained respondents; 85.4%, 10.8%, 2.5% and 1.3% households were trained byagricultural extension officer, NGO, model farmers and researchers respectively. According to the result

below (Table 9),agricultural extension officers deliver agroforestry based technical assistance for farmers in three different methods. Demonstration in the field, Oral advice and a combination of demonstration and oral advice were accounting 28.5%, 33.2%, and 38.3 % respectively.

Table 9 Extension system for agro forestry practice

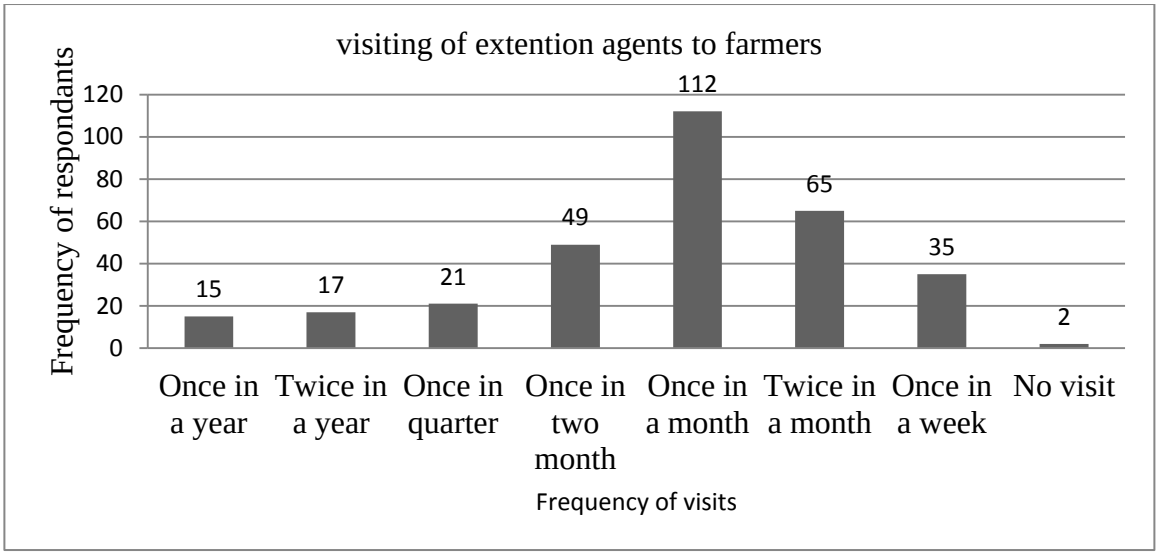
variable	Frequency	Percent
Information sourcesabout agro forestry		
Formal training	4	1.3
Community meeting	1	0.3
Personal advice	2	0.6
Extension works	55	17.4
Inherited family	244	77.2
Own trial	10	3.2
Agroforestry training participant		
Yes	247	78.2
No	69	21.8
Owner of trainer		
Agricultural extension officer	270	85.4
Researchers	4	1.3
Farmer	8	2.5
NGO	34	10.8
Means of deliver technical service		
By demonstration	90	28.5
Oral advice	105	33.2
Both by demonstration and oral advice	121	38.3

Sources; household survey, (2023)

4.3.3.2. Access to extension Service

Kebele agricultural developments office of the Peninsula offers different services to forest growers,the purpose was to suggest suitable and effective information source to perform

better satisfaction of farmers and rural community.That means the dissemination of information through farmers contact with extension and research agencies can influence the adoption of new technologies.This can be through the extension agent visits to the farmers or the farmer visits to the extension office seeking information and advice.The sampled households contact with extension agent presented(Figure3) shows that, Once in a month, twice in a month,once in two month, Once in a week, once in quarter, twice in a year, once inayear,andno visitaccountingrespectively (Figure 3).



Sources; household survey, (2023)

Figure 3Visting of the extension agent to farmers

4.4 The sources of labor in the study area

The strong competition for household labor with other activities in the farming system particularly during critical periods would obviously influence farmers.According to the respondents in the study area; the labor sources for agricultural activities were mainly of family itself (65.5%). Whereas, (family and wage per day), (hired), (wage-per day), (debo/cooperative), (family hired and wage-per day), and (family and Debo /cooperative)were other source of labor in the study area (Table 10).

Table 10 Sources of labor in the study area

Variables	Frequency	Percent
the sources of labor on in the study area		
Family	207	65.5
Hired	22	7
Wage-perday	7	2.2
Debo /cooperative	5	1.6
Family and wage-perday	68	21.5
Family and Debo /cooperative	3	0.9
Family,Hired and Wage-perday	4	1.3

Sources; household survey, (2023)

4.5 Livestock production system in the study area

Out of the total 316 respondents, 266(84.2 %)of them carried out livestock rearing and 50 (15.8 %) did not.According to the respondents the type oflivestock that existed in the study area were cattle, Equines ,sheep, hen and beehives, hen and beehives, beehives and sheep, sheep, goat,hen and cattle,cattle and hen,goat,sheep and beehives,sheep, beehives (Table11).Among the three rural kebeles Ura and Yiganda livestock rearing and agricultural activity were prohibited in the area **(**TilahunTeclehaimanot and Mirutse Giday, 2007).Since around 2007, sheep fattening has been promoted by governmental extension agents as a resilience strategy in light of declining livelihoods, ignoring the religious ban of livestock on the peninsula (Dagninet Amare *et al*., 2017).

Table 11 Livestock production system in the study area

variable	Frequency	Percent
Reare of animals		
Yes	266	84.2
No	50	15.8
The type of livestock		
Cattle	42	13.3
Equines	9	2.8
Sheep , hen and beehives	62	19.7
Hen and beehives	84	25.2
Beehives and sheep	25	7.5
Sheep,goat, hen and cattle	14	4.4
Cattle and hen	3	0.9
Goat ,sheep and beehives	1	0.3
Sheep	12	3.8
Beehives	14	4.4

Sources; household survey, (2023)

4.5.1 The source of feed for the livestock

The result showed that (Table 11) 266 (84.2%) carried out livestock rearing. From this respondents (Table 12) 201 (63.6%) respondents got livestock feed from their own land whereas, 115 (36.4%) respondents did not have livestock feed. The sources of livestock feed from zegie kebele is mainly fragmented grazing lands in and around the vicinity of farmers own holdings. These areas include seasonally water logged and fragments at the margin of Lake Tana, a land not suitable for arable farming.

According to the respondents the major sources of animal fodder in the study area were forage, tree/shrub/ fodder, grassland/ grazing land, feed from cropresidue, industrial feed, hay harvesting andcollection, and local beverage residues.The quantity and quality forage normally decline in the dry season.To maintain animal health and avert loss of productivity,

farmers supplement dry season forage with concentrates or fodder from trees and shrubs (Bayala *et al.* 2014a).

Table 12 Source of feed for the livestock

Variable	Frequency	Percent
Having livestock feed		
Yes	201	63.6
No	115	36.4
Source of feed for the livestock		
Forage	37	11.1
Tree/shrub/ fodder	74	22.2
Grassland/ grazing land	19	6.01
Crop residue	31	9.8
Industrial feed	6	1.89
Hay harvesting and collection	14	4.43
Local beverage residues (lbeer and alcohol residues	20	6.32
Total	201	

Sources; household survey, (2023)

4.6 Major types of Agroforestry Practice in the Study Area

In the study area, the majority of respondents received knowledge of agroforestry practice from local indigenous people and has a history of doing so.In the study area; eight typical agroforestry types were discovered and the findings of the household survey revealedthat home gardens 315 (99.7%), coffee based multistory AFPs 261 (82.6%), live fences141 (44.6%), boundary planting 53 (16.8%), scattered trees on cropland 23 (7.3%), wind breaks/shelter belts 8 (2.5%), fodder bank 6 (1.9%), and trees on pasture4 (1.3%) (Table13). In addition to these scattered trees on cropland, wind breaks/shelter belts, fodder bank, and trees on pasture found only in Zegie kebele. Whereas; home gardens, coffee based multistory AFPs, live fences were found in all Kebeles of the study area, trees on boundaries was found in Ura and Zegie kebele but not commen in Yiganda kebele.According to the study's findings, coffee based multistory was the second most popular agroforestry technique among farmers in

the study area next to home gardens, while trees on rangeland had the lowest proportion thestudy area (Table13).

Table 13 Major AgroforestryPractices

Variable	Frequency				
	Ura	Zegie	Yiganda	Total	Percentage
Scattered trees on cropland	0	23	0	23	7.3
Home gardens	114	73	128	315	99.7
Trees on boundaries	13	40	0	53	16.8
Wind breaks/shelter belts	0	8	0	8	2.5
Live fences	89	50	2	141	44.6
Fodder bank	0	6	0	6	1.9
Trees on rangeland	0	4	0	4	1.3
Coffee based Multistory AFPs	114	42	105	261	82.6

Sources; household survey, (2023)

Multiple responses Sources, household survey 2023

Farmer's tree/shrub species preference for major AFPs

4.6.1 Homegarden AFP and Farmers tree/shrub species preference

Food and nutritional security is the primary role of homegardens (Kumar, B.M and Nair, P.K.R 2006).In homegardens, trees, shrubs, vegetables and other herbaceous plants are grown in dense and random arrangement (Whitney *et al*.2018). Based on farmers' experience they inherited from their parents, 315 (99.7%) of the respondents in the study area adopt homesteads agroforestry practice (Table 13).The most commonly grown trees/shrub's near homesteads both planted artificially and grown naturally were:- Rhamnus prinoides (24.4%), Olea africana (10.1%), Cordia africana (54.7%), Persea americana (12.7%), Mangifera indica (17.1%), Musa sapientum (5.4%), Azadirachta indica (11.4%), Prunus persica (1.6%), Psidium guajava (9.8%), Citrus sinensis (2.5%), Citrus aurantifolia (15.8 %), Croton macrostachyus (38.9 %), Albizia gummifera (44 %), Ficus vasta (5.1%), Coffee arabica (37.3%), Grevilia robusta (10.1%), Millettia ferruginea (34.2%), Ehretia cimosa (37.3%),

Rothmannia urcelliformis (20.3%), Diospyrosa abyssinica (19.6%), Celtis africana (6.3%), Moringa olifra (4.7%), Mimusops kummel (6.3%) Albizia malacophy (3.5%), Acacia nilotica (3.2%), Erythrina abyssinica (1.3%), Entada abyssinica (0.6%), Juniperus procera (2.5%), Grewia ferruginea (0.6%), Stereospermum kunthianum (1.3%) Rbus glutinosa (0.6%), Adansonia digitata (1.3%), Vernonia amygdalin (4.1%), Sesbaina sesban, (1.9%), Senna siamea (1.6%), Dracaena steudneri (2.5%), Gardenia volkensii, (1.3 %) Bersama abyssinica (0.3%), Morus mesozygia (0.3%), Podocarpus falcatus (0.9%), Vangueria volkensii (1.9%), Ritchiea albersii (0.3%), Syzygium guineense (2.2%) (Appendix 2),and in general it covers 43 (35 tree and 8 shurb) Species included.

According to focuse group disscussions farmers in the study area have experiences of intercropping of Aframomum corrorima (Korerima), Zingiber officinale (Zinjible),Ipomoea batatas (Sukar dinich), and Cucurbita pepo (Duba)with multipurpose trees in home garden agroforestry.

4.6.2 Coffee based multistory AFPand Farmers tree/shrub species preference

Multistorey coffee systems (MCS), broadly refer to the semi-managed production of coffee under the canopy of scattered taller trees. This generally has positive side effects on the coffee stands with respect to microclimate amelioration, biodiversity, pest control, pollination, and water and soil conservation (Snoeck *et al.,* 2000; Rice, 2010; Alemu, Mekonnen 2015). The result showed 261 (82.6%) of the respondents adopt Coffee based multistory AFPs(Table13), the major tree species grown on Coffee based multistory AFPsin the study area were Albizia gummifera (70.6%), Millettia ferruginea (63.9%), Croton macrostachyus (62.7%), Ehretia cimosa (60.4%), Cordia africana (66.1%),Olea africana (8.9%), Moringa olifera (13.3%), Celtis africana (40.2%), Rothmannia urcelliformis (61.7%), Diospyros abyssinica (53.5%), Mimusops kummel (32.3%), Albizia malacophylla (4.1%), Vangueria volkensii (52.2%), Stereospermum kunthianum (12.7%), Coffee Arabica (82.6%), Rhamnus prinoides (40.5%), Citrus aurantifoli (39.2%), Mangifera indica (16.8%), Citrus sinensis (2.8%), Azadirachta indica (13.6%), Dracaena steudneri (2.2%), Erythrina abyssinica (0.9%), Gravilia rubusta (7.6%), Juniperus procera (2.5%), Prunus persica (3.5%), Ficus vasta (3.8%), Podocarpus falcatus (4.4%), Grewia ferruginea (0.3%), Psidium guajava (7.3%), Musa sapientum (0.9%),

Adansonia digitata (0.3%), Gardenia volkensii (0.6), Prunus africana (0.3%), Persea Americana (5.7%) (Appendix 3)The most ranked tree /shrub species are Coffee arabica, Albizia gummifera, Cordia africana, Millettia ferruginea and Croton macrostachyus respectively. In general26 tree and 7 shurbs Species included.

During FGD,and key informants mentioned that the major agroforestry practices in the study area were,scattered treeson cropland ,homegarden, Coffee based multistory AFPs, live fence, wind break, boundery planting were mentioned. Scattered trees on cropland integrated with maize, teff, bean millet crops, homegarden and Coffee based multistory AFPsintegrated with fruits, vegetables, root and tubers. Live fence integrated with fruitsand wind break, and boundery planting integrated with animal fodders, fruits and different grass**.** It is a self-reliant and resource-conserving land use system that uses tree and non tree component, as aresult received two or more outputs from each practice.

4.6.3 Living fence AFPandFarmers tree/shrub species preference

Living fences are most common practices in rural landscapes of Ethiopian.Among the total respondents 141(44.6 %) carried out living fence agroforestry practice in the study area, from the respondents response at Ura 89 (28.16%), Zegie 50(15.8%), and Yiganda 2 (0.6%),were experienced of planting trees and shrubs as live fences (Table 13). The most widely grown tree/shrub species as living fence in the study area were Grevilia robusta (3.2%), Dracaena steudneri (8.9%), Justicia schimperiana (31.3%),Millettia ferruginea (2.2%), Ehretia cimosa (6.3%), Albizia gummifera (1.6%), Diospyros abyssinica (0.9%), Carissa spinarum (0.6%),Rothmannia urcelliformis (0.9%), Vernonia amygdalina (14.6%) ,Capparis tomentosa (13.3%), Entada abyssinica (3.2%), Erythrina abyssinica (0.6%), Cordia Africana (3.5%), Eucalyptus globulus (1.6%), Eupborbia abyssinica (0.3%) and Azadirachta indica (0.6%), Acacia nilotica (0.6%), Phytolacca dodecandra (0.9%), Morus mesozygia (0.3%),and Euphorbia tirucalli (0.9%) (Appendix 4).In general 16 tree and 5 shrub species included.

4.6.4 Farm boundaries (border) planting AFPand Farmers tree/shrub species preference

On vacant ground along agricultural farm boundaries, trees are cultivated in a type of strip planting that is nocompetitive. From316 respondents 53 (16.8%) were carried out boundary planting in the study area (Table13). The most widely grown tree/shrub species as boundary

planting in the study area were Mangifera indica (2.5%), Gravilia Rubusta (1.6%), Justicia schimperiana (5.7%), Vernonia amygdalina (10.8%), Eucalyptus globulus (0.6%), Capparis tomentosa (1.6%), Croton macrostachyus (1.9%), Adansonia digitata (0.3%), Senna siamea (0.3%) Albizia gummifera (1.6%), Sesbaina sesban (4.1%), Cordia Africana (1.6%), Entada abyssinica (0.3%), Dracaena steudneri (0.6%), Syzygium guineense (1.3%), Azadirachta indica (0.9%), Moringa olifera (1.6 %), Carica papaya (0.3%), and Millettia ferruginea (0.6 %)(Appendix 5). Farmers plant boundary or border trees in the study areas for the purpose of fuel wood, cash income, lumber, medicinal value, construction wood, live fence and fodder for animals. However farmers informed that using some species such Eucalyptus globulus care should be taken due to their adverse effect on agricultural crops. In general Farmers prefer 16 tree and3 shrub species included for planting along boundaries.

4.6.5 Scattered trees on cropland and Farmers tree/shrub species preference

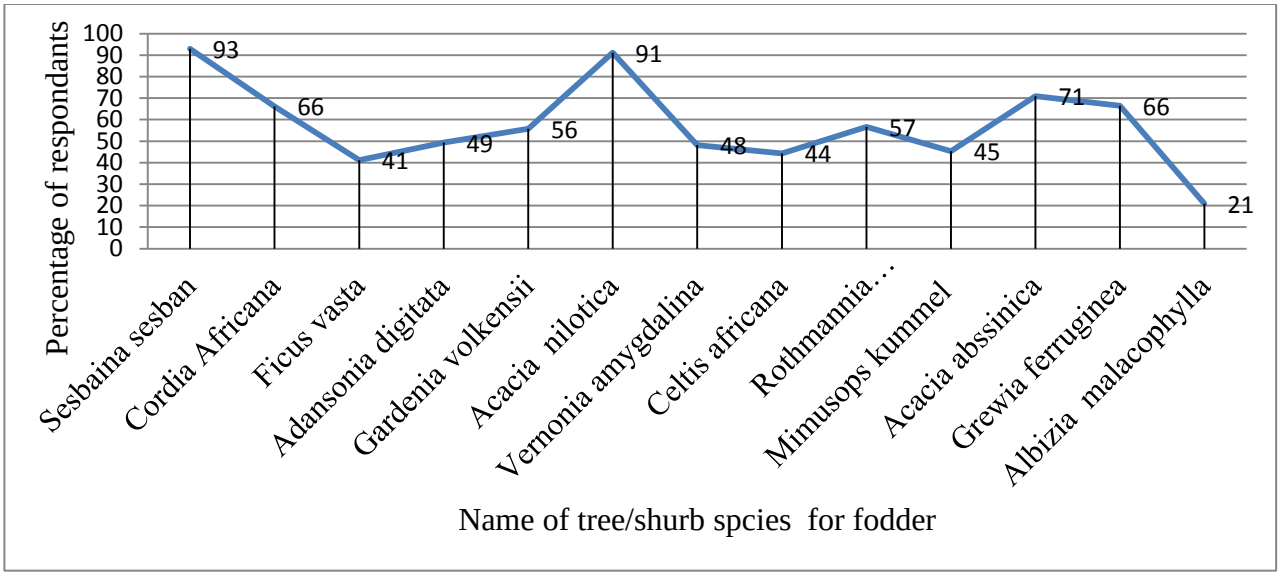
The practice of growing and maintenances of scattered trees on cropland has also supported the protection and management of selected matured trees already on the positioning (Mehari Alebachew, 2012).Scattered trees on farmlandfunction; food, fuelwood, construction wood, fodder, mulch, rawmaterials for creating agricultural implements, household utensils; employment and financial gain for the farmers (Mehari Alebachew 2012).According to the respondents response inUra and Yiganda kebele scattered tree on cropland was not common practice.However, deliberate leaving of naturally grown matured trees and shrubs are common in Zegie kebele. Out of 316 respondent's 23(7.3%) respondences were practiced scattered trees on cropland (Table13).Farmers preferences of planting trees scattered on crop lands in the study area (Appendix 6) were Cordia Africana (5.1%), Mangifera indica (0.9%), Carica papaya (0.3%), Podocarpus falcatus (0.3%), Acacia abyssinica (0.3%), Grevilia robusta (0.6%), Persea Americana (0.3%), Azadirachta indica (0.6%). Adansonia digitata (0.6%), Acacia nilotica (1.3%), Celtis africana (1.3%), Ficus vasta (1.3%),Ehretia cimosa (1.9%), Albizia gummifera (2.2%), Croton macrostachyus (3.2%), Diospyros abyssinica (1.6%),Mimusops kumme (0.6%), Millettia ferruginea (1.3%), Rothmannia urcelliformis (0.9%),Vangueria volkensii (0.6%), Gardeniam volkensii (0.3%), and Albizia malacophylla (0.3%). In general 22treespecies included.

4.6.6 Wind break and shelter belt AFP andFarmers tree/shrub species preference

Dense crowns, stout boles, retention of lower limbs and uniform rates of growth are all characteristics that contribute to making effective windbreaks (USDA,2017).Out of the total 316 respondents 8(2.5%) adopt wind breaks/shelter belts agroforestry practice (Table13).The tree species that preferred by farmers in wind break and shelter belt were Eucalyptus globulus (1.2%), Senna siamea (0.3%), Grewia ferruginea (0.3%), Coffee arabica (0.3%), Grevilia robusta (0.3%) Azadirachta indica (0.9%), Vernonia amygdalina (0.3%), Sesbaina sesban (0.6%), and Cordia Africana (0.3%) (Appendix 7), and in genera l5 tree and 4 shurb species included.

4.6.7 Fodder tree systemsAFP andFarmers tree/shrub species preference

To maintain animal health and avert loss of productivity, farmers supplement dry season forage with concentrates or fodder from trees and shrubs (Bayala et al. 2014a).According to the respondents 6 (1.9%) were carried out fodder tree systems (Table 13). In addition to this according to the respondents the major tree and shrub species for foddertree systems agroforestry practice from the higest coverage to lowest coverage (Figure4) were;Sesbaina sesban, Acacia nilotica, Acacia abyssinica,Grewia ferruginea,Cordia africana,Rothmannia urcelliformis, Gardenia volkensii, Adansonia digitata,Vernonia amygdalina,Mimusops kummel,Celtis africana, Ficus vasta,and Albizia malacophyllawere 93%, 91%, 71%, 66%, 66%, 57%, 56%, 49%, 48%, 45%, 44%, 41%and 21% respectively.



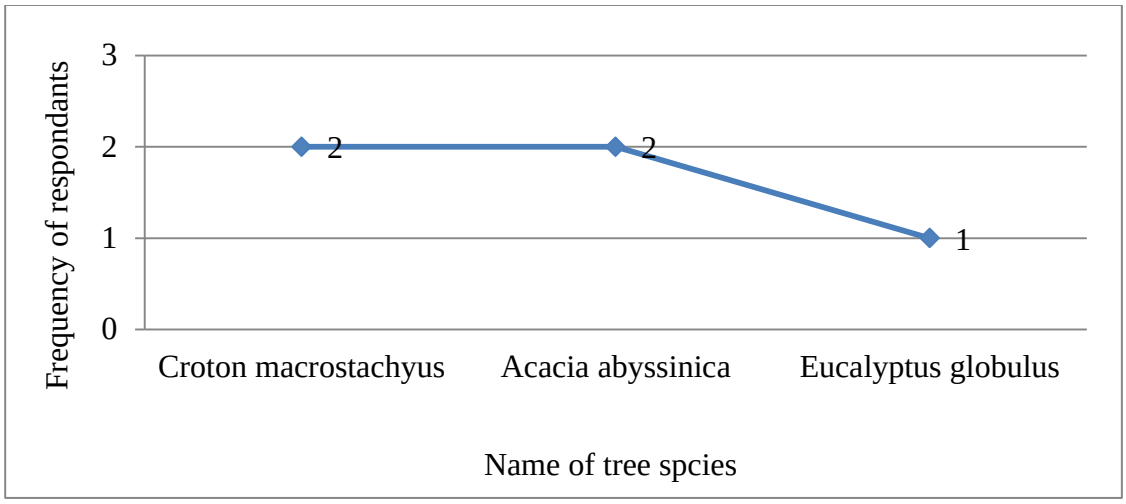
Sources; household survey, (2023)

Figure 4Farmers preference tree and shrub species for fodder bank

During focuse group discussion and key informants mentioned that the major tree and shrub spcies used for for livestock fodders were,(Acacia nilotica), (Celtis africana), (Vernonia amygdalina), Sesbaina sesban, (Cordia africana), (Adansonia digitata), and other source of feed also grassland, elephant grass,crop residue, industrial feed, local beer residues, local alcohol residues.The above idea agreed with the result of house hold interview.

4.6.8 Scattered trees in rangelands andFarmers tree/shrub species preference AFP

In the study area, it is uncommon to plant trees inrangeland,however, intentional preservation and management of naturally occurring trees on rangeland is a common practice because these trees provide a variety of benefits, including lumber,construction wood,medicinal value,sheds,and firewood**.**According to theresult showed 4(1.3%) respondents' practiced tree planting on rangeland (Table 13).The preferred species by the respondents were,Croton macrostachyus 2(0.6%),Acacia abyssinica 2(0.6%),and Eucalyptus globulus 1(0.3%) were the three main tree species naturally growing on grazing lands at Zegie Kebele, However, at Ura and Yiganda Kebeles, Scattered trees planted on grazing lands not common practiced (Figure 5).



Sources; household survey, (2023)

Figure 5Tree species for planting on grazing landagroforestry practice

4.7 Factors that Determine the Rural Households Choice to Participate in AF practice

Multinomial logistic regression is used to predict categorical placement in or the probability of category membership on a dependent variable based on multiple independent variables. The multinomial logistic model was employed to determine the factor that determines farmers' choice of boundary planting, scattered trees on crop land, live fence, multistory and homegardens of agroforestry practice. Therefore, the multinomial regression model was employed to the factors that determine the choice of agroforestry practice by household with 12 explanatory variables. Before using the multinomial logistic regression model for hypothesized variables, it is necessary to test the problem of multicollinearity or association among the potential independent variables.

The goodness of fit measures were checked and validated that the model fits the data well;the likelihood ratio test statistics exceeds the Chi-square critical value at less than 5% probability level. This implies that the hypothesis, which says all coefficients except the intercept is zero, was rejected. Since goodness-of-fit for the model showed that the odds ratio of selection were simultaneously related to the independent variables. Moreover, the quality of the model is labeled robust and not affected when the pseudo *R2* value is more than 15 % (Garson, 2008; Kabir *et al*., 2013). Since the Cox and Snell *R2* was 26.9 %, while the Nagelkerke *R2* was 28.4 %, which is enough for supporting the model's quality accordingly.

The other way to validate the goodness-of-fit of the regression model is the Hosmer and Lemeshow test (*X2* test). A non-significant value ($p > 0.05$) of the test is one routine method in validating goodness of fit of the multinomial logistic model (Julie, 2011). Hence, the test statistics were chi-square=55.436, and p-value= 0.156.

A total of 12 explanatory variables were considered in the model, out of which coefficient of 6 variables were significant in explaining the factors that affects the choice of agroforestry practice by household in the study area. These were gender of household heads, price of agroforestry, availability of credit access, household Size, availability of water sources, and farmland size of household heads.

Table 14Multinomial logistic regression model results for the factors influencing selection of agroforestry practices in zegie penisula

Dependent variables	Explanatory variables	B	Std. Error	Wald	Sig.	Odds ratio [Exp(B)/$\mathbf{e^B}$]	95% C.I.for EXP(B)	
							Lower Bound	Upper Bound
Scattered trees on cropland	Intercept	-1.974	1.279	2.383	.123			
	Age	-.006	.017	.117	.732	.994	.961	1.029
	Famsize	-.216	.107	4.035	.045*****	.806	.653	.995
	Size land	1.096	.320	11.732	.001*****	2.993	1.598	5.606
	Income	.000	.000	2.971	.085	1.000	1.000	1.000
	Animal	-.091	.079	1.342	.247	.913	.782	1.065
	Sex(1=male)	.301	.459	.431	.512	1.352	.550	3.326
	Education(1= Literate)	.523	.419	1.553	.213	1.686	.741	3.836
	Credit(1=yes)	.363	.507	.514	.473	1.438	.533	3.882
	landtenur(1=yes)	-.579	.443	1.711	.191	.560	.235	1.335
	Price(1=yes)	.101	.429	.056	.814	1.106	.478	2.563
	Marketacc(1=yes)	.541	.402	1.810	.178	1.718	.781	3.778
	WaterS(1=yes)	.338	.386	.767	.381	1.402	.658	2.988

Dependent variables	Explanatory variables	B	Std. Error	Wald	Sig.	Odds ratio [Exp(B)/e^B]	95% C.I.for EXP(B)	
							Lower Bound	Upper Bound
Multistory	Intercept	-2.194	1.048	4.383	.036			
	Age	-.005	.014	.125	.724	.995	.967	1.023
	Famsize	.006	.082	.006	.939	1.006	.856	1.183
	Sizeland	.704	.265	7.049	.008*	2.021	1.202	3.398
	Income	.000	.000	3.710	.054	1.000	1.000	1.000
	Animal	-.072	.062	1.370	.242	.930	.824	1.050
	Sex(1=male)	.011	.348	.001	.976	1.011	.510	2.001
	Education(1= Literate)	.348	.338	1.059	.303	1.416	.730	2.747
	Credit(1=yes)	.355	.389	.835	.361	1.426	.666	3.055
	landtenur(1=yes)	-.641	.356	3.243	.072	.527	.262	1.058
	Price(1=yes)	1.032	.345	8.928	.003*	2.807	1.426	5.524
	Marketacc(1=yes)	.464	.312	2.207	.137	1.590	.862	2.933
	WaterS(1=yes)	.911	.309	8.680	.003*	2.487	1.357	4.558
Trees on boundary	Intercept	-1.593	1.648	.934	.334			
	Age	-.038	.025	2.326	.127	.962	.916	1.011
	Famsize	-.282	.157	3.216	.073	.754	.554	1.027
	Sizeland	1.135	.419	7.349	.007*	3.111	1.369	7.069
	Income	.000	.000	.305	.581	1.000	1.000	1.000
	Animal	.059	.097	.369	.544	1.061	.877	1.283
	Sex(1=male)	1.405	.694	4.098	.043*	4.077	1.046	15.892
	Education(1= Literate)	.329	.570	.333	.564	1.390	.455	4.248
	Credit(1=yes)	1.483	.626	5.608	.018*	4.405	1.291	15.027
	landtenur(1=yes)	-.286	.624	.210	.647	.751	.221	2.551

Dependent variables	Explanatory variables	B	Std. Error	Wald	Sig.	Odds ratio [Exp(B)/e^B]	95% C.I.for EXP(B)	
							Lower Bound	Upper Bound
	Price(1=yes)	-1.425	.637	5.005	.025*	.241	.069	.838
	Marketacc(1=yes)	-.261	.616	.180	.671	.770	.230	2.577
	WaterS(1=yes)	-.017	.542	.001	.975	.983	.340	2.846
Live fences	Intercept	-1.303	1.341	.943	.331			
	Age	-.009	.018	.230	.631	.991	.957	1.027
	Famsize	-.235	.109	4.654	.031*	.790	.638	.979
	sizeland	.261	.352	.552	.458	1.299	.652	2.589
	Income	.000	.000	.054	.816	1.000	1.000	1.000
	Animal	.048	.075	.412	.521	1.050	.905	1.217
	Sex(1=male)	1.226	.495	6.136	.013*	3.409	1.292	8.994
	Education(1= Literate)	.539	.419	1.657	.198	1.714	.755	3.894
	Credit(1=yes)	-.256	.573	.199	.655	.774	.252	2.381
	landtenur(1=yes)	.632	.460	1.885	.170	1.881	.763	4.633
	Price(1=yes)	-.701	.434	2.610	.106	.496	.212	1.161
	Marketacc(1=yes)	-.637	.453	1.975	.160	.529	.218	1.286
	WaterS(1=yes)	.262	.392	.446	.504	1.299	.602	2.803

The reference category is: Homegarden

-2 Log likelihood 814.164

Pseudo R-Squares (Cox and Snell R^2=26.9 % and Nagelkerke R^2 =28.4%)

Sources; Computed from Household Survey data, (2023)

Farm land size: From the study area, the result revealed that; the size of land has a significant positive association at ($p < 0.05$) with the selection of agroforestry practices (Scattered trees on cropland). A household with larger land size was expected to select and own of scattered

trees on cropland. In this result a unit increases in the size of land, the probability of selecting and own scattered trees on cropland increases by a factor of 2.993.

And also it has a significant positive association at ($p < 0.05$) with the selection of boundary planting in the study area. A household with larger land size was expected to increase the selection of boundary planning. In this result a unit increases in the size of land, the probability of selecting and own trees on boundary planting increases by a factor of 3.111.

Gender**:** Gender of the heads of the household was positive and significant at less than 5% probability level to determine the choice of household to participate in boundary planting. The positive and significant effect of this variable means that households headed by men appeared more likely to belong to the category of boundary planting owners compared to households headed by women. In addition households headed by men were more likely to own boundary planting on their farms than households headed by women. The odds ratio indicates that, other things being constant, as male headed household increase by one unit, the farmer decision to choice and being participate in boundary planting increases by a factor of 4.077. The same was true for live fences; as a result a unit increases in male headed household, the probability of selecting and own live fences increases by a factor of 3.409. In other words, households headed by women were less likely to own live fence and boundary planting on their farms than households headed by men.

Price**:** From the study area, the result revealed that; the selling price of agroforestry products has a significant positive association at ($p < 0.05$) with the selection and owning of multistory. In this result a unit increases in the price of agroforestry products, the probability of selecting and own multistory increases by a factor of 2.807 than selection and owning of homeguarden. On the other hand the selling price of agroforestry products has a significant negative association at ($p < 0.05$) with the selection and owning of boundary planting. Hence a unit increases in the price of agroforestry products, the probability of selecting and own boundary planting decreases by a factor of 0.241 than the selection of homeguarden agroforestry practice.

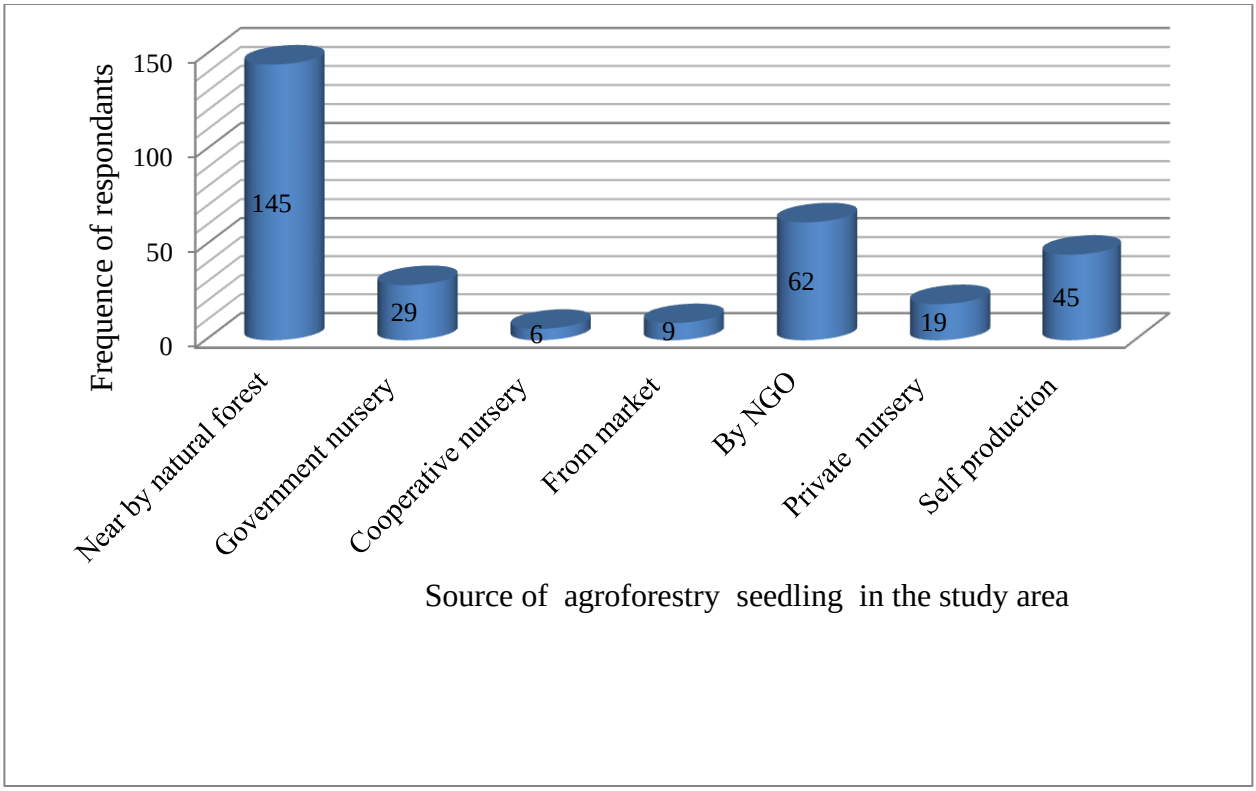
Access to credit: The result revealed that access to credit is a significant factor to select and own agroforestry practices. Based on the result from (Table 20); given other factors remain constant, it is likely to increase households' decision to select boundary planting by a factor of 4.405. Access to credit enables the rural farm households to select and own boundary planting agroforestry practices than selection of homeguarden agroforestry practice.

Household Size: The result revealed that; the size of a household has a significant negative association at ($p < 0.05$) with the selection of scattered tree plantation on cropland and live fences. A household with larger family size was expected to inhibit the selection and usage of these agroforestry practices than homeguarden agroforestry practice. In this result a unit increases in the household size, the probability of selecting scattered tree plantation on cropland and live fences decreases by a factor of 0.806 and 0.79 respectively with the selection of homeguarden agroforestry practice.

Availability of water sources**:** Accesses to available water established a positive significant relationship ($p < 0.05$) with the selection of various agroforestry practices at household level in the district. A one unit increase in availability of water to rural farm households is likely to increases the probability of the selection of multistory by 2.487 units than selection of homeguarden agroforestry practice. This reveals thatavailability of water is a key factor in influencing the selection of multistory.

4.8 Source of agroforestry seedlings material in the study area

According to the study's findings,the sources of agroforestry seedling comes from varies sources such as:-nearby natural forest, buying from a private nursery,government nurseries,cooperative nurseries, buying from the market, donations from an NGO, and self-production.These result showed thatin the study area's tree seedling supply comes from seven dissimilar sources (Figure 6).



Sources, household survey 2023

Figure 6Source of agroforestry seedling

4.9 Socio-economic benefits of Agroforestry practice in the study area

Agroforestry activity provides awider range uses for poor, like to secure cash income from wood products to enable the farmer tobuy food which helps farmers to meet their basic needs and minimizes the risks associated with agricultural production, increases the sustainability of agriculture and support livelihood of the farming community by generating income for smallholder farmers. Furthermore agroforestry practices have too many contributions for community, farmersand ranchers, and for the ecosystem. Why this because of agroforestry practices is naturallyprovides and replenishes land as productive and sustainable manner to them.

Table 15 Socio-economic benefitsof AF in the study area

	Benefits of AF	Frequency			Total	Percent	Rank
		Ura	Zegie	Yiganda			
1	Fuel wood	114	62	128	304	96.2	1
2	Diversify farmers' incomes	99	64	110	273	86.4	2
3	Medicine	78	69	108	255	80.7	3
4	Soil nutrient improvement	70	66	107	243	76.9	4
5	Honey production	86	49	81	216	68.4	5
6	Food supply (food security)	60	56	78	194	61.4	6
7	Erosion restriction	46	57	58	161	50.9	7
8	Biodiversity conservation	53	35	67	155	49.1	8
9	Micro climate amelioration	63	16	72	151	47.8	9
10	Sociocultural and recreational value	37	52	57	146	46.2	10
11	Improving water use efficiency	32	66	39	137	43.4	11
13	Job opportunity	32	20	25	77	24.4	12
14	Fodder production	33	13	18	64	20.3	13

Multiple response Sources, household survey 2023

Fuel wood

Fuelwoodwas ranked the most products obtained from the agroforestry trees indicating the reliance of farmers on the woody products as the main source of energy.According to the result showed that304(96.2%) of respondents emphasized that they dependent on fuel wood for their house hold utilities obtained from agroforestry(Table 15). The result supported by reported elsewhere by Gideon P.K.and Verinumbe I(2013),HermosillaC.A.(2000),Malakini M.*et al.,(*2013), reported that about 33% of the world's population uses wood and charcoal to produce at least 90% of the energy, while Hermosilla C.A. (2000) reported that in development countries at least 70% of energy is supplied by fuelwood and charcoal.

Diversify farmers' incomes

According to the study's findings, 273 (86.4%) respondents revealed that agroforestry provides diversifiedfarm incomes and give an opportunity for farmers to diversify their farms and thus increase sustainability and resilience to shocks by reducing the consequences of crop-failure (Table 15). Trees also provide a number of ecosystem services, and important for resilience to climate change (Verchot *et al.,* 2007; Mbow *et al.,* 2014).

Medicinal value

According to the result obtained (Table 15)255 (80.7%) respondents revealed that agroforestry benefits for medicinal value. Agroforestry products provide medicinesand treatments of some ailments/disseasesinthe greatest part of rural people. The result supported elsewhere by Gideon P.K.and Verinumbe I. (2013), Muok B.O *et al.,(*2001), and also Mander M. and Lebreton G,(2006)further reported that about 80% of the world's populations, mostly in developing countries, rely on traditional medicine for primary health care.

Soil nutrient improvement

According to the respondents response, the result showed that, (Table 15) 243(76.9 %) of respondentsagreed agroforestry adding nutrients to the soils hence assist in restoring and conserving soil fertility. Pinho R.C *et al.(*2012**)** reported that trees planted with crops fix nitrogen and produce large amounts of biomass that improve soil fertility. Furthermore, agroforestry trees leads to increase soil organic matters through leaf litter hence replenishing soil fertility and also vegetation helps to stabilize the soil by retaining it to its original state. Studies in Ethiopia also showed AFPs have greater potential in improving soil nutrient status compared with conventional mono-cropping systems (Gindaba *et al.*,2005; Belayneh Ayele,2010;Lalisa Duguma *et al.,* 2010; Balay Manjur *et al.,* 2014).

Honey production

According to theresultshowed that (Table15) 216 (68.4%) respondentsagreed that agroforestry benefits for honey production. The practiced of bee hives integrated with trees or shurbs and other agroforestrycomponents in different ways, and got honey for their home consumption and sale to market.

Food supply (food security)

As a result of population increment throughout the world famine and starvation are knocking with speed (Olajidetaiwo *et al.,* 2010). In solving such problem agroforestry practice play a vital role. According to the result showed (Table 15) out of the total respondents 194 (61.4%) acquiredfoodand improve family food security from agroforestryproducts.Agroforestry discipline can boost in securing food supply to some extent and there are three pathways through which agroforestrycould contribute to food security of forest dependent local communities in the study area. These include: i) Direct food: fruits, vegetables, root crops, honey; ii) enhanced farm forest interfaceagroforestry can support to livestock and crop production through fodder, grass, mulch, manure, watershed protection, soil conservation, and protection of biodiversity; iii) Agroforestry-based income and employment through timber, NTFP, ecotourism and Payment for Ecosystem Services (PES) and Reducing Emission from Deforestation and Forest Degradation (REDD+).The result agreed with (Zemede Assefa, 2001,Kalaba *et al.,* 2009), and also similar studies by Tesfaye Abebe (2005) showed that in Southern Ethiopia 88.8% of the surveyed households were food secured throughout the year due to presence of extensive agroforestry.

Erosion restriction

The results of the study (Table 15) showed that 161 (50.95%) belived that erosionrestriction was one of the services obtained from agroforestry practices.According to Rocheleau *et al.* (2004) agroforestry trees help to decrease water velocity and make rainwater to fully sink into the ground which is later retained to the surface for crops hence maintaining soil moisture. Kalaba *et al.* (2010) also reported that agroforestry practices increases the infiltration and water holding capacity of the top soil increases, the ability of the soils to capture and use on-farm runoff. Combining woody plants and annual crops helps in conserving top soil and increase water availability below the soil surface and increases soil moisture. Agroforestry species helps to hold running waters such that they sink down, this helps to deepen the ground water table and then this groundwater is then slowly released when the surface is dry (moisture retention).

Biodiversity Conservation

The study result showed (Table 15) 155 (49.05%) respondents agreed that traditional agroforestry systems conserving biodiversites. According to (Montagnini et al. 2011) traditional agroforestry systems are best examples of agro-biodiversity conservation and it provides shelter for soil flora and fauna, birds, insects and wildlife and supported the result that obtained.

Micro climate Amelioration/modification

The study result showed 151 (47.8%) of respondents respond that trees and shrubs in agroforestry systems can contribute to better microclimate by providing shade and windbreak (Table 15).The presence of trees reduces heat and light. Atmospheric temperature, humidity, movement of air, soil temperature and soil moisture are changed due to agroforestry systems. The smaller temperature fluctuations under shade are attributed to reduced radiation load on the crops during the day and to reduced heat loss during the night. A reduction in vapour pressure deficit causes a reduction in transpiration and hence reduced water stress for intercrops. Microclimate amelioration also reduced the disease and pest pressure by facilitating biological control agent. The trees bring about a whole complex of environmental changes, affecting not just available light but also air temperature, humidity, soil temperature, soil moisture content, wind movement, (SileshiGezachew, *et al.,* 2007a). These factors impact plants, and the effect can be beneficial to a wide array of crops.

Sociocultural and Recreational Value

According to the results of the study (Table15) showed that 146 (46.2%) respondents agreed that agroforestry benefits**,** forcultural services (non-material benefits)and people obtain through spiritual enrichment, cognitive development, reflection, recreation, and aesthetic experience, including knowledge systems, social relations, and aesthetic values.The indigenous and traditional systems have been appreciated for ecological principles and sustainability;but very little attention has been paid toward the recreational and cultural values of the systems. The result supported by (Tangjang and Nair, 2016) wherever these systems are practiced, an important component of local cultural heritage and the unique way of preserving the ecology.

Improving water use efficiency

The study result showed that (Table 15) among the sampled HHs 137(43.4%) confirmed that agroforestry practice improving water use efficiency, and some authors like(Turner&Ward 2002) agreed thatthere is robust evidence that agroforestry systems have the potential for improving water use efficiency by reducing the unproductive components of the water balance like run-off, soil evaporation and drainage.Since an agroforestry system occupies more ecological niches,it has the potential to use the available water more efficiently, compared to annual crop systems.Studies from India show that agroforestry systems can double the rainwater utilization because trees use water unavailable for the crops in between growth seasons (Pandey, 2007).

Job opportunity

The study result showed(Table 15) 77 (24.4%) of respondents respond that from agroforestry got two or more out puts and employment opportunities for jobless youths in the study area.Agroforestry systems due to diverse options and products provide opportunities for employment generation in rural areas. Dhyani *et al.* (2003) have highlighted the role of agroforestry products and environmental services to meet the subsistence needs of low income households and providing a platform for greater and sustained livelihood of the society.

Fodder Production

According to the respondent's response, (Table 15) 64 (20.25%) respondents agreed that fodder products obtained from the agroforestry trees. The trees are grown in fodder banks and these helps to provide feeds to livestock during dry season when most pastures have dried up. Fodder banks are developed by using both indigenous and introduced fodder species (trees, and shrubs).The quantity and quality of this forage normally decline in the dry season. To maintain animal health and avert loss of productivity, farmers supplement dry season forage with concentrates or fodder from trees and shrubs (*Bayala et al. 2014a).*

4.10 Constraint of agroforestry practice in the study area

The study showed that there are huge potentials for agroforestry development in the study area, such as the existence of indigenous woody perennials (the basic component of

agroforestry practices), commodity crops (coffee and fruit), other types of crops, livestock components integrated together and traditional knowledge of the community which enable them managing the existing agroforestry practices.However, here are also major constraints that hindered/ hindering the development of agroforestry practices in the area.

Table 16 Constraint of agroforestry practice in the study area

No	Constraints of agroforestry Practice	Frequency					
		Ura	Zegie	Yiganda	Total	percent	Rank
1	Diseases and Pests	114	73	127	314	99.4	1
2	Scarcityof land	89	34	103	226	71.5	2
3	No marketing access	71	59	84	214	67.7	3
4	Lack of credit facilities	57	12	92	161	50.9	4
5	Water Shortage	50	49	49	148	46.8	5
6	Lack of improved species	31	52	47	130	41.1	6
7	Lack of farmers knowledge	11	41	71	124	39.2	7
8	Losses of Perishable Products	32	16	75	123	38.9	8
9	Food and Nutritional Insecurity	71	6	45	122	38.6	9
10	Unavailability of labour	42	23	38	103	32.6	10
11	Lack of extension services	19	45	35	99	31.3.	11
12	Lack of capital	28	8	62	98	31	12
13	Lack of land tenure	45	7	37	89	28.2	13
14	Transportation Problem	21	3	38	62	19.6	14
15	Lack of planting materials	9	22	28	59	18.7	15
16	Free-grazing	0	40	0	40	12.7	16

Sources; household survey, (2023)

1. Incidence of Diseases and Pests

According to the result showed that314 (99.4%)**,** respondents were affected by diseases and Pests problems such as Coffee bear, Coffee leaf rust, Leaf minor, White scale, Root root, Scale insect,Termite problems and different tree worms.It was ranked asupper most

constraints to agroforestry practices implementation and expansion in the study area (Table16).This could result to poor yield, low quality / market value, and poor return to households and agreed with the idea of (Mabel, 2015).

2. Shortage of Farm size

According to the result showed226 (71.5%)respondents affected by shortage of farm size,even though the concept of agroforestry and its importance was well understood among the respondents, the size of the land available to the farmers, served as a limiting factor (Table 16).Most of the farmers complained that their farm sizes too small to allow for the integration of trees, as aresult the respondents were engaged in subsistence farming which was mainly for household consumption and very little for sale due to the small size of farmland.

The result greed with some previous literature tried to show the relationship between land size and agroforestry practices. For instance, Ajayi and Kwesiga, (2003) from Zambia and Oyewole *et al.* (2015) from Nigeria reported that land size is a basic one for enhancing agroforestry practice because the farmer who has a large size of land is willingly engaging in retaining/planting tree species on their land. Besides the farmer who is holding a large size of land is more participating in the practice of agroforestry system in central Ethiopia (Mulugeta Sisay and Kindu Mekonnen, 2013).On other hand,afarmer who has small land size is less or not retaining naturally regenerated or planting trees on their land (Kofi, A.F, et *al.*, 2003).

3. Lack of marketing access

According to the result showed that (Table 16) 214 (67.7%), respondentsaffected by lack of marketing access.Due to the presence of market problems and producers lead them to sell their products by farm gate prices. This result is similar to the barriers to agroforestry development identified by FAO (2013). Due to this resulted into low earnings and food insecurity (IFAD 2012). For many agroforestry products, markets are poorly structured and coordinated (Roshetko *et al.* 2007); this results in low and unstable returns to farmers.

4. Lack of credit facilities

The result showed that (Table 16)161(50.9%) respondents revealed that credit facilities were one of the major constraints for expansion of their farm size as well as the purchase of other farm inputs. Credit is said to be a major concern to hafe of the respondents.When loans are granted to farmers, they usually have a short payback time and high interest rates making

long-term investments less profitable. Many credit institutes do not have credit lines for agroforestry, just for forestry and/or agriculture.Agroforestry requires an upfront investment in terms of money and time but the return on the investment is longer than for annual crops (Sharma *et al.*, 2016).

5. Water Shortage

According to the respondent result showed that (Table 16) water shortage was the major constraints faced by the farmers in the study area for planting trees and irrigated plantation site on their farmlands. Out of 316 respondents 148 (46.8%) farmers in the study area affected by water shortage in the dry season and did not irrigated their land mostly by their own weakness particularlysome area of the Gott near to Lake Tana. The remaining 168 (53.2 %) respondents did not affect. People have to be careful about the misuse of water and recycling of the used water has to be practiced at small scale level (Taimoor *et al.*, 2017).

6. Lack improved tree and shurbs species

The result showed that 130 (41.1%) respondentswere lack of improved tree and shurbs species to performe agroforestry practices effectively (Table 16).The result agreedwith Ajayi (2006**)** reported that one of the greatest constraints of some agroforestry technologies was lack of access to quality seed and seedlings. Unlike the seeds of annual crops in which established institutions exist to promote them and also private sector organizations have been engaged in their multiplication and distribution, there is little or no institutional structure to make the seeds of AF tree species available.

7. Lack of farmers' knowledge

The result showed that (Table 16) 124 (39. 2 %) respondents were lack of adequate technical knowledge to perform agroforestry pracices perfectly and the existed agroforestry pracices were adopt /inherited from their own family. Whereas, knowledgeable farmers adopted more agroforestry types in their own farm land**.** The result agreed with Mashinini *et al.* (2011) reported that lack of adequate knowledge pertaining the type and amount of inputs to be used by farmers hindered farmers to produce more food, and also (Peter *et al.*, 2017) reported that lack of awareness and fragmented extension service affecting expansion of agroforestry practice.Findings clearly indicated that educated farmers had more awareness and they are very keen to adopt more agroforestry practices as compared to illiterate farmers. When

farmers are educated they have better access to information and innovations which help farmers to quickly adopt new technology. However, this finding supports Mekoya et al., (2008) who found that agroforestry technologies are knowledge intensive and therefore require enough education in the adoption process

8. Losses of Perishable Products

According to the result showed that (Table16) 123 (38.9%) respondents affected the quality of agroforestry products that have a very short shelf life, particularly fruits and vegetables, in the study area. For perishable goods such as fruit, the result is also high wastage along the supply chain and a failure to reach quality grades.The result agreed with Ramathani (2002) and Kadzere *et al. (*2006) reported that postharvest handling and transport are the major causes of losses of perishable agroforestry products.

9. Food and Nutritional Insecurity

According to the result showed that (Table 16) 122 (38.6%**)** respondents did not got food at all times, have physical and economic access to sufficient, safe, and nutritious food to meet their dietary needs,and affected by food security due to presence of a number of constraints in agroforestry production and the result agreed with Beckford *et al.(*2011).

10. Unavailability of labour

According to the resultshowed that (Table16) 103 (32.6%) respondents revealedlabour shortage.This indicated that a house hold had more labor they adopt and expand more agroforestry practices and ahouse hold had less labor they adopt small agroforestry practice in the study area.Nwaru (2004) observed that large household size would help in reducing labour constraint in agricultural production.This implies that, majority of agroforestry farmers in study area have family labour potential. This is essential since agroforestry require intensive labour especially at the rudimentary stage of production. The large household size also implies that farmers will save cost in hiring labour for farming therefore channel their scarce resources to more economic activities for livelihood development.

11. Lack of capital

According to the result showed that (Table 16) 98 (31.1%) of respondents revealed in adequate access to capital usually considered as a serious constraint for increasing household production and financial gain to invest in additional economical land use.The result was

supportedby Ibrahim, *et al.(* 2019) report inadequate capital could affect the inputs of the farm, results from poor or low yield, inaccessibility to soft loans either from the government or non governmental bodies and reduced standard of living.

12. Lack of land tenure

According to the results showed that (Table 16)89(28.2%) of the local people have been feelings about tenure security of agroforestry,while the remaining 227 (71.8%) of respondents were not agreed on this statement.Successful long-term agroforestry and tree planting strategies require land tenure systems that guarantee continued ownership of land.The result supported by Bakengesa *et al.* (2002) reported that insecurity on land tenure has resulted in low adoption of AFTs by farmers. Msuya *et al.* (2006) also noted that a fundamental challenge in dissemination and adoption of AF was lack of permanent land ownership. Generally, farmers fear to invest on the land which does not belong to them.

13. Transportation Problem

According to the result showed that (Table 16)62 (19.6%) respondent's in the study area lack of transportation access means (the transportation network linking the villages to the market centers).A lot of farm produce deteriorates during bumper harvest due to the aforementioned problems as well as the perishability nature of some produce Kofi, A.F., *et al.*(2003).

14. Lack of extension services

The result showed that (Table 16) 99 (31.3%**)** respondent'srevealed lack of extension services as aresultthe practice did not applied properly; due to this low yields of agroforestry production continue.The main aim of extension servicesincrease farmer's awareness of specific technical advice and increases rate of technical adoption. The result supported Orisakwe *et al.(*2011) poor extension delivery was the factor that limited adoption of AF, and inefficient government extension services contribute to continue low yields of production.

15. Lack of planting materials

According to the result (Table 16) showed that, 59 (18.7%) respondents in the study area were interested in planting of trees on their farms but do not have access to seedlings so that lack of planting materials limited the expantion of groforestry practices.The result agreed with (Kwesiga *et al.* 2003) lack of planting materials is a limitation for the expansion of agroforestry.

16. Free-grazing

According to the result obtained (Table 16) 40(12.7%) of the respondents affected byfree grazing problemin Zegie kebele in some Gott among the three Kebele. In zegie kebele 40(12.7%) respondents revealed that animals destroy the trees after planting either by browsing the leaves and removing the biomass or by physically trampling over the plants (Table 22). During this period there is a critical feed problem and therefore animals should turn to existing trees/bushes so as to get feed. This will have a greater contribution for declining of newly emerged and planted seedlings.The result supported by (Dereje Tegaye *et al.*, 2012),

Both focus group discussions (FGDs) andkey informants mentioned that they have been obtaining diverse types of benefits from agroforestry practices. Tree product (charcoal, firewood, pole, timber, and construction materials), Diversification of income, medicinal value, soil nutrient improvement, honey production, food supply for household consumption, soil conservation,wind speed reduction,shade, micro climate, fodder, improve water potential, and recreation value were some of the major benefits obtaining from agroforestry practice.

During FGD,and key informants mentioned that the major constraints of agroforestry practice werediseases and Pests,water shortage,lack of improved species,no marketing access,free grzing**,**lack of farmers knowledge,lack of capital, lack of land tenure security,lack of employment opportunity,high cost of agricultural input,lack of improverd livestock species, Scarcity of land,lack of implementation of different laws, lack of extension services, lack of management practice,un periodical rain fall and snow, food and nutritional insecurity, lack of planting materials were listed.

According to FGD, and key informants idea the most serious problems of agroforestry practice implementation were diseases and pests, water shortage, lack of improved species, lack of management practice and low access marketing chanall.

According to key informants **s**uggestion that the solution of agroforestry practices constraints in study area were create awreance for the farmers and give enough training by practical demonstration,make water and soil conservation structure,useunder ground water, use improved species of tree and shurbs,use diseases, Pests and drought resistance species, reduced and abandoned free grazing,irrigate the plantation site by using moter pumps from lake tana,government and other organization create creadit facility opportunity, jobless youths organized themselves and producing seedlings and sell to farmers in fair price, giveenough extention service,are the major solutions of zegie penisula traditional agroforestry Practice.

5. CONCLUSION AND RECOMMENDATION

5.1. CONCLUSION

Agroforestry generates economic incentives to farmers from the joint interaction of trees and crops, and /or animals as well it generates social (intangible) benefits to the society through implementing environmental friendly practices.The farmers are more familiarized with practicingdifferent types of traditionalagroforestry practice, which includes; scattered trees on crop lands,homegarden,boundary planting,windbreaks/shelterbelts,livefence,fodder bank,trees on pasture and Coffee based multistory agroforestry practices,were found,and farmers prefered varied tree and shrub species in each agroforestry practice.It plays great role in diversifying production from asingle land unit,due to this it is more acceptable thanmono-croping from farmers point of view. The result showed that almost all of the respondents were adopting agroforestry practice in their farmlands and only one respondants did not adopt.Farmers in the study area have been obtaining various types of benefits from these traditional agroforestry practices suchas, fuelwood,diversify farmers'incomes,medicine,soil nutrient improvement,honey production,food supply,erosion restriction, biodiversity conservation,micro climate amelioration,sociocultural and recreational value, improving water use efficiency,carbon sequestration,job opportunity,and fodder production.The major constraints were also identified for the implementation and wider expansion of agroforestry practice mentioned by the respondentswere diseases and pests, scarcityof land,lack of marketing access,lack of credit facilities,water shortage,lack of improved species, lack of farmers knowledge,losses of Perishable Products,food and nutritional insecurity,unavailability of labour,lack of extension services,lack of capital, lack of land tenure, transportation problem,lack of planting materials,free-grazing wereoccurred.Among the constriants of traditional agroforestry in the study area diseases and peststhat attack seedlings and even killed them before they matured posed a major treat to tree planting in the study area.

5.2. RECOMMENDATION

Based on the main finding of the study the following recommendations are made.

- Almost all farmers in the zegie penisulia affected by diseases and Pests problems, so thatin order to get adequate agroforestry products, improved, diseases, pests, and droughts resistance species both exotic and indigenous should be required.
- Half of the farmers in the study area, face lack of credit to develop their farms.Moreover, credit facilities should be established with affordable institutional regulations for community empowerment, easy and timely access to their required agroforestry inputs, hence high production and better living standards of the communities.
- Land tenure insecurity of farmers had significant impact on planting of trees and shrubs in agroforestry practices. Hence, it needs the appropriate policy attention.
- Near to half of the farmers in the study area affected by water shortage, suport should be made available by the government and non-governmental agencies to farmers through the provision of adequate water moter pump to farmers, to irrigate agroforestry fields in the dry season.
- Farmers in the study area preferred agroforestry tree and shurb species in different traditional groforestry practices based on their local knowledge so that, research programmes should be designed and carried out with the purpose to promote the most preferred species for each agroforestry practices to improve the traditional system where it already exists.
- There is also need for research on the plant diseases and pest, farmers'encounter in the field particularly coffee bear diseases and white scale with a view of providing local solution in the study areas.
- Further research is required on endangered and threaten indigenous tree and shrub species in the area are not properly documented.Therefore,it is important to study the endangered and threaten species in the area and their benefits and effect on on associated crops.

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7. Appendix.

Appendix 1 Household survey questionnaire

Kebele administration--- Code Number _____ Name of the enumerator _____sign ___ Date of interview:

1. HOUSEHOLD BACKGROUND

1. Age (years) 1. 18-252.26-35 3.36-45 4.46-55 5.56-65 6.Abov e 65 years

2. Sex: 2.1. Male 2.2.Female

3. Marital status. 1 single 2 Married 3 Divorced 4 Widow

4. Household family size. 1 Small size (1 – 3)2 Medium size (4 – 8) 3 Larger size (>9)

5. Education level. a. illiterate b. can read and write only c. church education d. elementary school(1- 8 grades) e. secondary school (9- 10 grades) f. preparatory school g. college /university

6. Religion 1. Orthodox 2. Protestant 3. Muslim 4. Catholic 5. Others

2. Socio-economic characteristics of sampled household respondents

7. Occupation of the household's head 1. Farming 2. Small business 3. Others Specify_

8. Do you participate in additional income generating off-farm activities? 1. Yes 2. No

9. If your answer for question8 is" yes", what are the other sources to supplement the deficiency?

1. Fsh trap 2 Local daily wage labour 3. Petty/ local trading 4 Security guards5. Relative'sremittance 6. Selling local drinks 7.Church employer)

10. Where do you sell your food crops, fruits animals and tree produces? 1. Local Market 2. Urban market 3. On farm 4. Other (specify)

11. Did you receive appropriate price for your products? Yes=1 No=2

12. If No for Q13, what will be reasons?

1. Low price 2. Lack of transportation 3.Lack of market information 4.Lack of storage facility 5. Lack of know how to handle & processing and 6. Current political condition

3. Institutional factors for Agroforestry practices

3.1. Land system and Tenure security on agro-forestry

15. Do you own the land you stay on? 1. Yes2. No

16. What size of your farm land 1. ≤ 0.5ha 2. 0.6-2 ha 3. 2.1-3ha 4. >3ha

17. How did you obtain your farm land?

1) Inheritance 2) Rent 3) Bought 4) Given by government 5) From family 6) Others (specify

18. Are you satisfied with your land size? 1. Yes 2.no

19. Do you feel tenure security? 1. Yes 2. No

20. What are the sources of labor on your farm?

1. Family/household 2.Hired 3.Wage-perday 4.Debo /cooperative 5.family and wage-perday

6. Family and Debo /cooperative 7. Family/household, Hired and Wage-perday

3.2. Extension system

21. Who introduce these agro forestry practices to you?

1) By formal training 2) By community meeting 3) By personal advice 4. Extension works 5 Inherited from my family 6. My own trial 7) Others (specify)

22. Have you received training in how to practice agroforestry? 1. No 2. Yes

23 .If yes in Q22 by whom have you been trained

1. Agricultural extension officer 2. Researchers 3. Farmer 4. NGO

24. If yes in Q22 , how they deliver their technical service?

1) By demonstration 2) Oral advice 3) Both

25. How often the extension agents do visit you? 1. Once in a year 2.Twice in a year 3.Once in quarter 4.Once in two month 5.Once in a month 6.Twice in a month 7.Once in a week 8.No visit

26. Do you think that the extension agent services are satisfactory? 1) Yes 2) No

4. ANIMAL PRODUCTION SYSTEM

27. Do you rare animals? 1 Yes 2 No

28. What type of livestock do you have? **1.** Cattle 2. Equines 3. Sheep , hen and beehives 4. Hen and beehives 5. Beehives and sheep 6. Sheep, goat,hen and cattle 7. Cattle and hen 8. Goat, sheep and beehives 9. Sheep 10. Beehives

29. Do you have livestock feed? 1 Yes 2 No

30. If yes, in Q29 What is the source of feed for the animals?

1 Forage 2 Tree/shrub/ fodder. 3 Grassland/ grazing land 4 crop residue .6.Industrial feed 7. Hay harvesting and collection 8.Local beverage residues (local beer and local alcohol residues)

5. Agroforestry practice in the study area

31.Do you practice agroforestry activity on your farm? 1. Yes 2.No

32. If say yes in question 31, what are the major agroforestry practices most commonly implemented in your locality?(you can select more than one)

1. Scattered trees on cropland 2. Homegardens 3. Trees on boundaries 4. Alley cropping/Hedgerow intercropping 5. Wind breaks/shelter belts 6. Live fences 7. Fodder bank 8 .Taungya 9. Trees on pasture 10.Tree planting for Gully areas 11.Multistory coffee systems

33. What are the tree /shrub species found in each agro forestry practice? Write infront of each List see it question 32the selected agro forestry practice and mark it from the table

Tabele 1 Which tree species preferences of farmers planting trees in agroforestry system? Write (yes or no)

no	Local name	Scientific Name	Scatter on crop land	Home .G	Multistorycoffee.s	boundry	Livefence	Wind .B	Fooder.bank	Trees on pasture
1	Gesho	Rhamnus prinoides								
2	Woira	Olea Africana								
3	Wanza	Cordia Africana								
4	Avocado	Persea Americana								
5	Mango	Mangifera indica								
6	Muze	Musa sapientum								
7	Nim	Azadirachta indica								
8	Koke	Prunus persica								
9	Zayitun	Psidium guajava								

10	Birtukn	Citrus sinensis								
11	Lomi	Citrus aurantifolia								
12	Bisana	Crotonmacrostachyus								
13	Sesa	Albizia gummifera								
14	Warka	Ficus vasta								
15	Buna	Coffee Arabica								
16	Gravilia	Grevilia robusta								
17	Birbira	Millettia ferruginea								
18	If others list the name									

34. What is the source of agroforestry seedlings/planting material?

1. Nearby natural forest 2. Model (government) nurseries3. Cooperatives nurseries 4. Buying from market 5. Donation by NGO 6. Private nurseries 7. Self-production

35. Who is mostly taking care of the home garden agroforestry (such as weeding, pruning, collecting etc. activities) in your family? 1. Husband 2. Wife 3.Children 4.we all equally

7. Agroforestry practice Benefits in the study area

36. Have you realized any benefits of agroforestry? 1. yes 2. No

37. If your answer is yes in question 36, what are the benefits from agro forestry?

1. Improving water use efficiency 2.Soil nutrient improvement 3. Biodiversity Conservation 4. Micro climate Amelioration5. Fodder Production 6. Honey production7. Fule Wood8.Food supply (food security) 9. Sociocultural and Recreational Value 10. job opportunity 11**.**Diversify farmers'incomes 12**.** Erosion restriction 13**.** Medicine

38. What are the constraints of agroforestry practice implementation in study area**?** What are the major constraints of agroforestry practice implementation in your locality? Rank based on severity 1, 2, and 3, 4, 5.6…

No	Constraints	No/x	/yes	Rank
1	Free-grazing			
2	Pests and diseases			
3	Food and Nutritional Insecurity			
4	No marketing access			
5	Lack of credit facilities			
6	Lack of farmers knowledge			
7	Lack of planting materials			
8	Lack of extension services			
9	Unavailability of labour			
10	Lack of capital			
11	Water Shortage			
12	Lack of land tenure			
13	Shortage of land/ Farm size			
14	Transportation Problem			
15	Losses of Perishable Af Products			
16	Lack of improved species			

Gridlines for key informant's interview

1. What are the major agroforestry practices in your locality? Describe
2. What are the benefits of agroforestry practices in zegie Penisula?
3. What is the most serious problem of the agroforestry practice implementation?
4. What is your suggestion to bring solution to constraints of agroforestry practices?
5. What are major tree/shrub species used for livestock to provide fodder?
6. How agroforestry practice introduced in zegie Penisula?

Chalkiest for Focus Discussion (FGD)

1. What are the major benefits of the agroforestry practices in the community?
2. What are the most constraints identified in the agroforestry system?
3. What are the major of tree and shrub for livestock fodders for you?
4. What is the main source of wood for fuel and constructionin the community?

5. What are the Additional income generating off-farm activities?
6. When did you learn agroforestry in the first time in the study area?

Chalk liest forPersonal Observations.

1. What are the major types of agroforestry practices tree species implemented in study area? Observe, list and take photo

2. What are the major reasons of using major agroforestry practices at farmland?

Appendix 2 Farmers preferredspecies for home gardens Agroforestry practice

No	Species preferred		Life form	Frequency			Total	Percent
	Local name	Scientific Name		Ura	Zegie	Yigana		
1	Avocado	Persea americana	Tree	1	39	0	40	12.7
2	Azamira	Bersama abyssinica	Tree	0	1	0	1	0.3
3	Bamba	Adansonia digitata	Tree	0	3	1	4	1.3
4	Bariyaqob	Rothmannia urcelliformis	Tree	30	0	34	64	20.3
5	Birbira	Millettia ferruginea	Tree	61	16	31	108	34.2
6	Birtukan	Citrus sinensis	Shrub	2	6	0	8	2.5
7	Bisana	Croton macrostachyus	Tree	39	38	46	123	38.9
8	Buna	Coffee arabica	Shrub	48	27	43	118	37.3
9	Chebah	Acacia nilotica	Tree	3	2	5	10	3.2
10	Digita	Senna siamea	Tree	1	4	0	5	1.6
11	Dngayseber	Ritchiea albersii	Tree	1	0	0	1	0.3
12	Dokma	Syzygium guineense	Tree	0	2	5	7	2.2
13	Enbilta	Entada abyssinica	Tree	0	1	1	2	0.6
14	Eshe	Mimusops kummel	Tree	14	2	4	20	6.3
15	Gambello	Gardenia volkensii	Tree	0	4	1	5	1.6
16	Gesho	Rhamnus prinoides	Shrub	24	37	16	77	24.4
17	Girawa	Vernonia amygdalin	Shrub	1	11	1	13	4.1
18	Gravilia	Grevilia robusta	Tree	16	12	4	32	10.1
19	Injori	Morus mesozygia	Tree	0	0	1	1	0.3

No	Species preferred		Life form	Frequency			Total	Percent
	Local name	Scientific Name		Ura	Zegie	Yigana		
20	Itsepatos	Dracaena steudneri	Tree	6	1	1	8	2.5
21	Kndapa	Ehretia cimosa	Tree	71	8	39	118	37.3
22	Koke	Prunus persica	Tree	4	1	0	5	1.6
23	Korech	Erythrina abyssinica	Tree	2	2	0	4	1.3
24	Lenquta	Grewia ferruginea	Tree	1	1	0	2	0.6
25	Lomi	Citrus aurantifolia	Shrub	19	16	15	50	15.8
26	Mango	Mangifera indica	Tree	14	34	6	54	17.1
27	Muze	Musa sapientum	Shrub	0	17	0	17	5.4
28	Nim	Azadirachta indica	Tree	25	7	4	36	11.4
29	Qamo	Rbus glutinosa	Tree	0	1	1	2	0.6
30	Qawa	Celtis africana	Tree	16	1	3	20	6.3
31	Selechegn	Diospyros abyssinica	Tree	31	0	31	62	19.6
32	Sesa	Albizia gummifera	Tree	72	18	49	139	44
33	Sespania	Sesbaina sesban	shrub	0	5	1	6	1.9
34	Shenbelekita	Vangueria volkensii	Tree	6	0	0	6	1.9
35	Shiferaw	Moringa olifra	Tree	5	10	0	15	4.7
36	Tise	Albizia malacophylla	Tree	8	2	1	11	3.5
37	Wanza	Cordia africana	Tree	63	52	58	173	54.7
38	Warka	Ficus vasta	Tree	10	5	1	16	5.1
39	Woira,	Olea africana	Tree	25	4	3	32	10.1
40	Yehabesha tsid	Juniperus procera	Tree	3	0	5	8	2.5
41	Zana	Stereospermum kunthianum	Tree	0	1	3	4	1.3
42	Zayitun	Psidium guajava	Shrub	7	14	10	31	9.8
43	Zigba	Podocarpus falcatus	Tree	1	0	2	3	0.9

Appendix 3 preferredspecies for multistory Agroforestry

no	Preferred species on multistory		Life form	Frequency			Total	Percent
	Local name	Scientific Name		Ura	Zegie	Yiganda		
1	Avocado	Persea americana	Tree	0	18	0	18	5.7
2	Bamba	Adansonia digitata	Tree	1	0	0	1	0.3
3	Bariya qob	Rothmannia urcelliformis	Tree	101	0	94	195	61.7
4	Birbra	Millettia ferruginea	Tree	107	7	88	202	63.9
5	Birtukan	Citrus sinensis	Shrub	4	5	0	9	2.8
6	Bisana	Croton macrostachyus	Tree	80	25	93	198	62.7
7	Buna	Coffee arabica	Shrub	114	42	105	261	82.6
8	Eshe	Mimusops kummel	Tree	77	0	25	102	32.3
9	Gambello	Gardenia volkensii	Tree	0	1	1	2	0.6
10	Gesho	Rhamnus prinoides	Shrub	57	15	56	128	40.5
11	Gravilia	Gravilia rubusta	Tree	14	6	4	24	7.6
12	Itsepatos	Dracaena steudneri	Tree	7	0	0	7	2.2
13	Kawa	Celtis africana	Tree	79	0	48	127	40.2
14	Kndapa	Ehretia cimosa	Tree	92	2	97	191	60.4
15	Koke	Prunus persica	Tree	9	1	1	11	3.5
16	Lenkata	Grewia ferruginea	Shrub	1	0	0	1	0.3
17	Lomi	Citrus aurantifolia	Shrub	34	9	61	104	32.9
18	Mango	Mangifera indica	Tree	12	16	25	53	16.8
19	Muze	Musa sapientum	Shrub	1	2	0	3	0.9
20	Nime	Azadirachta indica	Tree	23	5	15	43	13.6
21	Selechegn	Diospyros abyssinica	Tree	97	0	72	169	53.5
22	Sesa	Albizia gummifera	Tree	112	5	106	223	70.6
23	Shenbelaketa	Vangueria volkensii	Tree	87	1	77	165	52.2
24	Shiferaw	Moringa olifera	Tree	37	3	2	42	13.3
25	Tikur enchet	Prunus africana	Tree	1	0	0	1	0.3
26	Tisd	Juniperus procera	Tree	8	0	0	8	2.5

no	Preferred species on multistory		Life form	Frequency			Total	Percent
	Local name	Scientific Name		Ura	Zegie	Yiganda		
27	Tise	Albizia malacophylla	Tree	13	0	0	13	4.1
28	Waneza	Cordia africana	Tree	84	34	91	209	66.1
29	Warka	Ficus vasta	Tree	7	2	3	12	3.8
30	Wyira	Olea africana	Tree	28	0	0	28	8.9
31	Zaitun	Psidium guajava	Shrub	3	9	11	23	7.3
32	Zana	Stereospermum kunthianum	Tree	1	0	39	40	12.7
33	Zigba	Podocarpus falcatus	Tree	12	0	2	14	4.4

Appendix 4 Preferred species for live fence agroforestry practice

No	Species preferred by farmers		Life form	Frequency			Total	Percent
	Local name	Scientific Name		Ura	Zegie	Yiganda		
1	Agam	Carissa spinarum	Shrub	2	0	0	2	0.6
2	Bahirzaf	Eucalyptus globulus	Tree	0	5	0	5	1.6
3	Bariyaqob	Rothmannia urcelliformis	Tree	3	0	0	3	0.9
4	Birbra	Millettia ferruginea	Tree	6	1	0	7	2.2
5	Chibha	Acacia nilotica	Tree	1	0	1	2	0.6
6	Endod	Phytolacca dodecandra	Shrub	3	0	0	3	0.9
7	Grawa	Vernonia amygdalina	Shrub	19	26	1	46	14.6
8	Grvilia	Grevilia robusta	Tree	5	4	1	10	3.2
9	Gumero	Capparis tomentosa	Shrub	9	32	1	42	13.3
10	Injori	Morus mesozygia	Ttree	1	0	0	1	0.3
11	Itsepatos	Dracaena steudneri	Tree	27	1	0	28	8.9
12	Kendapa	Ehretia cimosa	Tree	20	0	0	20	6.3
13	Kontir	Entada abyssinica	Tree	4	5	1	10	3.2
14	Koreche	Erythrina abyssinica	Tree	1	1	0	2	0.6

No	Species preferred by farmers		Life form	Frequency			Total	Percent
	Local name	Scientific Name		Ura	Zegie	Yiganda		
15	Kulkual	Eupborbia abyssinica	Tree	0	1	0	1	0.3
16	Nime	Azadirachta indica	Tree	1	1	0	2	0.6
17	Qnchib	Euphorbia tirucalli	Tree	2	1	0	3	0.9
18	Selechegn	Diospyros abyssinica	Tree	2	1	0	3	0.9
19	Semiza	Justicia schimperiana	Shrub	75	23	1	99	31.3
20	Sesa	Albizia gummifera	Tree	4	1	0	5	1.6
21	Wanza	Cordia africana	Tree	10	1	0	11	3.5

Appendix **5** Preferred Species for farm boundary agroforestry practice

no	Species preferred by farmers boundary planting		Life form	Frequency			Total	Percent
	Local name	Scientific Name		Ura	Zegie	Yiganda		
1	Bahirzaf	Eucalyptus globulus	Tree	0	2	0	2	0.6
2	Bamba	Adansonia digitata	Tree	0	1	0	1	0.3
3	Birbra	Millettia ferruginea	Tree	1	1	0	2	0.6
4	Bisana	Croton macrostachyus	Tree	1	5	0	6	1.9
5	Digta	Senna siamea	Tree	0	1	0	1	0.3
6	Dokma	Syzygium guineense	Tree	3	1	0	4	1.3
7	Gravilia	Gravilia rubusta	Tree	1	4	0	5	1.6
8	Grawa	Vernonia amygdalina	Shrub	11	23	0	34	10.8
9	Gumero	Capparis tomentosa	Shrub	0	5	0	5	1.6
10	Itsepatos	Dracaena steudneri	Tree	1	1	0	2	0.6
11	Kontire	Entada abyssinica	Tree	0	1	0	1	0.3
12	Mango	Mangifera indica	Tree	7	1	0	8	2.5
13	Nime	Azadirachta indica	Tree	1	2	0	3	0.9

no	Species preferred by farmers boundary planting		Life form	Frequency			Total	Percent
	Local name	Scientific Name		Ura	Zegie	Yiganda		
14	Papaya	Carica papaya	Tree	0	1	0	1	0.3
15	Sasepania	Sesbaina sesban	Tree	3	10	0	13	4.1
16	Sesa	Albizia gummifera	Tree	2	3	0	5	1.6
17	Shiferaw	Moringa olifera	Tree	4	1	0	5	1.6
18	Smiza	Justicia schimperiana	Shrub	4	14	0	18	5.7
19	Wanza	Cordia Africana	Tree	1	4	0	5	1.6

Appendix 6 Farmers preferredspecies for scattered tree on crop land agroforestry practice

no	Preferred species scattered on crop land		Life form	Frequency			Total	Percent
	Local name	Scientific Name		Ura	Zegie	Yiganda		
1	Avocado	Persea americana	Tree	0	1	0	1	0.3
2	Bamba	Adansonia digitata	Tree	0	2	0	2	0.6
3	Bariyaqob	Rothmannia urcelliformis	Tree	0	3	0	3	0.9
4	Birbira	Millettia ferruginea	Tree	0	4	0	4	1.3
5	Bisana	Croton macrostachyus	Tree	0	10	0	10	3.2
6	Chebah	Acacia nilotica	Tree	0	4	0	4	1.3
7	Eshe	Mimusops kummel	Tree	0	2	0	2	0.6
8	Gambello	Gardenia volkensii	Tree	0	1	0	1	0.3
9	Grar	Acacia abyssinica	Tree	0	1	0	1	0.3
10	Gravilia	Grevilia robusta	Tree	0	2	0	2	0.6
11	Kndapa	Ehretia cimosa	Tree	0	6	0	6	1.9
12	Mango	Mangifera indica	Tree	0	3	0	3	0.9
13	Nim	Azadirachta indica	Tree	0	2	0	2	0.6
14	Papaya	Carica papaya	Tree	0	1	0	1	0.3

no	Preferred species scattered on crop land		Life form	Frequency			Total	Percent
	Local name	Scientific Name		Ura	Zegie	Yiganda		
15	Qawa	Celtis africana	Tree	0	4	0	4	1.3
16	Selechegn	Diospyros abyssinica	Tree	0	5	0	5	1.6
17	Sesa	Albizia gummifera	Tree	0	7	0	7	2.2
18	Shenbeleketa	Vangueria volkensii	Tree	0	2	0	2	0.6
19	Tis	Albizia malacophylla	Tree	0	1	0	1	0.3
20	Wanza	Cordia africana	Tree	0	16	0	16	5.1
21	Warka	Ficus vasta	Tree	0	4	0	4	1.3
22	Zigba	Podocarpus falcatus	Tree	0	1	0	1	0.3

Appendix 7 Preferred species for wind break and shelter belt agroforestry practice

no	Species preferred by farmers wind break		Life form	Frequency			Total	Percent
	Local name	Scientific Name		Ura	Zegie	Yiganda		
1	Bahirzaf	Eucalyptus globulus	Tree	0	4	0	4	1.2
2	Buna	Coffee arabica	Shrub	0	1	0	1	0.3
3	Digta	Senna siamea	Tree	0	1	0	1	0.3
4	Gravilia	Grevilia robusta	Tree	0	1	0	1	0.3
5	Grawa	Vernonia amygdalina	Shrub	0	1	0	1	0.3
6	leneqata	Grewia ferruginea	Shrub	0	1	0	1	0.3
7	Nime	Azadirachta indica	Tree	0	3	0	3	0.9
8	Sasepania	Sesbaina sesban	Shrub	0	2	0	2	0.6
9	Wanza	Cordia africana	Tree	0	1	0	1	0.3

Appendix 8. Multinomial logistic regression model fit tests

-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
814.164	.269	.284

Hosmer and Lemeshow Test		
Chi-square	df	Sig.
55.436	8	.156

Multicollinearity tests		
Model	Collinearity Statistics	
	Tolerance=1/VIF	VIF
Age of the house hold	.914	1.094
Sex of the house hold	.768	1.302
Family size of the Household	.792	**1.262**
Education level of the house hold	.836	1.197
Size of your farm land	.910	1.098
Total income of HH	.970	1.031
Availability of credit access	.911	1.098
Land tenure security	.801	1.249
Total livestock unit holds by the households	.974	1.027
Price of AF products	.800	1.249
Availability of Market access	.912	1.097
Availability of Water	.944	1.059

Appendix 9 Photograph of AF practice taken during field observation

Appendix 10. Household servey enumeraters at the time of data collection

Appendix 11 Photographs of Key informats interview participant in the field

Land commity Model farmers

Elders FHH

Appendix 12 Photographs of Focus group disscusstion participants

Appendix 13 Photographs of enumeraters at the time of orientation /training

8.BIOGRAPHICAL SKETCH

The author was born on 03 September 1982 in Yilmana densa, District, West gojaim, Amhara regional state Ethiopia. He attended his primary education (1-8) at Senkegnaelementary School and his secondary and preparatory education (9-12) from Adet secondary and preparatory school. Then the author joined of Bahirdarr University College of Agricultureand Enviromental scienes in 2007 in Natural Resource Management department and he was did his BSc Research project on the role of community mobilization in soil and water concervation in Dinblal Water Shed South Achiefer District North western Ethiopia. Finally he graduated on June 30, 2010. After one month of unemployment, he was employed since july 30, 2010 and works in Yilmana densa Agricultural office, then transform to konje kolela land administration office as forest expert,and also enviromental protection department head , Bahir Dar city administration agriculture office as forester expert. Then after, the author joined school of graduate studies from Bahir Dar University College of Agriculture and Environmental Sciences.Who currently studies Masters in Agroforestry and his research interest includes traditional agroforestry assessment, benefits and constraints.