

COLLEGE OF NATURAL AND COMPUTATIONAL SCIENCE,

DEPARTMENT OF BIOLOGY

AN INVESTIGATION OF WOODY SPECIES CONTRIBUTION FOR AGROFORESTERY AND COMMUNITY MANAGEMENT PRACTICE IN MISRAK MESKAN DISTRICT OF MISRAK GURAGE ZONE CENTRAL ETHIOPIA REGIONAL STATE, ETHIOPIA.

MSc THESIS

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An Investigation of Woody Species Contribution For Agroforestery And Community Management Practice In Misrak Meskan District Of Misrak Gurage Zone Central Ethiopia Regional State, Ethiopia.

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A LIST OF ACRONYMS AND ABBREVIATIONS

AFTA: Association for Temperate Agroforestry

DBH: Diameter at Breast Height

EBI: Ethiopian Biodiversity Institute.

FAO: Food and Agriculture Organization

ILCA: International Livestock Center for Africa.

IVI: Importance Value Index.

PASDEP: Plan for Accelerated and Sustainable Development to End Poverty

MEFCC: Minster of Environment Forest and Climate Change

WAC: World Agroforestry Centre

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DECLARATION

I, the undersigned, affirm that this argument is entirely initial with no submissions for master's degrees at other universities, I thank all of the sources of the information used in this study. Technical and ethical guidelines were closely adhered to throughout the gathering, examination, and completion of this thesis's data,and all scholarly material was properly cited ,I affirm that all sources referenced in these document has been duly acknowledged,everey an attempt has been taken to ensure that this thesis is free of plagiarism.

TABLE OF CONTENTS

ACKNOWLEDGMENTS iv
DECLARATION v
TABLE OF CONTENTS vi
LIST OF TABLES ix
LISTE OF FIGURS x
ABSTRACT xi
CHAPTER ONE 1
1. INTRODUCTION 1
1.1. Background of the study 1
1.2. Statement of the problem 3
1.3. Research questions 3
1.4 Objective of the study 4
1.4.1 General Objective 4
1.4.2 Specific Objectives 4
1.5 Significance of the study 4
CHAPTER TWO 5
2 LITERATURE REVIEW 5
2.1 The Overview of Agroforestry systems 5
2.2 Woody Species on Farmland 5
2.3 Use of Farmland Woody Species 6
2.4 Agroforestry Practice in Ethiopia 6
2.5 Global Agroforestry Cover 7
2.6 Types of Agroforestry systems 7
2.6.1 Agrosilvicultural system 7

2.6.2 Silvipastural systems 8
2.6.3 Agrosilvopasture systems 8
2.7 Common Agroforestry Practices 8
2.7.1 Hedgerow inter-cropping 8
2.7.2 Scattered Trees on Cropland 8
2.7.3 Live Fences 9
2.8 The role of Woody Species on Agroforestry 9
2.8.1 Soil fertility improvement and soil conservation 9
2.8.2 Fuel wood and energy 9
2.8.3 Crop productivity 9
2.9 Woody species Management practice 10
2.9.1 Coppicing 10
2.9.2 Pollarding 10
2.9.3 Lopping 11
2.9.4 Branch pruning 11
2.10 Factors Influencing Woody Species management on Farmland Farmers 11
2.10.1 Farm size 11
2.10.2 Lack of capital 11
2.10.3 Drought 12
2.11 Obstacles to advancing agroforestry techniques 20
2.11.1 Limitations of Policy 20
2.11.2 Limitations in the Distribution of Tree Products to Markets 20
CHAPTER THREE 21
3. MATERIALS AND METHODES 21
3.1 Description of the study area 21
3.1.1 The study area's geographic location 21
3.1.2 The climate 22
3.1.3 Population 23
3.1.4 Vegetation type of the study area 23
3.1.5 Income source 23

3.2 Research Design 24
3.3 Method of sampling and sample size 24
3.4 Methods 26
3.4.1 Study design 26
CHAPTER FOUR 29
Results 29
4.2 DISCUSSION 42
CHAPTER FIVE 44
5. CONCLUSSION AND RECOMMENDATION 44
5.1 CONCLUSION 44
5.2 RECOMMENDATIONS 45
6 REFERENCES 46
7 APPENDICES 52
7.1 Appendix 1 55
7.2.Appendix 2 55
7.3.Appendix 3 56

LIST OF TABLES

Table 1: Sample households 25
Table 2: Socioeconomic Features of the Respondent 30
Table 3 Farmland Woody Species. 32
Table 4: Woody Species Frequency 37
Table 5: Woody Species Density 38

LISTE OF FIGURS

Figure 1 Map of the study area (Source, CSA data, 2007) 21
Figure 2 Three Year (2014 to 2016) average monthly temperature of study area 22
Figure 3: Three Year (2014 to 2016) average monthly rain fall of study area 23
Figure 4 Respondents religion. 31
Figure 5 Coppicing Tree. 34
Figure 6 Lopping Tree 35
Figure 7 Density of top five woody species in the study sites 40
Figure 8 Among the farms that were evaluated, woody species with the highest IVI values 41

ABSTRACT

Woody species conservation is an issue of scientific, economic and ecological concern at global level.Woody species play many functions and make a real contribution to farmland protection, making them essential parts of an agroforestry system.Farmland plays significant role in the woody species conservation. The study was conducted to An Investigation of Woody Species Contribution For Agroforestery And Community Management Practice In Misrak Meskan District Of Misrak Gurage Zone Central Ethiopia Regional State, Ethiopia.Using systematic sampling techniques were representative kebele were selected from district . Four kebele and a total of 400 households were included in the study. Data on woody species were collected using a line transect across 60 plots, each measuring 40m × 40 m, spaced at 100 m intervals on farmland. For all woody species ≥5 cm, the diameter at breast height (DBH) was measured. Key materics such as important value index, density, dominance, and frequency were computed and analyzed. A total of 20 families and 33 woody species were identified and documented.The average basal area of woody species on farmland in study area was 0.55 m2. Farmers preferred woody species that provided for fuel wood, timber, shade and construction materias, with Fiaderbia albida the most favored, followed by Eucalyptus camaldulensis and Acacia abyssinica. The common management practices include coppicing and Lopping. Socioeconomic aspects like the size of the farm, educational background, and wealth status influenced the management of woody species on farmland.With 6 species, the Fabaceae family was the most represented. Fiaderbia albida., Eucalyptus camadulensis., Acacia abyssinica., Balanites aegyptiaca., and Cordia Africana. were the most common species, occurring in 85%, 80%, 76%, 68.33%, and 65% of the farms that were sampled.Overall, the study demonstrated that an agroforestry system is essential to the preservation of woody species.While farmers employ traditional management practice for wood species on their farmland,these practices required better support and extention service to address existing challenges.

Key words: agroforestry, management practices Wooody species

CHAPTER ONE

1. INTRODUCTION

1.1. Background of the study

Growing scattered woody species in farmlands is characterizing a large part of the Ethiopian agricultural landscape and it is the most dominant agroforestry practice in the semi-arid and sub humid zones of the country (Hailemariam Kassa., *et al* 2010).Scattered woody species within crop fields are common features of smallholder agriculture, which dominates both economic and social activity for millions of farmers in Ethiopia (Charles *et al.*,2010).Since the very beginnings of agriculture, many farmers retained or actively incorporated woody species as part of their agricultural landscapes (Chirwa,2016). Over 1 billion hectares (46%) of agricultural land worldwide has more than 10% tree cover (Khadka.,*et al* 2021). Woody species are crucial parts of the farming system, particularly in the tropics, (Mala,2016). Home gardens and strewn trees in cropland as parks agroforestry methods, trees in boundary fields, and grazing land are the most popular types of agroforestry (Dagninet Amare and Menale Wondie.,2018). As a household method of producing food, fuel wood, and fodder, traditional agroforestry land usage could be considered a model for sustainable forestry and agricultural methods (Badege Bishaw, and Abdelkadir Abdu.,2003). Agroforestry is a dynamic, ecologically oriented natural resources management system that diversifies and sustains output for the growing socioeconomic and environmental benefits for all land users at all levels, according to WAC (2006).

The flora of Ethiopia is an estimated number of indigenous plant species 4481, of which 19.9% are considered to be endemic to Ethiopia (Sosef *et al*., 2017).Ethiopia has 12.3 million hectares of forests, which are made up of wood land and natural forests, covering roughly 15% of the country, with planted forests making up around 8% of the total (EBI,2020). Increased populations, followed by deforestation and land degradation, are the primary causes of the country's dwindling vegetation resources overall and of fragmented forest regions specifically (Molla Mekonnen, 2013). The country's rapid population growth has led to widespread forest clearing for agricultural purposes, resettlement programs, exploitation of the country's existing forests for fuel wood, building

materials, and starting forest fires for pasture (Badege Bishaw, 2009). Woody species conservation is an issue of scientific, economic, ecological and political concern at global level primarily because of an increase in extinction rates caused by human activities (Ehrlich and Wilson, 2011). In order to manage woody species in farmland for both conservation and production goals, it is important to understand the existing patterns of woody species (Kindt *et al.*, 2005). Data on tree and shrub species' population patterns reveal the history of previous disturbances to the environment and species. In addition, it is used to forecast the future trend of the species, which could provide information for conservation and management strategies (Demel Teketay.,2005). This study was aimed to An Investigation the Contribution of Woody Species in Agroforestery And Community Management Practice in Misrak Meskan District of Misrak Gurage Zone Ethiopia.

1.2. Statement of the problem

In the nation of Ethiopia rich in plant diversity, traditional agroforestry practices play essential in giving food, fuelwood, and fodder for rural communities. There is many research on woody plant species of Ethiopia conducted by many researchers for example, woody plants assessments were studied in south Ethiopia (Coppock,1994, Woody Species Diversity,Composition,and Regeneration Status of Ambo Sacred Forest (Alemayehu Yigeremu and Mesfin Woldearegay, 2018), Local Knowledge of Farmers on Opportunities and Constraints to Sustainable intensification of Crop-Livestock-Trees Mixed Systems (Kuria,2014) but There is no research done on the An Investigation the Contribution of woody plant species on the agroforestry and management practices of the community in Misrak Meskan (District), Central Ethiopia. Hence,it demands study and Investigation the Contribution of woody plant species on the agroforestry and management practices in the district.

To understand the composition and distribution of woody species with comperehensive inventory and documenting the common management practices employed by farmers to maintain and protect. woody species is essential for promoting sustainable agroforestry. By addressing this problem , the researcher aims to contribute valuable insights in to the management and ecological significance of woody plants in the agroforestry system of Misrak Meskan Misrak Misrak Gurage zone, Ethiopia.

1.3. Research questions

1. Which woody plant species are frequently found in the chosen kebele's agricultural practices?

2. In their agroforestry systems, what management techniques do farmers use to preserve and safeguard woody plants?

3. What is the current status of woody species found on farmland?

1.4 Objective of the study

1.4.1 General Objective

- To investigate the use of woody species on agroforestry and associated practices in Misrak Meskan District's.

1.4.2 Specific Objectives

- To identify the main woody species that are found in the nearby agroforestry.
- To prevalent agroforestry practices in the district.
- To evaluate the strategies used by the local community to preserve woody plant species.
- To investigate the effects of community actions on agroforestry sustainability.

1.5 Significance of the study

The study provide platform information about sustainable, better management practice and conservation of the woody species in the study area. The study display the current status of the woody species practice and its ,management activities. This study also provide important information for government and other stakeholders about woody plant and as means of identifying proper management approaches and conservation plan.The study articulate empowering farmers with knowledge about wood species and enhances their well-being. By promoting agroforestry practices, the study contributes to sustainable livelihoods for rural communities.

CHAPTER TWO

2 LITERATURE REVIEW

2.1 The Overview of Agroforestry systems

Agroforestry assists smallholders who are at risk from climate change in various ways while also boosting economic stability and productivity (Lin,2014). Agroforestry is a dynamic, environmentally focused approach to managing natural resources that promotes and diversifies smallholder agricultural production to enhance social, economic, and environmental advantages (Leakey,2017).Research describes agroforestry systems based on their structure, function, socioeconomic nature, level of management, and environmental spread (Nair *et al.*,2021). Agroforestry is a direct source of food, fruit and complements the wood and fuel sectors (Current *et al.*,1995). Furthermore, planting trees on the farm is the best way to prepare for different climate change scenarios and act as insurance.

2.2 Woody Species on Farmland

One method of environmentally friendly agro-ecosystem diversification that can preserve and possibly increase biodiversity is the introduction of woody species into crop areas (Sanchez *et al,* 1997).In addition to producing commercial forest products, they might replenish soil fertility. Increased agricultural yields (nitrogen fixation, increased soil organic matter content, nutrient cycling, and soil conservation) are among the pertinent services provided by woody species (Mugendi *et al.,* 2007).

They also serve as critical nesting, feeding, and roosting sites for a variety of bird and bat species. They also provide transient habitats for many migratory birds.The native forest plant are alos more likely to survive when woody species are present in agricultural lands.Furthermore,because they generate seed localy,on-farm trees are frequently used as a source of propagation for forest restoration, (Harvey and Haber, 1998).

2.3 Use of Farmland Woody Species

Agricultural system may be sustainable if there is diversity of woody species on farm land that fulfill varaious ecological and socioeconomic purpose (Tesfaye Abebe, 2005). Agriculture, or the use of trees on farms, is particularly well-suited to offer eco-agricultural solutions that effectively integrate the goals of improved food security and conservation benefits, particularly by encouraging the expanded use of native tree species (Atta-Krah *et al.,* 2004). For many communities in sub-Saharan Africa, woody species in farmland supply fundamental food products as well as a range of additional products, such as traditional remedies, fodder, spices, gums, resins, fuel wood, construction wood, and wood for making farm equipment (Zewuge Teklehaimanot, 2004). Those that connect the goods and services of agricultural woody species to the people who rely on them are known as the socio-economic links between farmland trees and food security.Farmland trees may have a variety of effects on a household's food security from their perspective (FAO, 2006).

2.4 Agroforestry Practice in Ethiopia

Agro-forestry is a dynamic, ecologically oriented, natural resources management method through integration of trees on farms and agricultural landscapes, diversifies and sustains production for greater social, economic, and environmental advantages for all land users at all levels (WAC, 2003).Agroforestry plays a significant role in Ethiopian farming systems and has lately been included as one of the country's development goals in the PASDEP of the national development policy (Jama and Zeila, 2005). In Ethiopia, the use of trees and bushes in agriculture dates back 7000 years (Brandt, 1984 and Edmond *et al.* 2000), and has developed during subsequent millennia into number of distinct indigenous agroforestry systems (Getahun Amare1974 and Kanshie, 2002). Agroforestry system there are both ecological and financial connections between different components (Bishaw Badege., 2003). In Ethiopia, home gardens, parkland agroforestry (scattered trees on croplands), and natural species regeneration in pasture and woodlands are the most common agroforestry practices. Examples of agroforestry in Ethiopian parklands include the intercropping of maize with *Cordia africana* in Bako and western Ethiopia, as well as agroforestry based on *Faidherbia albida* in the Hararghe Highlands and Bushoftu region (Boffa, 1995). Hedgerow intercropping is practiced in a number of Ethiopian regions; in the eastern Ethiopian hararghe

highlands, for instance, sorghum/maize and chat *(Catha edulis*) hedgerows are interplanted. Generally speaking, agroforestry is a viable, affordable alternative for both environmental preservation and food production; however, its advantages can only be fully realized when the appropriate tree species, crops, and management techniques are combined in the proper spatial arrangements (Andenet Hailu., 2021).

2.5 Global Agroforestry Cover

Intentionally connecting trees, crops, and animals under agroecological systems is the goal of agroforestry, a traditional land-use method that is practiced all over the world (AFTA, 1997).

Working study from the World Agroforestry Centre (WAC) estimates that agroforestry employs over 900 million people and encompasses 43% of all agricultural areas worldwide, or almost one billion hectares in worldwide. Agroforestry is also common in Asia, where it has long been essential to local livelihoods (Cannel, 1987). Thirty-five years ago, widespread concerns over land degradation and the lack of effective solutions in Africa led to the hope that international agroforestry research could contribute new solutions (King.,1978). Food insecurity, drops in per capita agricultural income, and land and soil degradation, made worse by biodiversity loss, have persisted in many parts of Africa despite local success stories (Tamene.,2010).

2.6 Types of Agroforestry systems

Tree fundamental elements define all agroforestry systems: herbaceous plants (crops, pasture species), woody perennials (trees and shrubs), and animals. Agroforestry systems can also be categorized for all practical purposes based on the make up of their constituent parts, which are based on these three fundamental elements.These are: Agro-silvicultural systems, Silvopastural systems, and Agro-silvopastural systems (Bishaw Badege and Abdilkadir Abdu., 2003).

2.6.1 Agrosilvicultural system

In this approach, trees and shrubs are planted alongside agronomic crops on the same plot of land to improve the long-term production of wood and feed from yearly crops. Multiple agroforestry practices may exist inside a single agroforestry system. Agroforestry systems are distinguished by specific practices that collectively constitute the predominant land use system in a given area, which

is defined by the environment, plant species and their arrangement, management, and social and economic roles (Bishaw Badege and Abdilkadir Abdu ,2003).

2.6.2 Silvipastural systems

Under the silvopasture system, domesticated animals are raised on the same piece of land as forests that are managed for timber production. This technique can be used to produce feed and woody materials on both range and forest areas. It can also be used to save soil on sloping terrain by growing grasses and trees/shrubs together (Annie *et al.,* 2016).

2.6.3 Agrosilvopasture systems

Grass and browse feed, biomass for fuel wood and green manure, and food for human consumption are all produced by this agroforestry technique, which combines food, pasture, and tree/shrub crops on a single plot of land. This approach is used when a farmer wants a unit of land to provide all the benefits of agro-silviculture and silvopasture systems. Such method is typically used on cultivated ground and is also used when cropland is threatened by erosion and slope (Mathukia et al., 2016).

2.7 Common Agroforestry Practices

2.7.1 Hedgerow inter-cropping

Many regions of Ethiopia use this type of agroforestry. One such instance is the intercropping of Chat (*Catha edulis*) and Sorghum/maize hedgerows. The shrub chat is a stimulant cash crop that generates cash for the farmer (Destaw Mequaninnt.,2010).

2.7.2 Scattered Trees on Cropland

This practice involves the growing of individual trees and shrubs in wide spaces in the farmland, while field crops are grown in the understory.In addition to planting new trees, the method of growing trees scattered across cropland may be founded on the preservation and prudent treatment of spontaneously regenerated trees. Some good examples of this practice include *Cordia africana* intercropping with maize in Bako and western Ethiopia, (Mehari Alebachew,2012) and the Gedeo indigenous agroforestry system (Gadisa Chimdesa.,2016).

2.7.3 Live Fences

To keep livestock and people away from crops or buildings, living fences are made up of closely spaced trees or plants. Although it can be found across the farm, it is most frequently seen near homesteads and gardens. In Ethiopia, it is a widespread practice (Andenet Hailu., 2021).

2.8 The role of Woody Species on Agroforestry

Woody species provide a variety of ecological, social, and economic purposes, from actual economic benefits to cultural ones (Hergarten et al.,2013) woody species provide a number of functions in agroforestry, including improving soil fertility and producing wood products (fuel wood, poles, timber, fruits, medicines, etc.), enhanced beekeeping, erosion prevention, and the ability of shrubs to serve as live barriers against people and cattle (Nair.,1993).

2.8.1 Soil fertility improvement and soil conservation

In the majority of Ethiopia, land degradation and diminishing soil fertility pose a serious danger to agricultural output and have an impact on human wellbeing. It is most severe in areas where a lot of soils are deficient in organic matter and plant nutrients, and heavy rainfall erodes topsoil. (Habtamuand Zerihun,2016).

2.8.2 Fuel wood and energy

For their energy needs, more than 80% of people in Ethiopia's rural areas rely on fuel wood. Increased tree planting and improved resource management might yield goods like timber, poles, fruits, and fuel wood all of which are becoming more and more expensive in addition to being scarce (Abera Assefa., 2016).

2.8.3 Crop productivity

The idea that trees maintain the essential interests of agricultural areas and their products by being extremely productive and protective (Eneji et al., 2004; Roy & Tiwari, 2012; Baker et al., 2018).
It has been demonstrated that agroforestry increased farmers' capacity to manage the consequences of climate change and create stability in rain-fed agriculture by increasing the efficiency of rain usage (Verchot *et al.*,2011). An agroforestry system, which combines trees and crops, can reduce soil erosion, increase soil fertility, improve water quality and conservation, and improve the area's aesthetics (Williams and Guille, 2008).

2.9 Woody species Management practice

Increasing the variety of woody species found in farmland also improves the stability and output of agro-ecosystems (Kindt and Coe, 2005).Four fundamental management techniques are recognized based on technical and traditional knowledge (Wojtkowski,1998).

2.9.1 Coppicing

A woody perennial was produce a large number of new branches when it is pruned near ground level. It also involves the removal of trees, letting the stumps grow back for a few years, and then harvesting the stems that are left behind. A stump that is 10 to 30 cm above the ground remains after the entire tree is down.Ideally, only small trees and shrubs should be treated with this technique (Wojtkowski, 1998).This helps with the production of biomass or fodder.

2.9.2 Pollarding

Similar to coppicing, but with the main stem chopped around two meters above the ground. It involves chopping off the tree's entire crown around two meters above the ground in order to promote lateral branches.Involves chopping off the entire crown of the tree to promote regrowth; this technique works on trees that are easy to climb. Actually, grazing domestic animals was one of the primary uses for pollarded trees, and pollarded stands also continuously provided stove wood for

domestic.Trees were trimmed back to make room for new sprouts, which were then chopped down and the bark and leaves removed by animals in order to create fodder (Ferrini, 2006).

2.9.3 Lopping

It is where the outer sections of the branches are clipped.The primary application is to boost fruit production but, by managing the canopy expansion, lopping can also be employed to regulate light reaching understory crops (Wojtkowski, 1998).

2.9.4 Branch pruning

A few primary branches are cut off the stem, or the main branches are clipped where they are found. In order to reduce the impact on crops, obtain animal feed, and gather wood for fencing, building homes, firewood, and sales, this management technique is used to increase the growth rate or health of the remaining trees (Motuma Tolera *et al.*, 2008).

2.10 Factors Influencing Woody Species management on Farmland Farmers

Numerous socioeconomic and biophysical environmental factors, as well as institutional and extension inputs, impact the efforts made to diversify and conserve tree species on their farmlands (Zebene Asfaw.,2003).Here are a few of the key elements:

2.10.1 Farm size

Farm size is likely the most crucial factor that affects tree-species richness and diversity on farmlands (Zebene Asfaw,2003).According to a study by Muktar Reshad (2006), the most pervasive obstacle to the addition and preservation of trees in the southern Ethiopian highlands was most likely the growing competition for land brought on by a growing population on a small land base. According to Tesfaye Abebe (2005), farm size is a essential variable in affecting the diversity and composition of trees species.

2.10.2 Lack of capital

As described by Imo et al., (2001) one of the woody species management difficulties to nursery were lack of funds for the procurement of potting materials, tools, and equipment (primarily watering cans, wheelbarrows and spades), pests and diseases, and animal damage.Several research have

reported the influence of lack of capital on the tree density and tree species-richness on farm areas (Zebene Asfaw, 2003; Tesfaye Abebe ,2005).

2.10.3 Drought

One significant limiting factor during the early stages of seedling growth and establishment is drought stress (Jaleel *et al*., 2009). Woody species' development and elongation on farms are both impacted (Shao *et al.,* 2008). As shoot growth is more susceptible to water availability than root growth, it suggests that water-deficit stress inhibited the growth of woody species by limiting the creation of leaves (Ashraf and Foolad, 2007). Low regeneration of woody species has been linked to drought and its suppression in tropical highland environments (Johnson *et al.,* 2002).

2.11 Obstacles to advancing agroforestry techniques

2.11.1 Limitations of Policy

In order to identify nations and areas that have profited from agroforestry and those that have not, policy is crucial. (Place *et al*. 2012) state that in order to increase the distribution of agroforestry advantages, two major policy sectors require the removal of obstacles. First, farmers require land and tree tenure.If these conditions are met, there will be more interest in agroforestry practices. If these conditions are not met, farmer participation in tree planting and management may be limited.Second, regulations that dictate how farmers acquire seeds, seedlings, and clones of a variety of tree species appropriate for their diverse planting needs are essential (Lilleso *et al.,* 2011). The disregard for tree products is an additional issue.

2.11.2 Limitations in the Distribution of Tree Products to Markets

Markets for many tree products are poorly structured and coordinated (Jonathan *et al*., 2014). This results in low and unstable returns to farmers and high prices for buyers of tree foods, which limits their consumption. Problems often cited by producers include the absence of a collective bargaining system, poor transport infrastructure, and the involvement of multiple intermediaries in the supply chain, (Jamnadass *et al*.,2011).

CHAPTER THREE

3. MATERIALS AND METHODES

3.1 Description of the study area

3.1.1 The study area's geographic location

The research was carried out in Misrak Meskan District, which can be found in Misrak Gurage zone of the Central Ethiopia Regional State ,Ethiopia. Its geographical coordinate range fron 38º 19' 30" to 38º 29´ 30" E latitude and 8º 0´ 0" to 8º 8´ 0" N longitude. Shares boarder with South Sodo woreda in the North, Mareko woreda, in the East, Silte zone, in the South and MeskanWoreda in the West. Enseno town, is the District 's administrative capital , is 147.5 kilometers to the south of Addis Ababa.

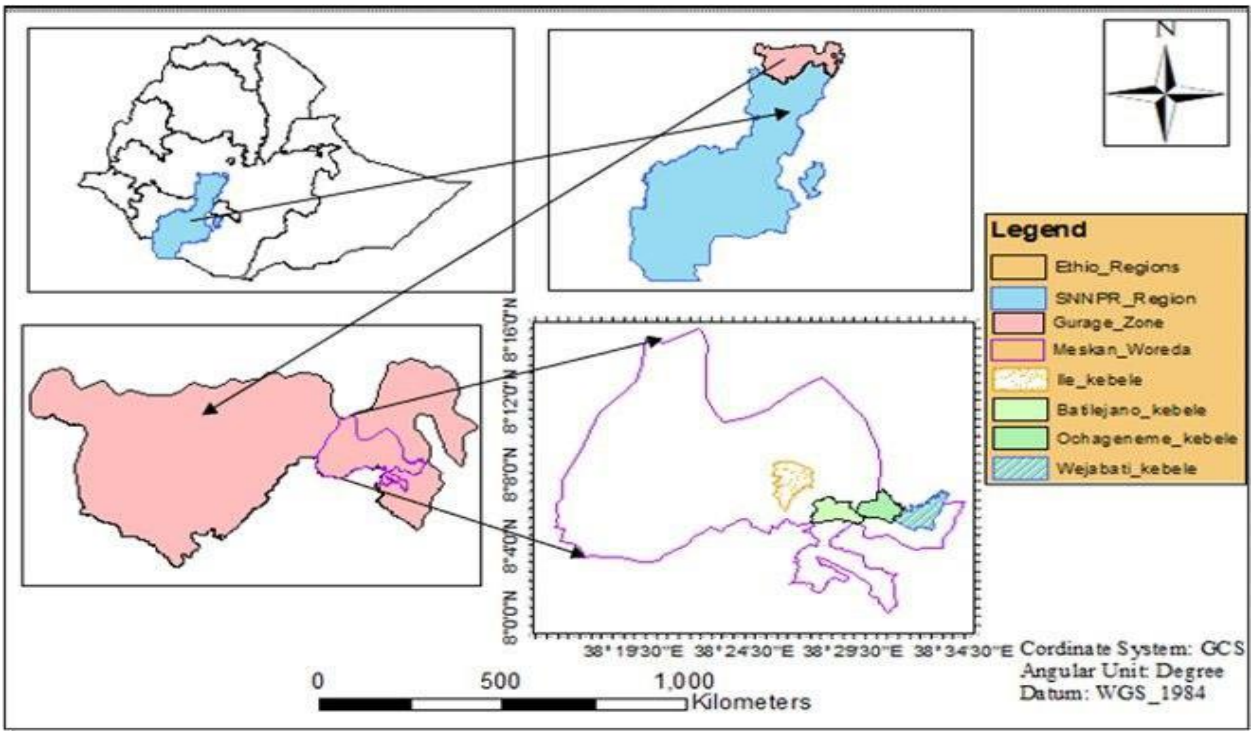


***Figure** 1 Map of the study area (Source, CSA data, 2007)*

3.1.2 The climate

Woinadega (moderate temperature), Dega (cold), Wurch (extremely cold), Kolla (semi-desert), and Bereha (desert) are Ethiopia's five climate zones; around 70% of the woreda is under Kolla, and Woinadega climates, which are 1000–1400 meters above sea level, are found in the remaining 30%. The average annual temperature ranges from 18°C to 26°C, while the mean annual rainfall falls between 801 mm and 1200 mm (Misrak Meskan Woreda Finance and Economic Development Department , 2015).

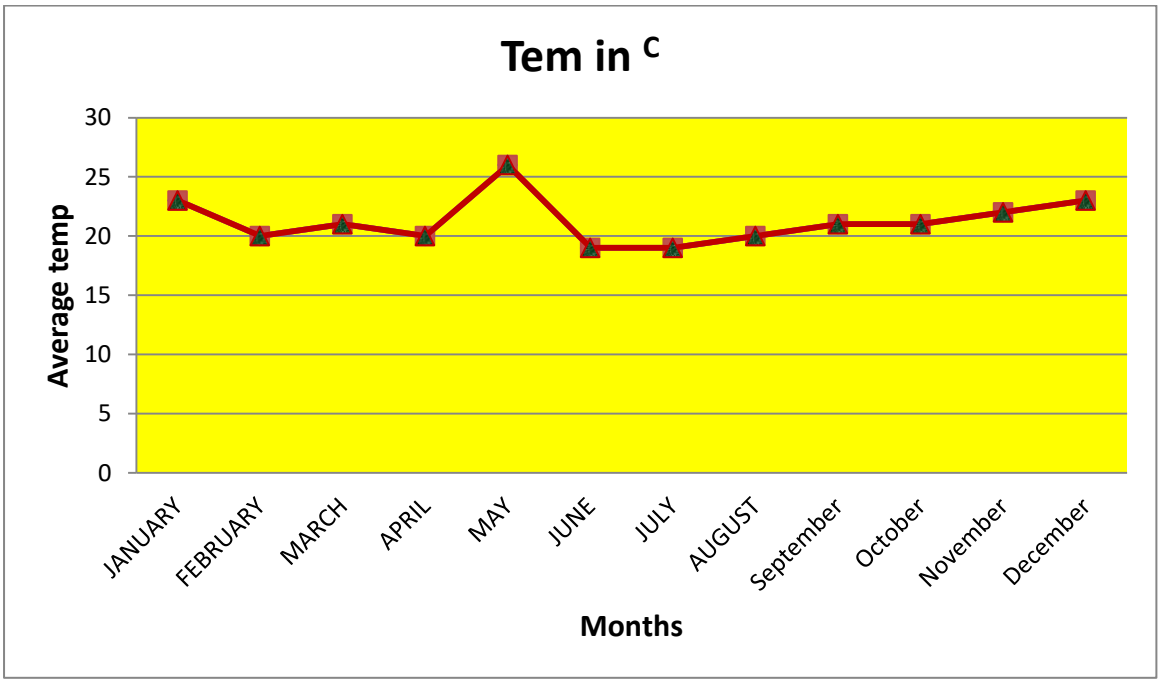


Figure 2 Three Year (2014 to 2016) average monthly temperature of study area

(**Source,** Misrak Meskan Woreda Agricultural and Extension Office,2016).

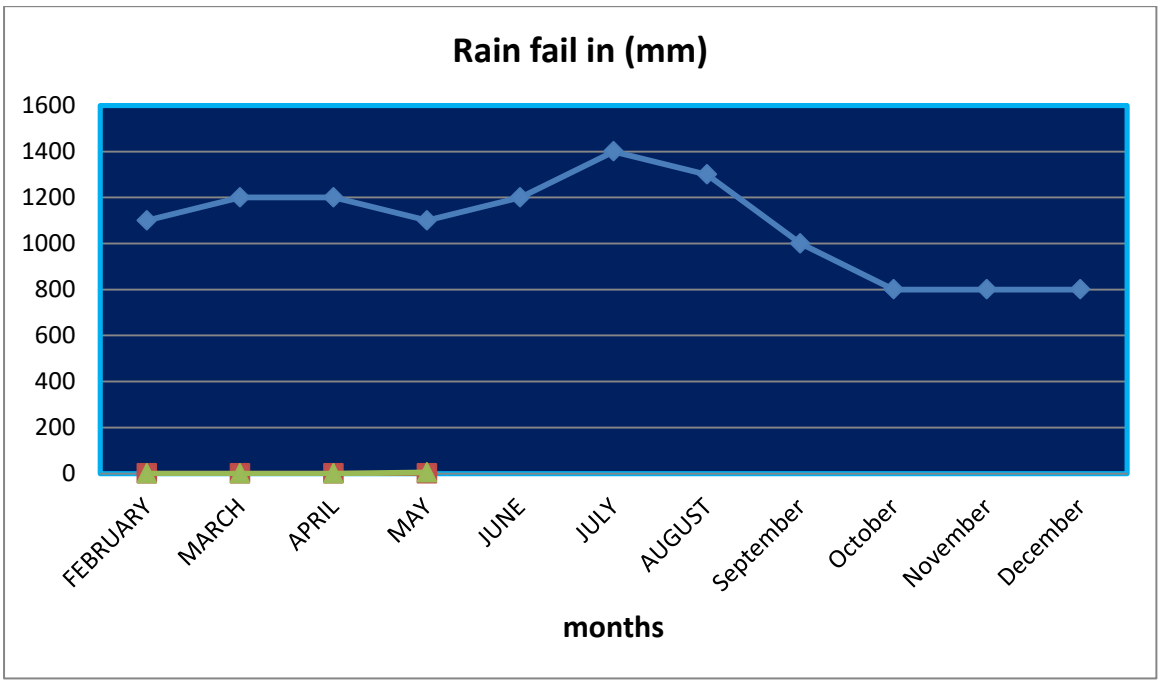


Figure 3: Three Year (2014 to 2016) average monthly rain fail of study area

(Source, Misrak Meskan Woreda Agricultural and Extension Office,2016).

3.1.3 Population

According to demographic data, Misrak Meskan District has 17 Kebeles and 74,628 residents, of which 37,621 are men and 37,007 are women (Misrak Meskan Woreda plan and Economic Development Office , 2015).

3.1.4 Vegetation type of the study area

Although there were sporadic natural forests across the woreda, human activity is occasionally causing these forests to disappear. Only 10% of the woreda's land area is now covered by forests. At the moment, *Fiaderbia albida, Cordia africana,Acacia abyssinica,Balantites aegyptiaca and* are among the common trees in the study region (Misrak Meskan Woreda Agricultural and Extension Office,2016).

3.1.5 Income source

Mixed agriculture, or the production of crops and cattle, is the primary source of income for the people of the Woreda.It is distinguished by the production of livestock linked to tree species on farms and the combined farming of rain-fed crops. According to their relative importance, the most widely grown crops in the research locations are maize (*Zea mays)* chat (*Catha edulis*), teff (*Eragrostis tef*), mashela (*Sorghum bicolor*), red pepper and wheat. Corn is the main food crop for most of the people, while chat (Catha edulis) is the dominant cash Crop.Fruits such as avocado (Persea americana), mango (Mengefra indica), papaya (Carica papaya), are also planted for home consumption to some extent money generation (Misrak Meskan Woreda Agricultural and Extension Office,2016).

3.2 Research Design

The researcher used descriptive research method was used because descriptive method used to describe research was qualitative and quantitative approaches and also used community-based cross sectional descriptive survey design,which is effective for understanding existing situation and collecting data on many variables.Descriptive statistically,questionnaire, collecting and recording. The analyzed data was be used to summarize and make the collected data simple to understand particular problem.

3.3 Method of sampling and sample size

The researcher used various sampling techniques to collect primary data.In the first phase , four kebeles (Elle , Bati lejano , Ocha genemea and Weja bati) were purposively selected from 17 kebeles in the Misrak Meskan districts, Based on the prevalence of agroforestery practices. In the subsequent stage the total sample size of 400 households was drawn from these four kebeles. The sample size was determined by using formula following Yamane (1967) ensuring 95% confidence level and 5% marginal of error (alpha=0.05).

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

n = N/ 1+ N (e2), Where: -

n=Samplesize

N=Totalsizeofhouseholds,and

e = acceptance level of error.

n = 2911/1+ 2911 (0.0025)

= 2911/ 7.28

= 400

Consequently, n = 400 is the smallest number of household members needed to produce accurate findings.

Lastly, In order to select sample members from four kebele households, the researcher used the proportional allocation approach. Simple random sampling was used to choose these sample members for data collection.Simple random sampling was used to choose these sample members for data collection.

n = 400

n1 (Elle) = n*N1/N = 400*737 /2911 =101

n 2 (Bati lejano) = 400*786 /2911 =108

n 3 (Ocha genemea) = 400*786 /2911 =108

n 4 (Weja bati) = 400*602 /2911 =83

Table 1: Sample households

No	Kebeles	Number of households			Sample of number
		M	F	T	
1	Elle	601	136	737	101
2	Bati lejano	662	124	786	108
3	Ocha genemea	560	226	786	108
4	Weja bati	410	192	602	83
	Total	2233	678	2911	400

3.4 Methods

3.4.1 Study design

For examiming the Contribution of Woody Species in Agroforestery And Community Management Practice

1.Recording and measureremet :- All woody species was documented. A diameter tape was used to measure the diameters at breast height (DBH) for all woody species that were ≥5 cm.

2.Transect Lines:-Tree transect lines was be aligned at 200m interval in every chosen kebele. On every transect,Four quadrats were placed at 100-meter intervals along each transect. The initial plot and the first transect line were chosen at random.

3.Quadrat Size:- Each quadrats was 40m × 40m (1600 m^2). A total of 60 quadrats, was laid out.This design help ensure a comprehensive and systematic sampling of tree and shurb in the agroforestry system.

3.4.2 Gathering socioeconomic data

Both primary and secondary data sources were employed for the socioeconomic analysis.

primary data collection /main gathering of data/ In each chosen kebele, a survey of households was done using standardized open-ended and closed-ended questionnaires. The questionnaires included data on a range of socioeconomic parameters, including age, family size, educational attainment, and management concerns for woody species.

secondary data collection:- This data was sourced from the disttiict's administration Office and Agricultural development Office.These sources provided additional context and background information to complement the primary data.A thorough grasp of the socioeconomic circumstances and management techniques within the studied area is guaranteed by this method.

Both primary and secondary data sources were employed for the socioeconomic analysis. In each chosen kebele, formal open-ended and closed-ended questionnaires were used to obtain primary data from the sample houses.The administrative office and agricultural development office of Woreda served as the secondary data source.Family size, age, educational status, and others were gathered by questionnaires.Thus, standardized open-ended and closed-ended questionnaires were used to gather data pertaining to woody species management issues.

1. **The Important Value Index (IVI)**

The importance value index (IVI) indicates the importance of species on farmland, and it was calculated with three components according to Kent and Coker, (1992) as follows:

$$\text{Relative abundance (\%)} = \frac{\text{Number of individuals of species}}{\text{Total Number of individuals}} * 100$$

$$\text{Relative dominance (\%)} = \frac{\text{Dominance of a species}}{\text{Total dominance of all species}} * 100$$

$$\text{Relative frequency (\%)} = \frac{\text{Frequency of a species}}{\text{Total frequency of all species}} * 100$$

Relative abundance, relative dominance, and relative frequency added up to each woody species' importance value.Woody species' significance was assessed using an estimated important value measure (Jose et al., 1994).

$$\text{Frequency of Species} = \frac{\text{the number of plots in which that species is occur}}{\text{Total number of plots}}$$

$$\text{Relative frequency} = \frac{\text{Frequency of species A}}{\text{Total frequency of all species}} * 100$$

2. **The Density**

When analyzing data, the density of woody species is one of the most crucial structural criteria to take into account.The density of a species reflects the numerical strength of species in each community (Dissanayake and Hettiarachchi,2013).

Density was measured by adding up all stems across all sample plots and translated to hectare basis.

$$\text{Density} = \frac{\text{Total Number of individuals}}{\text{Samles area in heactare (ha)}}$$

$$\text{Relative abundance} = \frac{\text{Number of individuals of species}}{\text{Total Number of individuals}} * 100$$

$$\text{Relative Density} = \frac{\text{Individual number of a species}}{\text{Individual number of all species}} * 100$$

3. The base area

Basal area was the other crucial structural component.At breast height, it is the cross-sectional area of tree stems. It gauges a species' relative dominance, which is the extent of its covering as a reflection of the area it occupy (Suratman, 2012). It was computed in this way:

$$AB = \frac{\pi * DBH^2}{4}$$

Where,BA=basalarea(m^2)

DBH= diameter at breast height (m).

Π =3.14

3. Data analysis

In order to use the proper descriptive statistical analysis, the field data gathered from farm plots was edited and presented quantitatively. Simple quantitative analysis methods were used, including frequency and percentage distributions.Simple mathematical computations and data entry were done with Excel 2007.In order to analyze and meaningfully understand the results and draw inferences and consequences, the results were finally summarized in a table format.Verbal open-ended questionnaires were used to gather qualitative data, which was then divided into more manageable themes, statistically interpreted, and summarized and told through physical observation.

CHAPTER FOUR

4. RESULTS AND DISCUSSIONS

Results

Socioeconomic status of the Respondent

This study presents the socioeconomic characterized the surveyed househlds (Table 2).The respondents average age was 45, with ages being between the ages of 24 and 72.The households sampled consisted of 54% males- headed and 46% females- headed households. The majorty of the respondents were Muslim (78.5%) followed by Orthodox 12.75% and Protestant (8.75%. Regarding educational level, 30% had No formal education (illiterate),21.75% could read and write,27.5% completed primary 1st cycle (grade 1-4), 13.5% had completed primary 2nd cycle (grade 5-8), and 7% secondary education (grade 9-12). In the field of study , about 71.5% of the household family siz fell with in the range of 5–10, 16% were inside the range of 1-4, and 11.75%, and had more than 10 members.

94% of the households were primarily employed in agriculture, with only 6% engaging in other unofficial sources of revenue. 28% of households fell into the poor wealth category, 52.25% into the medium wealth category, and 19.75% into the rich wealth category. Most households (98.25%) had been in the study area for more than 15 years, while the remainder households (1.75%) had been there for 11–15 years.Consequently, a greater percentage of the household heads sampled at the study location were local residents.Nearly every household in the research area was allowed to use the tree species that were on their farmland, but some did so without authorization, which may have an impact on the diversity of tree species.

Table 2: Socioeconomic status of the Respondent

Items	**Variables**	**Responses**	
		Number	Percent
Sex	Male	215	54%
	Female	185	46%
	Total	**400**	100%
Age	< 30 Years	36	9%
	31 -40 Years	148	37%
	41 – 50 Years	163	41%
	>50 Years	53	13%
	Total	400	100%
Education level	No formal education	121	30.25%
	read and write	87	21.75%
	Grade 1-4	110	27.5.%
	Grade 5- 8	54	13.50%
	Grade 9 – 12	28	7%
	Total	400	100%
Religion	Orthodox	51	12.75%
	Muslim	314	78.50%
	Catholic	-	-
	Protestant	35	8.75
Marital status	Total	400	100%
	Single	-	-
	Married	341	85.25%
	Divorced	21	5.25%
	Widow /Widower	38	9.50%
	Total	400	100%
No. of years lived in	11-15 years	7	1.75%
	> 15 years	393	98.25%
	Total	400	
Family size	1-4 persons	67	16.75%
	5-10 persons	286	71.50%
	>10 persons	47	11.75
		400	100
wealth status	poor,	112	28%
	Medium	209	52.25%
	Rich	79	19.75%
	Total	400	100%
Occupation	Agriculture	376	94%
	Agriculture and other	24	6%
	Total	400	100%

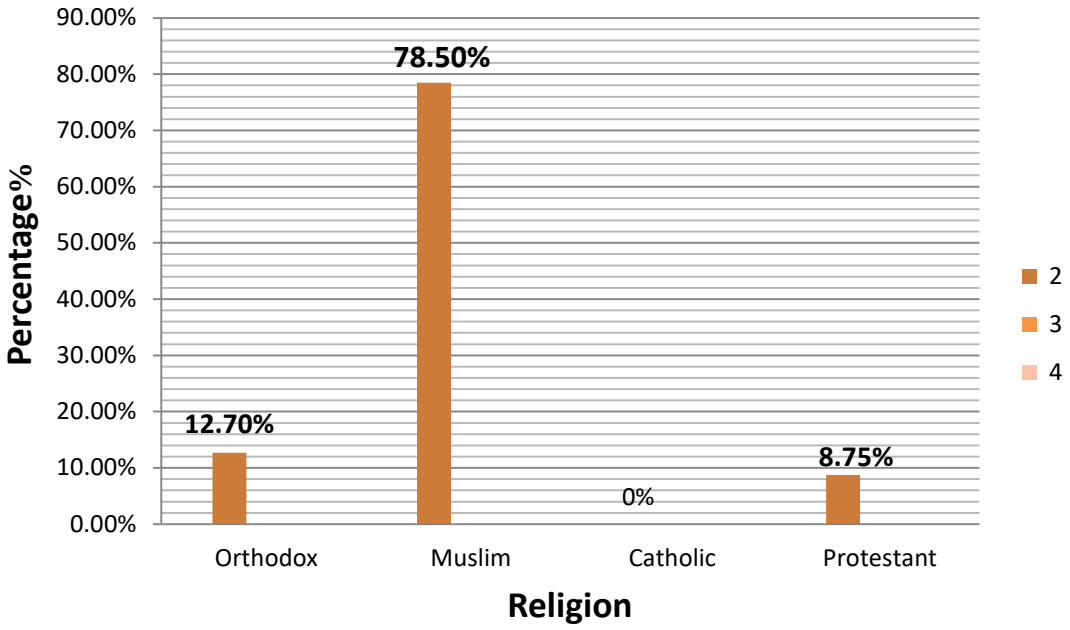


Figure 4 Respondents religion.

Woody species' applications on farms

The study found that many woody species were used for a variety of purposes on the study sites' farms. (Table 3).The primary uses of these farmland woody species includ, firewood (45.25%), construction material (27.5%), timber (11%), shade (39%), cash generation (4.25%) soil fertility improvement (2.25%), amongothers.Nearly every farmed woody plant that has been identified has dual uses *Grewia ferruginea, Moringa stenopetala* and *Croton macrostachyus* were the most important tree species; they offer farmers in the study area a number of advantages.Comparing these trees to other woody species at the study sites, their multiple functions allowed for their identification.

This result is consistent with Kindeya Gebrehiwot's (2004) findings that woody species can prevent wind erosion and supply fuel wood, charcoal, shade, building materials, agricultural tools, and animal feed.Additionally, according to Biruk Lulseged (2006), farmers in South East Langano, Ethiopia, kept trees and shrubs on their properties for a variety of socioeconomic uses, such as fuel wood, fodder, medicinal goods, and shade and shelter and Tamirat Egiso (2016) listed the most significant tree species that provide farmers in Gombora Woreda, Hadiya Zone, Ethiopia with a variety of uses.

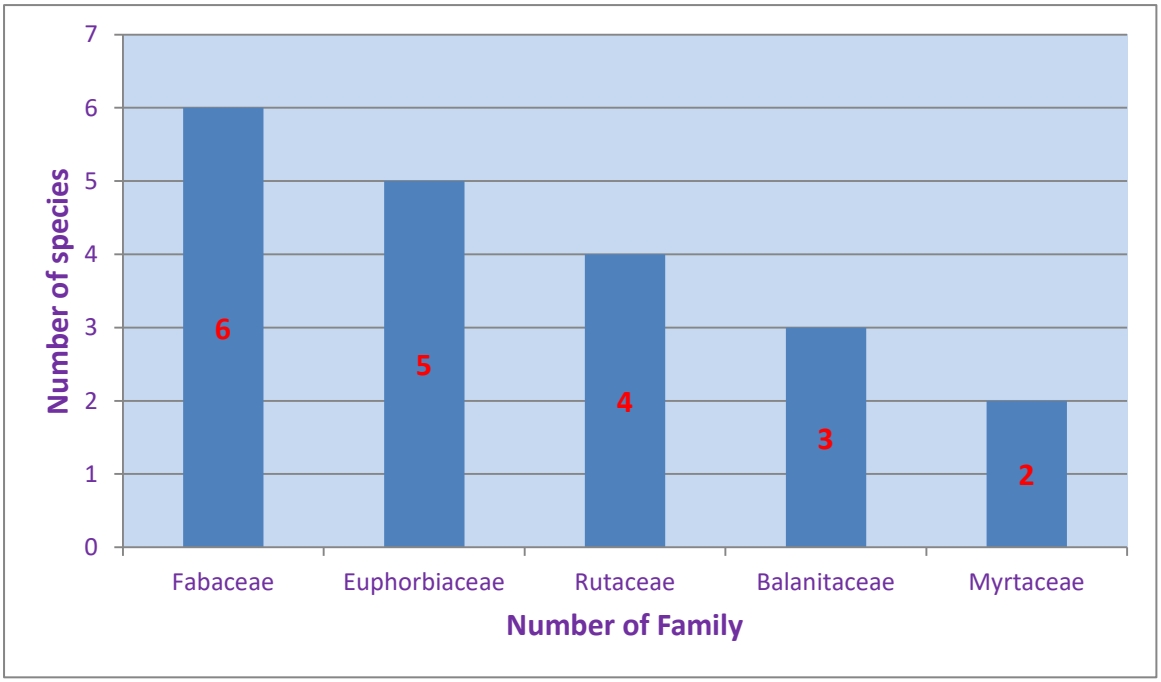


Figure *5* The most dominat family and number of species.

Table 3 uses Farmland Woody Species.

No	Major Use	respondents	Percent (%)
1	Firewood	181	45.25%
2	construction material	110	27.5%
3	Timber	44	11%
4	Shade	39	9.75%
5	cash generation	17	4.25%
6	soil fertility improvement	9	2.25%

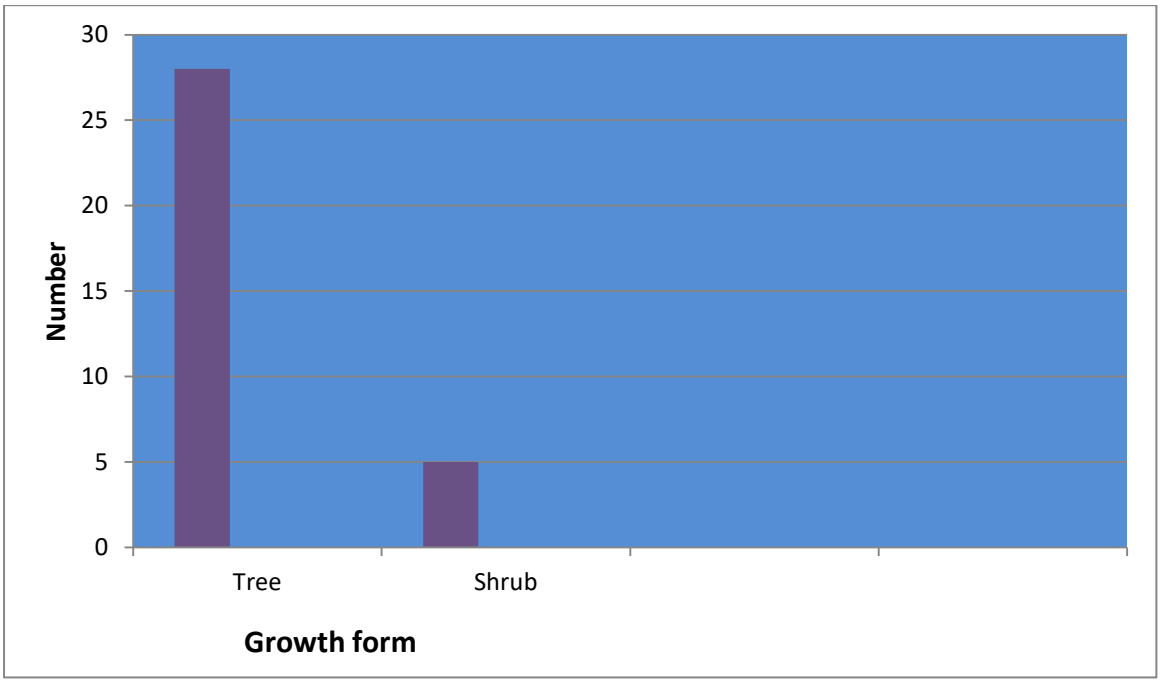


Figure *6* The gowth form woody species in study area

Woody Species Methods of Management

Coppicing and lopping were the two most often practiced management practices in the study area. oppicing was one of the woody species management techniques employed by respondents at all research sites (Figure 10).

This method was employed by farmers to harvest tree species for fuel wood, building materials, lumber, and, in limited quantities, tree regeneration.Most respondents engaged in coppicing for *Cordia africana* and *Eucalyptus camaldulensis* that were planted on their farms and by the side of the road, respectively.







Figure 7 Coppicing Tree.

Lopping was the other most crucial management technique. *Fiaderbia albida, Acacia abyssinica, Balanites aegyptiaca, and Olea Africana* were the trees under this practice's management (Figure 11) This technique was employed by farmers for growth, regeneration, fuel wood, fencing, and shade reduction.The current research supports the findings of Workneh Alemayehu (2002) and Tamirat Egiso (2016), who discovered that farmers frequently prune trees on croplands to lessen competition and to gather fuel wood for construction.



Figure 8 **Lopping Tree**

Socioeconomic Aspects of Woody Species Management

According to the current findings of the socioeconomic factor study, the most significant factors influencing the management practices of woody species on farmland were farm size, household wealth, and educational attainment. As household farmland size rose, so did the management of woody species. More species are planted or maintained on farms by farmers with bigger land sizes than by those with smaller land sizes.

Small-scale landowner farmers stated that although they would like to plant or keep trees, they do not have extra acreage to do so because a large portion of their land was already set aside for growing crops to support their families.The other significant element influencing the management of woody species on farmland was wealth level. The species variety on farmland was properly handled by a sample home that had enough necessities. However, because they cut trees to get money in order to exist, farmers with lower socioeconomic position did not manage trees.

Educational attainment was the other socioeconomic component that affected the management of woody species on agriculture in the research sites.Because they understand the benefits of managing woody plants, literate farmers handle them more effectively than illiterate ones. This study demonstrated that

the primary cause of the failure to manage woody plants on farmland was also illiteracy. Due to ignorance, uneducated farmers believed that this approach was detrimental to their crops.

Andenet Hailu ,(2021) supports the current work. One of the factors contributing to the low productivity of agroforestry techniques is education level, which also acts as a catalyst for pressure on the efficacy of these methods.

Woody species' frequency on farms

The frequency of woody species occurrence on farmland was noted in the research region. Among the most common woody species were *Fiaderbia albida*, *Eucalyptus camaldulensis*, Acacia abyssinica., *Balanites aegyptiaca*, and *Cordia Africana* Conversely, the least common woody species were *Acacia senegal* and *Acacia seyal*. On the farms in the study areas, the woody species' frequencies varied. In comparison to other locations, the frequency of presence of certain species was quite low.His could be because tree species are endangered because of human overexploitation and slower rates of regeneration than other woody species.

Nonetheless, *Eucalyptus camaldulensis* was the second most common woody species, after Fiaderbia *albida.* On the other hand, several species, such as *Acacia seyal*, and *Acacia senegal*, were the least common woody species in the research areas.This woody species was cut down for the extension of agricultural land since the local people did not want to keep it.

Table 4: Woody Species Frequency

No	Scientific name	Frequency
1	*Fiaderbia albida*	234
2	*Eucalyptus camaldulensis*	151
3	*Vachellia abyssinica*	144
4	*Balanites aegyptiaca*	105
5	*Cordia Africana*	88
6	*Grevillea robusta*	80
7	*Croton macrostachyus*	77
8	*Grewia ferruginea*	64
9	*Coffea Arabica*	61
10	*Catha edulis*	54
11	*Euphorbia tirucalli*	51
12	*Mangifera indica*	48
13	*Persea americana*	40
14	*Citrus sinensis*	37
15	*Dovyalis abyssinica*	31
16	*Psidium guajava L.*	28
17	*Annona cherimola*	24
18	*Citrus aurantium*	19
19	*Citrus aurantifolia*	18
20	*Entada abyssinica*	13
21	*Euphorbia ampliphylla*	11
22	*Acacia oerfota (*	11
23	*Olea Africana*	9
24	*Ricinus communis*	9
25	*Schinus molle*	8
26	*Justicia schimperiana*	7
27	*Ficus vasta*	6
28	*Sesbania sesban*	5
29	*Opuntia cylindrica*	4
30	*Casimiroa edullis*	3
31	*Moringa stenopetala*	2
32	*Vachellia senegal*	2
33	*Vachellia seyal*	1
		1445

.

Density

The density of woody species found on the farmland in the research region was noted. The top five woody species densities throughout the evaluated agricultural sites are displayed.With 234 individuals and the highest density (24.37), *Fiaderbia albida* emerged as the most prevalent species, followed by *Eucalyptus camaldulensis*, which had 151 individuals overall and a density of 16.04 ,*Acacia abyssinica* (15). *Balanites aegyptiaca.10.39 Cordia Africana and* 9.16. These species made up 50.2% of the research area's overall woody species density. 28 woody species that remained covered 49.8% of the total density. The Fifteen species that were documented in the research areas made up less than 1% of the total density.

***Table 5:*Woody Species Density**

N	Scientific name	Freque	Density	Number of individual
1	*Fiaderbia albida*	85%	24.37	234
2	*Eucalyptus camaldulensis*	80%	16.04	151
3	*Acacia abyssinica Hochst*	76%	15	144
4	*Balanites aegyptiaca*	68.33%	10.93	105
5	*Cordia Africana Lam*	65%	9.16	88
6	*Grevillea robusta*	63.33%	8.33	80
7	*Croton macrostachyus*	61.66%	8.02	77
8	*Grewia ferruginea*	58.33%	6.66	64
9	*Coffea Arabica L.*	56.66	6.35	61
10	*Catha edulis*	55%	5.62	54
11	*Euphorbia tirucalli*	50%	5.31	51
12	*Mangifera indica*	50.	5	48
13	*Persea americana*	48.33	4.16	40
14	*Citrus sinensis*	46.66	3.85	37
15	*Dovyalis abyssinica*	46.33	3.22	31
16	*Psidium guajava*	41.66%	2.91	28
17	*Annona cherimola .*	36.66	2.5	24
18	*Citrus aurantium*	31.66	1.97	19
19	*Citrus aurantifolia*	31.66	1.87	18
20	*Entada abyssinica*	25%	1.35	13
21	*Euphorbia ampliphylla*	25	1.14	11
22	*Acacia oerfota*	21%	1.14	11
23	*Olea Africana*	16.66%	0.93	9
24	*Ricinus communis*	13.33	0.93	9
25	*Schinus molle*	10%	0.81	8
26	*Justicia schimperiana*	10%	0.72	7
27	*Ficus vasta*	10%	0.62	6
28	*Sesbania sesban*	5%	0.52	5
29	*Opuntia cylindrica*	5%	0.41	4
30	*Casimiroa edullis*	1.66%	0.31	3
31	*Moringa stenopetala*	1.66%	0.20	2
32	*Acacia senegal*	1.66%	0.20	2
33	*Acacia seyal*	1.66%	0.10	1
			149.5	

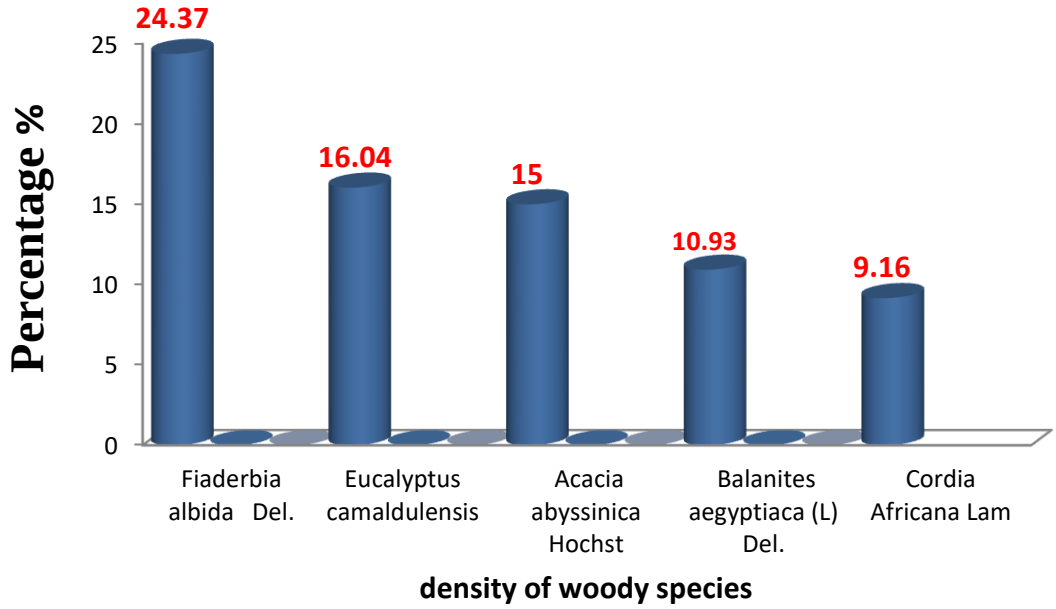


Figure 9 **Density of top five woody species in the study sites**

Key woody species value index on the research site

The The woody species' Important Value Index (IVI) helps assess the significance of species in the research region and shows the importance of specific species at the farm level. The species with the highest IVI values in the study area are *Fiaderbia albida* (50.70), *Eucalyptus camaldulensis* (38.30), *Acacia abyssinica* (37.90), *Balanites aegyptiaca* ((19.50) and *Cordia Africana* (19.00), *Grevillea robusta* (18.24), *Croton macrostachyus Del* (17.00), *Grewia ferruginea* (15.15), *Coffea Arabica L*(15.00), and *Catha edulis* (13.85).Of the woody species in the research area, these species made up 244.64 of the overall IVI value. The remaining 23 woody species covered roughly 144.96 of the total IVI.The two least significant tree species were *Acacia senegal* and *Acacia seyal* . The significance value index (IVI) result for this study showed that the most significant tree species were those with higher frequency or occurrences in the studied sites and uses. With an IVI of 50.70, *Fiaderbia albida* had the highest important value index.Because *Fiaderbia albida* trees serve a variety of services, including fuelwood, shade, tumber, and fence, they are the most significant trees in research locations for farmers.Another significant tree on the farms in the study areas is Cordia africana. *Cordia Africana* is a high-quality, long-lasting wood that is used to make doors, furniture, beehives, farm equipment, and other popular tree species.

In addition, it is utilized for fencing, soil fertility, shade, and fuel wood. One of the native tree species that grows quickly is *Cordia africana*.

Tesfaye Molla et al., (2023) concur with the existing findings, The distributed *Fiaderbia albida and Cordia africana* trees are crucial for restoring soil fertility, especially in the research area where low soil fertility was the primary obstacle to agricultural production, according to the study's findings (Musa Abdella and Lisanework Nigatu, 2021).A species' ecological success in a given area is shown by the IVI, which also gauges the species' overall significance. Species with high IVI values require less conservation work, whereas those with low IVI values are more endangered and require immediate conservation. The IVI values can also be used to select species for conservation.

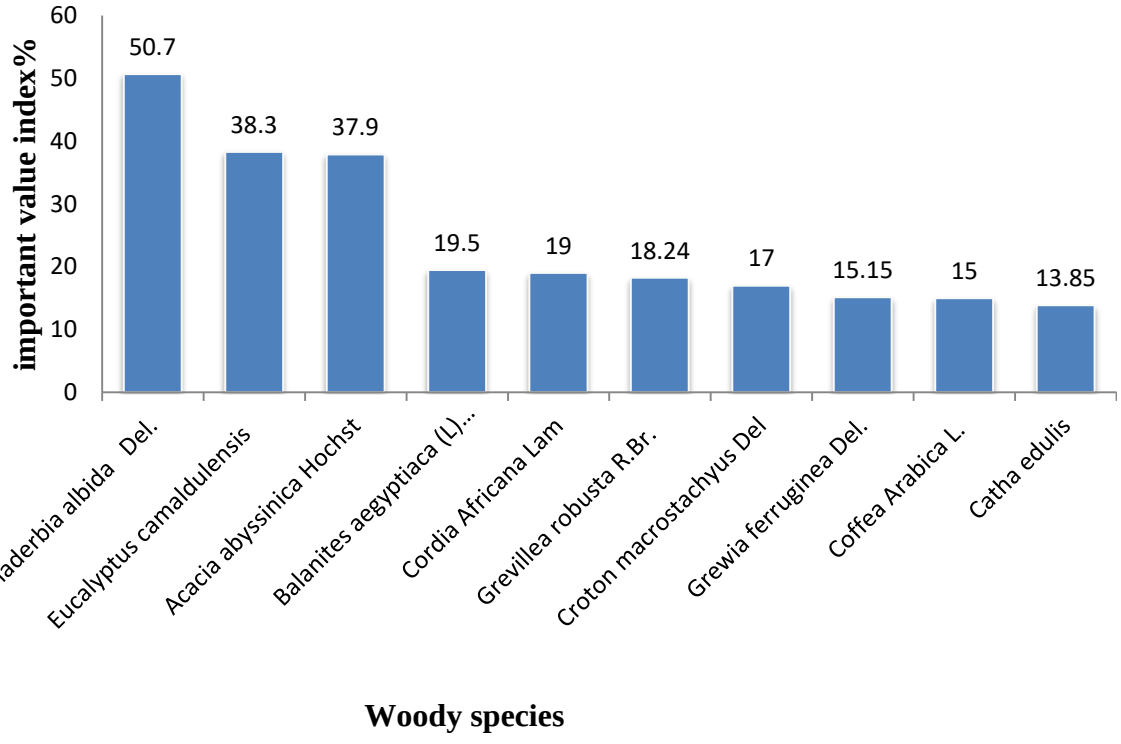


Figure 10 Among the farms that were evaluated, woody species with the highest IVI values

Basal area of woody species

The cross-sectional area of a tree at breast height is known as its basal area (BA), and it is measured in square meters per hectare.Diameter was used to measure it, often at breast height (DBH), which is 1.3 meters above the ground.The basal area of woody species with the top ten values throughout the evaluated farm locations Appendix 4 shows.Fiaderbia albida Del. has the largest basal area (35.72%), followed by Eucalyptus camaldulensis (19.21%), Acacia abyssinica Hochst (5.92%), Balanites aegyptiaca (L) Del. (5.57%), Cordia Africana Lam (7.40%), Grevillea robusta R.Br (3.12%), Croton macrostachyus Del (1.99%), Grewia ferruginea Del. (1.32%), Coffea Arabica L (0.37%), and Catha edulis, which make up 0.72% of the total basal area on the farm site.In the research area, these species made up 81.39% of the total basal area of woody species. The remaining twenty-three woody species covered around 18.61 percent of the total basal area.

4.2 DISCUSSION

According to the study's findings, baseline data on the frequency, important value index, density, and basal area of woody species on farmlands was provided by the woody species inventory.The majority of respondents agreed that woody species on agro-forestry practices benefited both them and others, according to the results of the study on the benefits of woody species on agro-forestry to the local community in the study area.The research area's farmland woody species offer advantages in terms of both goods and services.Fuel wood contributed the most to these advantages, with timber reasons coming in second.The most significant woody species that serve various community functions are *Fiaderbia albida, Eucalyptus camaldulensis, Acacia abyssinica, Balanites aegyptiaca, Cordia Africana,* and others with the highest IVI values. *Eucalyptus camaldulensis*, is used by farmers in the research area for fencing, building, and fuel wood.They include this plant in their grazing land and boundaries because of its quick growth and significant economic possibilities.Additionally, Cordia africana was used to produce fuel wood, fodder, improve soil fertility, and provide shade for both humans and animals.

As stated by Mesele Negash and Abayneh Legesse (2021) the species' IVI levels indicate how important they are for different purposes in the farm home. Additionally, the primary causes of the variation in the importance of the woody species in the study area may have been farmers' awareness of the relative benefits of various woody species, such as the ability to provide balanced shade for crops and understory vegetation, the quick rate at which leaf litter decomposes to improve soil fertility and additional values (cash and fodder), and the species' capacity for rapid growth (Mulugeta Lemenih et al., 2008). Additionally, Verma et al. (2016). According to the study's findings, *Eucalyptus* species and *Cordia africana* had the greatest important value index in India's agroforestry practices.

In the study region, lopping and coppicing are two often observed management techniques. Coppicing was one of the woody species management techniques employed by respondents at all research locations.

This method was employed by farmers to harvest tree species for fuel wood, building materials, lumber, and, in limited quantities, tree regeneration. Lopping was the other most crucial management technique. This method was used to handle the following trees: *Olea Africana, Acacia abyssinica, Fiaderbia albida, and Balanites aegyptiaca.*

33 plant species in all, representing 20 families, were identified in the study region.The Euphorbiaceae had four species, whereas the Fabaceae had six, making up the largest group of total plant species.In the study area, the main families have been Fabaceae and Euphorbiaceae. Similar to the findings of this

study, other writers have reported that the Fabaceae and Euphorbiaceae are prominent families (Tesfaye Molla., et al 2023). Woody species diversity in traditional agroforestry methods in South-Central Ethiopia's Wondo District.(Zerihun Kebebew et al., 2019). Int. J. Biodivers. Conserv., Woody species assessment in agroforestry systems in Jimma Town, Southwestern Ethiopia.The Fabaceae and Euphorbaceae families are the second and third largest families in Ethiopian and Eritrean vascular plants, respectively, which may account for the highest representation of species from these families (Belachew Bogale et al., 2020).This may also be related to its high ability to adapt to the various ecologies of the country, as well as its capacities and efficient dissemination strategies (Abiyot Berhanu et al., 2016).

CHAPTER FIVE

5. CONCLUSSION AND RECOMMENDATION

5.1 CONCLUSION

According to the data, there were 33 woody species, with the Fabaceae family accounting for six of them and the Euphorbiaceae family for four.In the research region, farmland woody species offer both product and service benefits (for improving livelihood).The most significant woody species, including Fiaderbia albida, Eucalyptus camaldulensis, Acacia abyssinica, Balanites aegyptiaca, and Cordia Africana, among others, serve a variety of functions for the community.Additionally, agroforestry techniques have helped to preserve woody species. By offering rural populations a variety of goods and uses, it may help lessen the overexploitation of species in natural forests and protected regions.The most significant socioeconomic determinants influencing woody species management techniques on agriculture in the study locations were farm size, household wealth, and educational attainment.Thus, this study's findings suggest that farmers use traditional local methods to control the wood species on their farms, but extension has not adequately supported these methods to address the issue.

5.2 RECOMMENDATIONS

Based on the research area's findings, the following suggestions were made to guarantee proper management and sustainable use of the woody species resources:

- More research on soil properties should be done; the current study was restricted to the function and management strategies of woody species in Misrak Meskan Distrct
- By planting seedlings that are appropriate for the local agro-ecology and socioeconomic circumstances, the study suggests that the current woody plant species be preserved and become more diverse than they are now.
- The entire community should be made sufficiently aware of the need to use this woody species resource wisely in order to prevent the extinction of some multipurpose woody species in the area.
- The impact of weedy species on crop productivity is not adequately documented Studying the impact of dominant woody species on crop productivity is crucial
- The study suggests using seedlings to preserve the current woody species rather than letting them deteriorate.

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7 APPENDICES

WOLKITE UNIVERSITY

COLLEGE OF NATURAL AND COMPUTATIONAL

SCIENCE DEPARTMENT OF BIOLOGY

Questionnaires
Introduction

Dear respondents.

The questionnaires are developed by a post graduate student in wolkite University for partial fulfillment of the award of M.Sc. Degree in Biology. The purpose of these questionnaires is to collect data for the study entitled with The Role of woody species on Agroforestery and management practice of the community in Misrak Meskan District, Gurage zone Ethiopia. Your answers will be used only for research purpose. So, I am kindly requesting you to give your genuine responses.

Thank you in advance.

General instruction

 Don't write your name.

 Put 'X' mark on the space provided for close ended and write your suggestions for open ended questions in the space provided.

Part I –: Socio-Economic characteristics of respondents

1.1 Name of kebele …….

1.2 Sex: Male □ Female □

1.3 Age: Less than 30 years □ 31-40 years □ 41-50 years □ Above 51 years □

1.4 Marital status: Single □ Married □ Divorced □ Widow/ Widower □

1.5 Educational background: No formal education □ Adult education □ Grade 1-4

Grade 5-8 □ Grade 9-12 □ Certificate □ Diploma and Above □

1.6 Religion: Muslim □ Orthodox □ Protestant □ Catholic □ If any Others, please specify_____

1.7 How long have you lived in this kebele? Less than 5 years □ 5-10 years □ 11-15 years □ Above 15 □

1.8 Family size: Less than 5 people □ 5-10 people□ > 10 people □

1.**Demographic Information**

What is your age----------

What is your level of education----------

How many years have you been involved in agroforestry in Misrak Meskan District----------

2.Knowledge and Perception about Woody Species

Can you name some woody species that you know and used in agroforestry in your area?

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How would you rate your knowledge about the role of these woody species in agroforestry?

What are the benefit of these woody species in agroforestry , in your opinion----------

3.Role of woody Species in agroforestry

What types of woody species do you use in your agroforestry practices----------

How do these woody species contribute to your agroforestry system----------

Have you notice any change in your agroforestry system after incorporating these woody species---------

4. Community Management Practices

What are the common practices in your community for managing for these woody species in agroforestry----------

How effective do you think these practices are----------

Are there effective do you think these practices are----------

Are there any practices that you think could be improved or changed----------

5. Challenge and Opportunities

What challenges have you faced in integrating these woody species in to your agroforestry system----------

What Opportunities do you see for the future use of these woody species in agroforestry in the area----------

6. Species Selection

Which of the following woody species do you use in your agroforestry practices?

A/ *Fiaderbia albida B/ Eucalyptus camaldulens*C/ Acacia abyssinica D/ Acacia seyal

What factors influence your choice of woody species?

A/soil type B/ Market demand C/climate

7.Benefits of Woody Species

How would you rate the impact of these woody species for soil fertility?

A/ No impact B/ High impact C / Medium impact D/low impact

How would you rate the impact of these woody species for crop yield?

A/ No impact B/ High impact C / Medium impact D/low impact

How would you rate the impact of these woody species for Biodiversity?

A/ No impact B/ High impact C / Medium impact D/low impact

How would you rate the impact of these woody species for resilience to climate change?

A/ No impact B/ High impact C / Medium impact D/low impact

8. Management Practices

which of the following management practices do you use for woody species in your agroforestry system.

A/ Pruning B/ Mulching C/intercropping D/ Coppicing

How effective do you find these practices.

A/not effective B/very effective C/ less effective

9. Challenges and Opportunities

What is the biggest challenge you face in managing the woody species in your agroforestry?

A/lack of knowledge B/pest and disease C/ traditional management practice

How significant are this challenge.

A/ less significant B/ significant C/ Not significant D/ very significant

7.1 Appendix 1

Proposed number of sample households of sample Kebeles

No	Kebeles	• No of house holds			No of sample
		M	F	T	
1	Elle	601	136	737	101
2	Bati lejano	662	124	786	108
3	Ocha genemea	560	226	786	108
4	Weja bati	410	192	602	83
	Total	2233	678	2911	400

7.2. Appendix 2 List of woody species recorded in the study site.

No	Local Name	Scientific name	Family Name	plant form	Frequency
1	ገርቢ	*Fiaderbia albida Del.*	Fabaceae	Tree	234
2	ቀይ ባህርዛፍ	*Eucalyptus camaldulensis*	Myrtaceae	Tree	151
3	ባዝራ ግራር	*Acacia abyssinica Hochst*	Fabaceae	Tree	144
4	በደኖ	*Balanites aegyptiaca (L) Del.*	Balanitaceae	Tree	105
5	ዋንዛ	*Cordia Africana Lam*	Boraginaceae	Tree	88
6	ግራቪሊያ	*Grevillea robusta R.Br.*	Proteaceae	Tree	80
7	ብሳና	*Croton macrostachyus Del*	Euphorbiaceae	Shrub	77
8	ጊራዋ	*Grewia ferruginea Del.*	Asteraceae	Tree	64
9	ቡና	*Coffea Arabica L.*	Rubiaceae	Tree	61
10	ጫት	*Catha edulis*	Celastraceae	Tree	54
11	ቅንጭብ	*Euphorbia tirucalli*	Euphorbiaceae	Shurb	51
12	ማንጎ	*Mangifera indica L.*	Anacardiaceae	Tree	48
13	ኣቮካዶ	*Persea americana Mill.*	Lauraceae	Tree	40
14	ብርኪን	*Citrus sinensis (L.) Osb.*	Rutaceae	Tree	37
15	ኮሸም	*Dovyalis abyssinica (Hook.f. and Harva.)*	*Flacourtiaceae*	Shrub	31
16	ዘይቴና	*Psidium guajava L.*	Myrtaceae	Tree	28
17	ጊሽጣ	*Annona cherimola Mill.*	Annonaceae	Shrub	24
18	ኮምጣጤ	*Citrus aurantium L.*	Rutaceae	Tree	19
19	ሎሚ	*Citrus aurantifolia (Christm.)*	Rutaceae	Tree	18
20	ቆንጥር	Acacia brevispica	Leguminosae	Shrub	13
21	ቃልቃል	*Euphorbia ampliphylla Pax*	Euphorbiaceae	Tree	11
22	ቁልቋል	*Opuntia*	Cactaceae	Tree	11
23	ዋይራ	*Olea Africana*	Oleaceae	Tree	9
24	ጉሎ	*Ricinus communis L.*	Euphorbiaceae	Tree	9
25	ትርማንትር	*Schinus molle*	Anacardiaceae	Tree	8
26	ሰንሰል	*Justicia schimperiana*	Acanthaceae	Tree	7
27	ዋርካ	*Ficus vasta Forssk*	Moraceae	Tree	6

28	ሸውሸቄ	*Sesbania sesban (L.) Merr*	Fabaceae	Shrub	5
29	ቃልቃል	*Opuntia cylindrica (Lam.)D.C*	*Cactaceae*	Tree	4
30	ካዝሚር	*Casimiroa edullis La Llave*	Rutaceae	Tree	3
31	ሞሪንጋ	Moringa stenopetala L.	Moringaceae	Tree	3
32	ዶዶቴ	*Acacia senegal*	Fabaceae	Tree	2
33	ዋጮ	*Acacia seyal Del.*	Fabaceae	Tree	1

7.3.Appendix 3

Woody species inventory sheet on sample plots

1. Woody species inventory on sample plots

1.1 Plot number ----------

1.2 Area or data recorded ----------m^2 for woody species on Farm land

1.3 Altitude of the plot in meter ----------

1.4 Total number of woody plants in the plot ----------

No	**Species Name**		**No Per/plot**	**Growth Habit**	**BA**	**height**	**Family Name**
	Local	**Scientific**					

7.4 Appendix 4 Basal area of woody species

N	Scientific name	Basal area (M^2)
1	*Fiaderbia albida Del.*	251
2	*Eucalyptus camaldulensis*	135.3
3	*Acacia abyssinica Hochst*	41.6
4	*Balanites aegyptiaca (L) Del.*	39.2
5	*Cordia Africana Lam*	52
6	*Grevillea robusta R.Br.*	22.2
7	*Croton macrostachyus Del*	14
8	*Grewia ferruginea Del.*	9.3
9	*Coffea Arabica L.*	2.6
10	*Catha edulis*	5.10
11	*Euphorbia tirucalli*	1.75
12	*Mangifera indica L.*	2.1
13	*Persea americana Mill.*	15.8
14	*Citrus sinensis (L.) Osb.*	2.47
15	*Dovyalis abyssinica (Hook.f. and Harva.)*	1.23
16	*Psidium guajava L.*	10.7
17	*Annona cherimola Mill.*	5.08
18	*Citrus aurantium L.*	4.9
19	*Citrus aurantifolia (Christm.)*	11.9
20	*Entada abyssinica*	4.02
21	*Euphorbia ampliphylla Pax*	1.54
22	*Acacia oerfota (A. nubica)*	3.12
23	*Olea Africana*	18.3
24	*Ricinus communis L.*	3.25
25	*Schinus molle*	1.64
26	*Justicia schimperiana*	2.02
27	*Ficus vasta Forssk*	53.7
28	*Sesbania sesban (L.) Merr*	3.1
29	*Opuntia cylindrica (Lam.) D.C*	1.95
30	*Casimiroa edullis La Llave*	4.24
31	*Moringa stenopetala L*	21.5
32	*Acacia senegal*	0.60
33	*Acacia seyal Del.*	0.29
	Total	702.6m^2