HAWASSA UNIVERSITY, SCHOOL OF GRADUATE STUDIES

FACTORS AFFECTING SMALL-SCALE TREE PLANTATION PRACTICES AND THEIR CONTRIBUTION TO THE LIVELYHOOD OF FARMERS IN GUMMER WOREDA, GURAGE ZONE, ETHIOPIA

MSc THESIS

HAYDER BIKA

ADVISOR: YADESSA GONFA

NOVEMBER, 2023

HAWASSA, ETHIOPIA

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A THESIS SUBMITTED TO THE SCHOOL OF GRADUATE STUDIES OF HAWASSA UNIVERSITY IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR MASTER OF SCIENCE DEGREE IN BIOLOGY

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This is to certify that the thesis entitled factors affecting small scale tree plantation practices and their contribution to the livelihood of farmers in Gummer Woreda, Gurage Zone, Ethiopia in partial fulfillment of the requirements for the degree of Master's in Biology, the Graduate Program of the Department/School of biology, and has been carried out by Hayder Bika, under my/our supervision. Therefore I/we recommend that the student has fulfilled the requirements and hence hereby can submit the thesis to the department.

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By my signature below, I declare that this thesis entitled ''factors affecting small scale tree plantation practices and the contribution of trees to the livelihood of farmers in Gummer Woreda, Gurage zone, Ethiopia'' and the work presented in it are my own and has been generated by me as the result of my own original research. The study in which all sources of materials used has been duly acknowledged. I have produced it independently except for the guidance and suggestion of the thesis Advisor. To the best of my knowledge, this study has not been submitted for any degree in this University or any other University. It is offered for the partial fulfillment of the degree of Masters of Science in biology in Hawassa University.

_____ _____ _____

Student name signature date

_____ _____ _____

Main advisor signature date

_____ _____ _____

Co-advisor signature date

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ACRONYMES

EFSR Ethiopian Forest Sector Review

NTFPs Non-Timber Forest Product

FAO Food and Agriculture Organization of the United Nations

SNNPRS South Nation Nationalities People Regional State

ICRAF International Center for Research in Agroforestry

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ABSTRACT

Tree plantation is one of the important issues in Ethiopia as it plays key role in improving the income and productivity of the farmers and contributes to the efforts to reduce the impacts of climatic changes. Similar to other woredas in Ethiopia, small scale tree plantation has been practices by the farmers of Gummer Woreda of Gurage Zone for many years. However, no thorough study has been carried out to determine factors that affect tree plantation practices and their benefits in the woreda. The present study aimed to investigate the factors that affect small scale tree plantation and the contribution of trees to the livelihood of farmers in Gummer Woreda, Gurage Zone. From the 18 kebeles in the woreda, three kebeles were selected purposively and 282 households were selected randomly from the selected kebeles following standard sampling method for interview. Moreover, predetermined number households and experts were purposively selected for key informant interview, group discussion and observation of tree plantations. Data collected were analyzed using descriptive statistics, chi-square test and narrative depending on the types of data. Tables and figures were used to organize and present the analyzed data. The results showed that land holding size, household income, availability of tree seedlings, labor, availability of market, age and genders of the household heads were the main factor that affect tree plantation in the study area. The main sources of income for the households of the study area were crops, trees and their products, domestic animals, daily work and trade. The majority of the households (90%) were categorized under low and middle income based on the wealth differentiation used in the woredas. It was found that farmers planted 13 species of trees that were classified under 13 genera and 10 families. The results also showed farmers most frequently plated exotic trees compared to indigenous ones. In the study areas, trees provide poles, timber, lumber and other materials for construction and furniture making, charcoal and firewood, and used as source of income by selling trees and their products. Trees also provide ecological services such as reducing soil erosion, improving soil fertility, providing shade, maintain suitable climate and as source of traditional medicine for the local community. The results showed that educational level had positive effect on tree plantation. Therefore, it is better to give trainings to the farmers concerning tree plantation and their uses.

Keyword: Gummer woreda, household, land size, livelihood, tree plantation

1. INTRODUCTION

1.1 Background and Justification

Ethiopia has a long history of tree planting activities. In the country tree plantation was as early as the 1400s by the King Zera Yakob (1434 to 1468) (Bekele, 2001). The practice of modern plantations, however, started by Emperor Menillik II (1844- 1913,) in 1895 by introducing exotic tree species from Italy, Portugal, Australia and Greece to alleviate firewood and construction wood shortage in the newly established capital, Addis Ababa (Bekele 2003). During this period, Emperor Menelik requested his advisor to get him a fast growing tree species to overcome the fuel wood shortage he faced at the time. During the early 19th century, it was reported that most of Addis Ababa was covered by trees and there were about 13,500 ha of Eucalyptus plantation in 1964(FAO, 1985).

Similar endeavors during the Derge regime (1974-1991) led to a rapid expansion of large-scale afforestation and community plantations (Moges *et al.* 2010). In 1981, peri-urban fuel wood plantation projects were launched in major cities such as Addis Ababa, Adama, Debre Berhan, Gondar, and Dessie (EPA 1998). In 2010, the government of Ethiopia, planned afforestation/forest restoration/plantations for the rehabilitation of degraded lands and has pledged to reforest/afforest 15 million ha for the coming 20-30 years, including 5 million ha in the Climate-Resilient Green Economy (CRGE) strategy (CRGE, 2011).In 2010 deforestation rate in Ethiopia amounts to 92,000 ha year^{-1} while new plantation area change is about 18,000 ha year^{-1} (Moges 2015). This results in dwindling of natural forests and critical shortage of forest products (Mussa et al. 2016). Although tree plantation has a long history in the country, plantations are mainly dominated by monocultures of non-native species from four genera: *Eucalyptus*, *Cupressus*, *Pinus*, and *Acacia*. *Eucalyptus* species alone cover more than 90% of the total planted forest area in the year 2011(Bekele 2011), and this tree species was also the first non-native tree species formally introduced to Ethiopia by Emperor Minilik II from Australia in the 1890s (Pukkala and Ponjonen 1989 ; Bekele 2003). According to the estimation made in 2010, over 500,000 ha of the land was covered by eucalypt plantations in Ethiopia (Abebe and Tadesse, 2014). The expansion has also contributed to increase the forest plantation cover

in the country from an estimated 190,000 ha in 1990 to 972,000 ha in 2010 (Bekele, 2011).

The review from Ethiopia Forest Sector (2015) indicated that Ethiopia would reach about 310,000 ha of well-managed new commercial plantation to satisfy its growing industrial wood demands, substitute imports, and engage in wood product exports from the year 2015 to 2025. Development of the new commercial plantations calls for the involvement of various actors and diverse investment options, including the private sector, domestic and foreign institutional investors, state forest enterprises and smallholder woodlots (MEFCC, 2018). The country has consumed roughly 124 million cubic meters of wood in 2013 and will consume more each year (Forest Sector Review, 2015). With population growth and economic development projections, total wood product demand would be estimated to increase by about 27% from 2013 to 2033, reaching an annual consumption of 158 million cubic meters by 2033(MEFCC, 2018).

In Ethiopia, the fast growing population that has led to the increasing of need for farmland, wood for construction, unsustainable harvest for timber and fuel wood extraction, high urbanization rate, road construction and over grazing is taken as the major causes of environmental degradation and forest depletion (Tola, 2005; UNDP, 2012).Attitudes towards tree planting can also change over time, leading to increase or decrease in tree planting activity (Nibbering, 1999).For many farmers, tree planting is an economically driven activity, providing a source of income (Salam, 2000; Arnold, 2001). If there is demand and a market, farmers planting trees as cash crop in order to produce timber, poles, pulp wood, bark, fruit, medicine, etc. (Scheer, 1997).

According to FAO (2010), the livelihood of most rural people of developing countries, including Ethiopia, is strongly linked to natural resources like forest. Trees can uphold soil moisture, maintain biodiversity balance, safeguard soil erosion, reverse land and biological degradation, conserve organic matters of the soil and reduce soil nutrient loss, provide shades for crops and improve land productivity (Bishaw 2001; Kassie et al. 2010).Nowadays, the government of Ethiopia encourages tree plantation and all citizens are mobilized for this activity. The Ethiopia's Green Legacy Initiative is a

massive reforestation campaign that was launched by the Ethiopian Government in 2019. Since then, the Green Legacy Initiative has become an annual tree-planting drive to increase the plantation cover of the country and to improve the local livelihoods and build climate resilience (Daniel et al., 2022).

Similar to other areas in Ethiopia, small scale tree plantation has been practices by the farmers of Gummer Woreda of Gurage Zone for many years. The governmental and some non-governmental organizations have encouraged the farmers to plant trees on their lands for decades. Both tree plantation and cutting of trees for different purposes have been practiced by the farmers of the woreda for many years. As far as the knowledge of the researcher, no thorough study has been carried out to investigate the factors that affecting small-scale tree plantation and the contribution of trees to the livelihood of farmers in Gummer Woreda. Therefore, the present study investigated the factors affect small scale tree plantation and the contribution of trees to the livelihood of farmers of Gummer Woreda of Gurage Zone, Ethiopia.

1.2. Statement of the problem

Trees have multiple roles in rural as well as in urban livelihoods, where they provide significant economic and ecological benefits. The findings of various studies revealed that trees can enhance a households income through sales of wood products and can contribute to risk management by diversifying outputs and spreading risks of agricultural production failure and decrease soil degradation (Jagger and Pender, 2003; Gebreegziabher et al., 2010; Pramova, et al., 2012).

Ethiopia has been struggling to achieve its objectives of economic growth and development. However, a significant increase in industry and agricultural productivity could not be attained where the land resource base is continuously degraded. Hence, sustainable land management is necessary for agricultural growth in Ethiopia (Anteneh, 2003). Sustainable tree planting can create multiple benefits including income generation (thus, improves the livelihood of the farmers), soil conservation, maintaining optimizing climate for crop production to mention a few.

Similar to other area in Ethiopia, in Gummer Woreda of Gurage Zone, beside crop cultivation, small scale tree plantation is a common practice of the smallholder farmers. Moreover, tree plantation practices of different farmers might vary, and thus, governmental and some non-governmental organizations tried to encourage small holder farmers to plant trees on their lands for several decades. However, factors that affect tree plantation practices of the farmers in Gummer Woreda and the benefits of trees to the livelihood of farmers have not been thoroughly studied. Therefore, the aim of the current study is to determine the factors that affect small-scale tree plantations practices of the farmers and the contribution of tree to the livelihood of farmers in Gummer Woreda, Gurage Zone of Ethiopia

1.3. Objectives of the Study

1.3.1. General objective

- The general objective of this study is to identify the factors that affect small-scale tree plantation practices of the farmers in Gummer Woreda and their benefits to improve the livelihood of the smallholder farmers.

1.3.2. Specific objectives

- To identify the major types of tree planted by smallholder farmers in Gummer Woreda
- To identify the factors that determine small-scale tree plantation practice of the farmers
- To determine the contribution of trees to the livelihood of the smallholder farmers in the woreda

1.4. Significance of the Study

Tree planting practice was critical in achieving social and economic transformation on the majority of rural poor society in Ethiopia. For Gummer woreda, to achieve these objective factors that affect tree plantation and contribution to the livelihood of farmers should be identified and managed appropriately. This study will believe to be important mainly for

the following reasons. It identified the factors that hindered tree plantation practices in the woreda, thus, the results could contribute to the efforts to improve the practice of tree planting. It also will help to widen the awareness of tree planting. Moreover, the result may serve as a starting point for other researchers who may conduct research on similar area. Finally the result of this study may also provide some important information to be considered by the policy makers.

1.5. Scope of the Study

This study was focused on the identification of factors affecting small-scale tree plantation practices and their contribution to the livelihood of farmers in Gummer Woreda by purposively sampling three kebeles. The households were selected for the study by randomly sampling method because they are large in numbers and not possible to take as a whole due to shortage of budget and time. The three kebeles were selected with the intent of generalizing the finding.

1.6. Limitation of the Study

The researcher encountered different limitations that were likely to obstructed access to information required by the study. Due to shortage of budget and time, the researcher purposively selected three kebeles for the study rather than including all the kebeles. The households for the study were also selected from the three kebeles randomly for the aforementioned problem. The researcher also faced challenges in acquiring secondary data from previous work or studies and documented material from different concerning bodies. Moreover, the researcher encountered problems of having a common meeting with the selected households to discuss the detailed objectives of the study for common understanding as this help to get-well organized information from the respondents, and it was difficult to discuss the detailed objectives and purposes of the study with each household during the interview. To overcome these challenges, the researcher used primary source of data besides secondary ones. The Kebele managers were requested to convince the households to have a meeting with the researcher. Moreover, more than three data collector (enumerators) were used to overcome the time constraints.

1.7. Organization of the Thesis

The first chapter is an introduction of basic information about the paper and includes background of the study, statements of the problem, research objectives, scope and significance of the study. The second chapter presents the related literature reviews. The third chapter explains the research methodology. Then, the forth chapter is the result and discussion part. Finally, the fifth chapter presents conclusions and recommendations of the study.

2. LITERATURE REVIEW

2.1. Tree Plantation

Plantation forests are cultivated forest ecosystems established by planting and/or seeding, which aids in the process of afforestation and reforestation for the purposes of wood biomass production, soil and water conservation and/or wind protection (FAO, 2012). Plantations comprise either introduced species (all planted stands) or intensively managed stands of indigenous species, which meet the following criteria: one or two species of uniform age that are regularly spaced and are characterized by relatively short rotations when compared with natural forests (FAO, 2012).

Forests plantations are defined by FAO (2012) as forest stands established artificially by afforestation on land previously did not carry forests, or forest stands established artificially by reforestation on land which carried forests within previous 50 years or within living memory and involving the replacement of previous crop by new and essentially different crops. Evans (1992), defines plantations simply as a forest crop or stand raised artificially either by sowing or planting. In Ethiopia forest plantation have started by the turn of the 19th century, when Emperor Menelik requested his advisor to get him a fast growing tree species to overcome the fuel wood shortage he faced at the time. During the early 19th hundred, it was reported most of Addis Ababa was covered by forests and there were about 13,500 hectares of Eucalyptus plantation in 1964 (FAO, 1964).Afforestation/reforestation practices are meant primarily to increase the supply of wood products in the country. These practices comprise mainly three forms: industrial plantation, peri-urban energy forestry and small-scale plantations. The former two are mainly government-driven, while the third is undertaken principally by farming households (Lemenis and Kassa, 2014) often termed non-industrial plantations, smallholder woodlots are the main suppliers of poles for electricity and scaffolding and contribute a significant share of the biomass fuel consumed nationally (Lemenis and Kassa, 2014) .

Agricultural policies in Europe until recently not only assumed that there wouldn’t be any trees but made tree planting experiments illegal. Tree cover on agricultural lands

thus has had to catch up with misperceptions and lack of recognition, similar to the ‘trees outside forests’ as defined by the Food and Agriculture Organization of the United Nations (De Foresta *et al* 2013) as complements of trees inside forests.

Ethiopia has engaged in tree plantation development for over 100 years. Tree plantations are comprised of three sub-types: commercial/industrial plantation, wood-lots, and peri urban plantation (mainly for fuel wood). The plantation forests in Ethiopia are comprised mainly of exotic tree species. With the decline and subsequent banning of industrial wood production from natural forests combined with growing demand for wood products, the importance of plantation forests is increasing (MoFECC, 2017).

The recent information related to tree plantation in Ethiopia revealed that, the total area of plantation forests in Ethiopia is estimated at 972,000 ha. Afforestation/reforestation practices are meant primarily to increase the supply of wood products in the country. These practices comprise mainly three forms: industrial plantation, peri-urban energy forestry and small-scale plantations. The former two are mainly government-driven, while the third is undertaken principally by farming households. Often termed non-industrial plantations, smallholder woodlots are the main suppliers of poles for electricity and scaffolding and contribute a significant share of the biomass fuel consumed nationally. Species wise, eucalyptus dominates the current plantation forests, covering more than 90%. Cupressus contributes 3.3% and other species cover a small fraction of the standing stock (MEFCC, 2018a).

2.2. Global Tree Plantation Expansion

There are different explanations for the rapid expansion of tree plantations in forest industry. At the visible level, for Dauvergne and Lister (2011), the global discount economy where big box retail companies squeeze producers down the commodity chains to produce timber products for them as much and as cheaply and reliably as possible is the main explanation for problems in the felling areas. The rising power and impact of corporations and their resource exploitation is linked to the globalization of neoliberal capitalism during the past two to three decades. This change is seen most evidently in the past decade, during which new mass-scale Southern producers of pulp have emerged, and traditional Northern firms have downsized at home and invested in the South.

The neoliberal international financial and trade infrastructure, demanding strong foreign currency reserves and seeking to squeeze costs, has led Southern governments to boost exports in commodities (such as pulp) and Northern governments to increase exports in machinery for commodity extraction in the South. Fiber costs are the most essential element in paper manufacturing, a main destination of plantation tree. Pulp millsproducing1-1.5 megatons of pulp per year (this figure is set to grow) have resulted in positive trade accounts in the South, while offering cheap fiber to Northern companies and products to (mostly Northern) consumers. Rising consumerism and expanding consumer-base, e-commerce and global trade drive the fast use of the fast-wood timber products. Global forestry capitalism experienced a cyclic change from its capitalization phase into material accumulation and territorial expansion. Arrighi's (1994) theory has illustrated in general how such cyclic change is inherent in global capitalist expansion. For example, smallholder-based agrarian structure led to the development of globally leading capital-intensive farming techniques in the American Midwest by the 1960s: when this emerging agribusiness/food complex globalized, it took the form of the Green Revolution in its land relations, particularly in the Global South (Moore 2011).

A similar type of cyclic change from capitalization to territorialization took place as the Northern forest industry cluster started to globalize in the 1970s. New tree plantations are thus linked to this deeper cyclic change in global capitalism. In this view, capitalism

is a socio-ecological relation (Moore, 2011) with currently globalizing forestry capitalism a plantation-based land use change project. Over-development of production capacity, in part pushed by machinery producing cores, further explains plantation expansion. The establishment of woodworking industries is the strongest driver of plantation expansion particularly in areas where the processing capacity surpasses timber supply, and natural forest logging is becoming ever harder, such as in Indonesia (Obidzinski and Dermawan 2010).

The interaction of social actors and nature also explains why the current expansion is taking place through land deals where elites and corporations race for the best remaining land and resources (Klare 2012). Climate change (e.g. increased droughts, disruptions in climate) will reduce yields, requiring increased plantation area. At a conservative estimate, expansion of 4.5 times the current area will be required by 2050 to meet the increased demand caused by climate change and maintain 1991 plantation fiber production levels in Brazil (Fearnside, 1999). In reality this figure will be much higher as global demand has grown, and according to Fear side this expansion incurs substantial further socio environmental costs (ibid).

Clear statistics on plantation coverage are difficult to come by, as different entities use different conceptualizations of forest and plantations, and the field is evolving rapidly and with unsatisfactory monitoring. The United Nations' Food and Agricultural Organization's (FAO) Forestry division maintains one of the most extensive databases, which is nevertheless also problematic in some ways. The FAO itself admits that 'consistent definitions and reliable data have proven problematic in quantifying plantation forests or planted forest resources in both industrialized and developing countries.'

However, the FAO data is useful, if used for the purposes for which it is suited. Conceptualization differences produce incomparability in databases. FAO, UNEP and other UN-bodies talk about 'forest plantations' or 'planted forests:' according to FAO (2010) there were 264 million hectares of these in the world in 2010. FAO (2011) states that Europe had 69.3 million hectares of plantations; but a joint publication of Forest

Europe, UNECE and FAO (2011) claimed that plantations cover 4 percent of Europe's 1 billion hectare total forest area, which would mean 40 million hectares. This is a big discrepancy in data, illustrating how even the official multilateral and government organizations are not aware or not in unison over plantation expansion.

The FAO gets its data from governments, which use industry associations' figures (for example in the case of Brazil, data from ABRAF, the Brazilian Association of Planted Forest Producers, is used). This is a problem, as governments, often close to companies, can be keen to hide the extent of tree plantations, and exaggerate the extent of natural forests, or not offer data to the FAO for whatever reason. Some key countries' data can be missed or misrepresented. NGOs claim that the real extent of plantation expansion is higher than those presented by governments and thus also the FAO. For example in Indonesia, one local NGO says that pulpwood ITPs are estimated to cover about 9 million hectares, with the government planning to expand them to 25 million hectares by 2025.

2.3. Main Land Use Changes

Very different landscapes have been turned into similar tree plantations (Patterson and Hoalst-Pullen 2011). Plantation forestry is steered more by humans than primary forest growth. The logical result of land cover change induced by humans is even greater landscape control by humans. Ever more adaptable species, rotation cycles and tree uses have increased the scale and scope of human-induced pathways, displacing more clearly non-human-induced forest expansion. The industry focus is on the decreasing cost of extraction and transport instead of increasing yields, and genetic work not focusing on yield increase on best lands but on developing hybrids for marginal lands (Fearnside 1998). This can be explained by the practical limits oil quality places on increasing yields in commercial scale plantations to 30m3 per hectare per year even in the world's best tropical climatic conditions of Brazil (ibid). Nature places limits on expansion.

The best, most fertile lands close to rural cities have been appropriated first in most expansion contexts. A study in New Zealand found that because forestry is a more intensive and higher demand land-use than pasture, tree plantations expand first closer to

the city, pushing the second priority pasture and agriculture use to peripheries (Nagashima et al. 2002). As the best lands become occupied by TPs, the focus turns increasingly to marginal lands.

According to Fearnside (1998), the industry focus on territorializing ever more marginal lands leads to damaging expansion in peripheries, with the search for lower costs cutting the limited local economic benefits in large firm-controlled plantation areas. Such expansion does not take place in 'vacuums', but in the contexts of rural cultural and human ecological mosaics with a resmyriad of different agrarian structures and relations. With depletion of finite resources, and natural limits on increasing yields on good lands, but the technical capability to make cultivation possible in cheaper marginal lands, expansion takes place in more peripheral, difficult-to-reach areas. The imperative is to get control over as much land as possible in areas where prices are still low (Kröger 2012a). The rapidity of land use change can also affect the countries of the Global North. In Australia, dramatic tree plantation (mostly eucalyptus) growth between 1997 and 2009 (from 1.2 to 2 million hectares) represents a radical change in rural landscape character and economic activity, with food-producing family farms turning into corporate ITPs (Stewart et al. 2011). Farmers have widely opposed this expansion (ibid), but according to the reviewed literature, not by physical protest.

2.4 Tree plantation Expansion predictions

TPs are expanding fast, with many consequences. In South America, the expansion pace is at 500,000 ha per year (Jobbágy et al. 2012) and this is increasing. In Africa, the rise may be even more dramatic than in South America: for example, Pöyry Forest Consulting – a leading expert on ITP expansion - suggests that within a decade Africa will be the center of TP expansion globally. Africa will see a wide spectrum of tree plantation types and uses, including ecosystem services plantations such as 'carbon sinks' operating on the REDD Plus markets and under development cooperation agendas; energy plantations; pulp projects integrated with plantations and mills; and other biomass ventures. Africa is also likely to attract timberland investment by portfolio funds seeking diversification, both from the private and the state sectors; Western

pension funds, for example, are looking to land investments for more secure returns than are to be found in the equity markets. Even though land is similarly also a speculative investment, as for example derivatives, land cannot completely lose its value if there is a financial system crash or downturn on financial markets. Land has real use value and not just fictitious value like stocks and derivatives. Land is also a resource whose ever-larger scale control and appropriation by core states and their industries has been and continues to be the essential element in driving capitalist globalization (Bunker and Ciccantell 2005). It is likely that in Africa land tenure will be controlled more tightly by foreign actors, than in the neodevelop mentalist countries of South America (such as Brazil) and Asia (such as China, Indonesia and India) where new laws curb foreign land ownership. China, the EU nations and some others have secured and will continue to attempt to secure 50- to 100-year leases from weaker governments, with ample investment guarantees. China deserves a closer look because of its important role in global TP expansion.

2.5 Market mechanisms of land access and their developmental consequences

Today, with overt violence discouraged in most political systems, companies have had to resort to a variety of market mechanisms and state negotiations to ensure land access: purchases, concessions, leases, outgrower schemes, partnership, or theft. The developmental consequences of leasing land from the government have been problematic: in the Mekong region, for example, ‘concessions have frequently been granted at the cost of the livelihoods of the poor, sometimes leading to greater impoverishment’ (Barney 2007). It might sometimes be possible for current landholders to demand non-exploitative terms, but, this is likely to happen only later. The institutional arrangements for dealing with the rapid pace of plantation expansion have remained very inadequate even in a country such as Australia (Mercer and Underwood 2002). Given the demand, ITPs have been given concessions so fast that few state institutions can monitor or regulate them. For example, in Laos the ‘exponential growth of the granting of land concessions’ has led to the feeling that the government has ‘lost control of the process’ (Hanssen 2007). Thus, the conditions under which pulp plantations may complement, rather than threaten livelihoods of local communities are

extremely limited, argue Pirard and Mayer (2009) in a study of Indonesia. They claim that at least one fifth of land should be left to intensified local agriculture and agroforestry instead of plantations. Company operations should be carried over with care and constant consultation with impacted populations, not too hastily and uncarefully. Priority should be given to local employment. The minimum conditions should also include careful determination of plantation sites and more transparent government licensing of plantation concessions and pulp mills recognizing local and customary rights (ibid).The abovementioned minimum conditions Pirard and Mayer (2009) find essential for ITPs and large-scale pulpwood TPs to support local livelihoods are very tight, in fact, so tight that it might be impossible to fulfill them by ITPs. Thereafter, some have argued for a need to turn more massively away from corporate monocultures and towards small-scale tree plantations that would ideally be controlled by and based on family forestry.

2.6. Trees Establishment on Farmland as Means to Combat Deforestation and Land Degradation

Forest provides important economic and environmental benefits. In addition, small wood lots on agricultural land play similar roles and are increasingly recognized for their contribution to solving energy problems, enhancing biodiversity conservation, addressing deforestation and mitigating climate change (Acharya, 2006). As the rate of deforestation continue to rise in some tropical countries, governments are faced with the challenge of finding approach w/c can reduce deforestation and provide rural livelihoods in addition to protect the environment. Much of these policy focus on the promotion of farm forestry , by providing incentives that encourage the farmers to establish and manage their own source of wood and non woody products on their farm lands (Glover, 2005).

Trees have multiple roles in rural livelihoods, where they provide significant economic and ecological benefits (e.g., they decrease soil degradation). Trees can augment a household's income through sales of wood products and can contribute to risk management by diversifying outputs and spreading risks of agricultural production failure. Some studies have indicated that eucalyptus trees, which are relatively fast

growing, are profitable. They found rates of return to farmers' investments in eucalyptus often above 20 percent (Jagger and Pender, 2003). The economic benefits are greatest when unproductive community lands (generally of low quality) are used for private tree planting. Similarly, the environmental benefits are substantial, particularly when the trees are planted on degraded land.

2.7 Factors affecting tree plantation

The most important factors found in the available literature include land size, sex, age, education level, household size wealth and availability of market (shackleton, 2008). Factors are unlikely to be valid across national region (Nadyambaje, 2013).

2.7.1. Demographic characteristics

Socio-demographic characteristics can be used as proxies for farmers' preferences for things such as risk tolerance and conservation attitude, factors that are otherwise difficult to measure (Pattanayak et al. 2003). In this regard, Gender has been found to influence tree planting activity, with male headed households or households with more male members being found to be more active in tree planting (Scherr 1995, Pattanayak*et al*., 2003).

As reported by Simmons *et al.* (2002) found that, age and education variables are indicators of human capital, which have been found to increase the likelihood of tree planting due to environmental awareness and knowledge of tree planting techniques in some cases. In fact, education is often seen as a key issue for all levels of sustainable forestry (Gordon *et al.* 1999), and it has been found that there is a positive relationship between formal education and tree planting enthusiasm (e.g. Thacher*et al*. 1997, Mercer *et al.* 2004).

Blaug (1972) revealed that education is positively associated with probability to adopt tree plantation practice. Those who are learned have more knowledge on the proper ways to plant trees, the best quality of seedling and the right species to plant. Whether and which trees are integrated into farm fields depends on many factors operating at different

levels of society, ranging from national and international policies to personal characteristics of household members or tree characteristics.

The influence of farmers' age on tree planting activity is unclear. In some cases, however, it has been found that household age demographics can influence the household decision to plant certain crops (Walker *et al.* 1996). Older farmers generally have higher risk-bearing capabilities, lower household needs in terms of income, more time available (e.g. no need to take care of the children), and are interested in less labor-demanding activities such as planting trees (Thacher *et al.* 1997). Younger households are generally less established in terms of land areas owned, labor availability and resource requirements (i.e. high consumption demands relative to labor supply). Thus, younger households have less capacity to cope with risks, and they need to allocate their limited labor to varying forms of income earning (being more dependent on off-farm work). Having lower land areas, younger households generally need to choose a diversity of crops that can provide regular income and food instead of planting trees (Wilk, 1984; Walker *et al.,* 1996).

Moreover, other studies have found that young, well- educated leaders in the village have been the innovative ones, engaging in tree planting (Song *et al*. 2004). In addition, personal characteristics can influence tree planting activity, as often tree planters come across in the literature as more innovative and courageous (in terms of risk) than non-tree planters (Mahapatra and Mitchell, 2001). Farmers' ethnic group has also been found to influence their perceptions on tree planting (Hares, 2008).

2.7.2. Labor status of farmers

Differences in the availability of the production factors, i.e. land, labor and capital, determine the management intensity of trees in farm fields (Arnold and Dewees, 1999). National and regional rules and regulations concerning tree planting, local land tenure arrangements and tree tenure arrangements can be stimulating or constraining factors for the actual planting and harvesting practices of local populations (Shepherd, 1992; Bekele, 2003).

It is a another factor that affect tree planting elsewhere in the world can be favored as a relatively low labor-demanding land use option, whilst the limited labor can be allocated to other on-farm (e.g. agriculture) or off-farm activities to provide regular income (Arnold and Dewees, 1997, Thacher*et al.* 1997, Dewees and Saxena, 1997, Ravindran and Thomas, 2000).

It has been found that households whose main income is from off-farm sources are more likely to use their land for tree planting than those households reliant on on-farm income (Thacher*et al.* 1997, Salam *et al.* 2000). Sometimes, however, households with a large number of working age members are positively correlated with tree planting activity (Summers et al. 2004), which could be because in some remote rural areas in the tropics, few off-farm income options are available for the unskilled poor (Scherr*et al.*, 2002).

Yet farmers do not always have enough capital to use the land for the most profitable crop, due to high establishment or management costs (Dewees and Saxena, 1997). If land is a limiting factor, and households have enough capital and labor, livelihood activities with lower land requirements and high labor demand (and returns) are more likely to be selected over tree planting (Dewees and Saxena, 1997; Byron, 2001). If tree planting is selected as a livelihood option, adequate labor is required for the proper establishment and management of the plantations (Evans, 1992).

2.7.3. Capital

Along the production chain, different capital demanding objectives are required to produce quality wood, such as seedlings, machinery, fertilizers, herbicides, and harvesting equipment etc. The capital intensity is even higher if more value is added to the production process, for example in the form of transportation, processing and product marketing. For poor farmers, a lack of capital is a major constraint for tree planting (Byron 2001), and it has been found that wealthier farmers, who are more capable of taking risky investments, are more likely to plant trees (Amacher*et al*. 1993; Scherr, 1995; Mahapatra and Mitchell 2001; Franzel and Scherr, 2002).

Furthermore, trees take a long time to grow (depending on species and plantation objectives), making it a long-term investment with little-to-no intermediate returns. The relatively long time periods involved in tree farming exposes farmers to risks in terms of price fluctuations, tenure insecurity and natural hazards (Angelsen and Wunder, 2003). This long waiting period combined with high risks does not favor poor farmers, who are highly dependent on their limited farm resources; often for day to day survival (Dewees and Saxena, 1997).

Furthermore, due to the limited access to capital and credit for investing in tree planting, and the financial inability to wait for trees to reach the minimum diameters required by industry, smallholders may also find it difficult to compete with the larger state and private owned plantation companies due to economies of scale (Maturana*et al*., 2005).

Compared to the cultivation of many other more intensive crops (such as oil palm), establishing and maintaining a tree plantation requires relatively low levels of capital investment (Ravindran and Thomas, 2000). This means that tree planting is sometimes chosen over other alternatives simply because of a lack of start-up capital for another cash crop, or because of a lack of capacity to optimize the productivity (Dewees and Saxena, 1997).

In addition, tree planting often does not require hired labor, as most of the work is done by the farmers themselves (Evans, 1992). Farmers are often even willing to work below the minimum wage if they are building assets on their own farms (Van Noordwijk*et al*, 2007).

2.7.4. Markets accesses

Whether the farmers are willing to plant and manage trees with an objective to sell wood is influenced by the availability of functional markets (Arnold, 2001; Byron, 2001, Scherr, 2004). There are two main factors that often complicate the markets for small-scale wood production, namely low quantity and quality. These complicating factors especially apply to farmers with small land areas and poor silvicultural management skills (Sen and Das, 1988; Arnold, 2001; Byron, 2001).

The small harvest volumes of small tree plantations may increase harvest and logistic costs, especially if located far away from the production plants and markets, making them less attractive for the industries. Often, farmers that are located near the production plants and local markets, and with relatively good infrastructure, have good market conditions for planting and managing trees (Scherr, 2004). Furthermore, the lack of continuous supply from small-scale plantations is a hindrance to industrial operations. The price of wood in the tropics can be held low by the availability of cheaper non-wood substitutes or the availability of relatively cheaper wood from natural forests, or by subsidies that are designed to promote agricultural crops or other cash crops (Guizol and Aruan, 2004; Scherr 2004). Low and unstable market prices for wood are major disadvantage for tree planters (Scherr, 2004). The lack of an open market can also give companies influence over individual farmers' production decisions, for example on what species to plant or when to harvest.

The farmers also often lack negotiation power on the prices they receive for the wood, and they often have little choice but to accept the company dictated price (even if it is well below market rates) because of their limited access to markets, limited market information, and inability to overcometransaction costs (Perdana*et al.*, 2012; Rohadi*et al*. 2012). The absence or lack of knowledge on price incentives for farmers to produce higher quality products is considered a barrier to improved silvicultural management practices (Van Noordwijk*et al*. 2007, Perdana*et al*. 2002).

Moreover, the involvement of middlemen often decreases the profits reaching the farmer (Hyman 1983, Sen and Das 1988, Kumar 2003, Perdana*et al*. 2012). The presence of middlemen is not always negative, but they often play a significant role in marketing tree products from numerous smallholder plantations (Roshetko*et al.*, 2007). Although smallholders may face many market constraints, there are also many competitive advantages and market opportunities for smallholders in the tropics that have emerged due to the global forest transitions (as discussed by Scherr*et al.* 2002 and Scherr 2004). These are namely: growing local demand, especially for domestic production of small-diameter and lower-quality wood; increasing concern over the environment and social equality, which creates markets for certified forest products and ecosystem services; extensive need for tree growing and commercialization on small farms due to forest scarcity; increased prices of timber (in some cases); use of marginal lands, tree domestication and out-grower arrangements; globalized markets providing niche markets and contacts to buyers with special requirements; and finally, a general trend towards more democratic governance that gives greater voice to local people and support for indigenous land rights. These new opportunities, however, are not equally accessible for all groups of smallholders in the tropics (Scherr*et al.*, 2002).

2.7.5. Attitudes, motivations and disadvantages

Many researchers show that farmers' favorable or unfavorable attitudes towards tree planting (Amacher*et al*, 1993; Nibbering, 1999; Salam *et al.*, 2000) as well as other peoples' attitudes around them (Mercer, 2004) have influenced farmers' willingness to plant trees. Attitudes towards tree planting can also change over time, leading to increases or decreases in tree planting activity (Nibbering, 1999). Tree planting can contribute to farmers' livelihoods in various ways, and farmer's plant trees based on different motivations. The motivation for planting trees - which can be economic, environmental, social or cultural - influences both the species selection and the associated requirements for management (Evans, 1992).

2.7.6. Knowledge and skills

Different researchers forwarded their idea on knowledge related factors affecting tree plantation. Moreover, there are conflicting opinions between different authors about how knowledge affects tree planting. Despite a large body of traditional knowledge on tree planting, there is a general lack of knowledge and skills related to tree planting and management amongst farmers, which is considered to be a major constraint to successful small-scale tree planting (Carnea, 1992; Thacher*et al.* 1997; Byron, 2001; Pattanayak*et al.* 2003, Cossalter and Pye Smith, 2003). Smallholders in Indonesia and other developing countries in the tropics often manage their timber plantations using poor silvicultural practices with low levels of labor inputs, which lead to low quantities and quality of timber (Harrison and Herbohn, 2001b; Maturana*et al.*, 2005).

Spacing is often irregular, species composition is sometimes result of chance rather than a conscious decision, and farmers often lack the technical skills necessary to achieve best practice (Gunasena and Roshetko, 2000). The most common management activity is often limited to harvesting of wood, while trees are just let to grow without any silvicultural management between planting and harvesting (Roshetko*et al*., 2007). Hence, improved extension activities are commonly recommended in order to improve the success of smallholder tree planting and management (Thacher *et al*. 1997; Roshetko *et al*. 2007).

It is, however, also recognized that farmers often do have knowledge about tree planting and management, but this knowledge is often not applied because of other reasons such as socioeconomic constraints (Byron, 2001, Harrison and Herbohn, 2001b; Walters *et al.* 2005; Maturana*et al.*, 2005). Furthermore, it is questionable whether silvicultural techniques that are designed for large-scale plantation management can be adapted for smallholder plantation management (Byron, 2001; Nawir, 2007).

Selection of appropriate tree species is one of the most important silvicultural decisions to be made, and has a strong influence on the success of smallholder tree planting efforts. The species selected should be suitable for the local environmental conditions, but

should also suit farmers' objectives and livelihood strategies and available markets (e.g. Evans, 1992; Scherr, 2004).

A major problem faced by Indonesian farmers, community organizations and even government projects/offices is that they often lack access to good quality tree seeds for the desired tree species (Roshetko*et al*., 2004).

2.7.7. Characteristics of the farm

2.7.7.1. Land area, tenure and location

The size of the farm, the wealth status and age of the farmers are factors influencing tree planting activities (Schuren and Snelder, 2008), as are the environmental conditions influencing actual growth and survival of trees related to specific tree characteristics (De Jong, 2001; Bannister and Nair, 2003).

According to Ajayi (2006),land size has positive association with farmers decisions to plant tree on their farms. Tree planting farmers own larger land areas compared to non-tree planters (Salam, 2000). Most of small scale farmers in many African fall within the customary tenure system whereby families depend on acquiring land through ancestry accession. Therefore as family size increase, their share of land gets smaller to smaller. As a result the land is too small to plant tree and food production has to be prioritized. Tree planting requires land, but the poorest farmers in the tropics generally have very little ownership or access to private land, or only very small areas of land, such that they have little choice but to plant staple food crops that provide annual returns, instead of the relatively slow growing trees (Salam et al., 2000; Simmons et al., 2002; Kumar 2003, Summers et al., 2004). Hence, it is often found that farmers with larger areas of land tend to plant and manage trees more than the farmers with limited land (Amacheret al. 1993; Thacheret al., 1997; Summers et al. 2004). Sometimes, however, poor farmers with small land areas have high densities of trees on part of their farms, because they are dependent on essential forests products (such as fuel wood) that may be otherwise scarce (Scherr, 1997). Furthermore, as farmers are often highly dependent on the limited resources produced on their land for their livelihoods, they have an incentive

for managing their crops, including trees, in the most sustainable and efficient way (Sen and Das, 1988).

Small land areas can also be more easily protected from damage (such as forest fires or diseases) and there is an incentive to focus on quality production. On the other hand, small sized land provides small volumes of wood, which can make harvesting and transportation to market uneconomical (Scherr, 2004). The often unclear land tenure in Indonesia and other areas in the tropics can discourage farmers from planting or managing trees if they cannot ensure the right to use or sell trees (Thacheret al., 1997; Byron, 2001; Simmons et al., 2002; Pattanayaket al., 2003).

Changes to forest governance structures that are strengthening local rights over the land and trees have been occurring throughout the tropics (White and Martin, 2001; Kaimowitz, 2003; Luttrell et al., 2011). Such changes can empower the farmers, improve their decision making power over their land and resources, and encourage them to plant and manage trees; but on the other hand it can sometimes make it even more difficult for the most vulnerable, landless poor (or other marginalized groups) to access the forest resources (Angelsen and Wunder, 2003; Arnold, 2001; Kaimowitz, 2003; Luttrell et al., 2011).

Land allocated for tree planting is often already used by rural people for other purposes, and such changes in land use allocation can negatively impact people's livelihoods and cause conflicts and marginalization (Nawir and Santoso, 2005; Nawir, 2007; Barr et al. 2010). This is especially the case in Indonesia where the definitions and data related to land and forest cover - including degraded land that is often targeted by the plantation programs - is not clear, and is often already inhabited, or under some form of agro-management by local people or settlers (Nawir, 2007; Luttrell et al. 2011). The often imposed requirement for clear land ownership can even prevent farmers that have unclear land tenure rights from participating in tree planting programs (Hyman, 1983). On the other hand, some case studies have shown that tree planting schemes that require titles over the land have actually helped farmers to be recognized as the legal land owner (Arnold, 1997), so the influence of land tenure is clearly case specific.

The location of a farmers' land in relation to a range of factors - including their house, natural forest or other sources of forest products, wood industries and markets - can affect the farmers' decision whether to plant and manage trees or not (Arnold 1996, Dewees and Saxena, 1997; Scherr, 2004). For example, in many developing countries, working far from home (be it temporarily or permanently) is the only option for some groups of people seeking better livelihoods (Rudel, 2009). If a farmer is living and working far from their land, planting it with trees is a productive option, and in some cases it has been known to secure the control over the land whilst they are away (Dewees and Saxena, 1997; Van Noordwijket al., 2007). This is often the case in Central Java, where at least one household member generally works as a migrant laborer in the bigger cities on Java. On the other hand, farmers often live in or near their farms, enabling them to protect and manage their trees in a more efficient manner (Arnold, 1996; Race and Desmond, 2000). Furthermore, the presence of trees on the farm reduces the household time spent and labor burden collecting forest products from distant areas, especially if natural forest is scarce (Arnold and Dewees, 1997). The location of the farm in relation to markets influences tree planting activity, especially when wood is produced for cash sales. Remote areas, with a low population density and low levels of physical infrastructure, complicate the access to market. Peri-urban areas close to wood consuming industries are more viable, whereby transport costs to the markets are not a constraining factor (Scherr, 2004).

Successful long-term agroforestry and tree planting strategies require land tenure systems that guarantee continued ownership of land. As Nair (1990) indicated, the incentive for investing in soil-fertility improvement for the future is low unless the benefits accrue to the tree planter. This holds true in Ethiopia today, where land is still under the communal control of the government. Unless land is redistributed to individual farmers and they are guaranteed continuous ownership, success in the adoption of agro forestry and tree planting on the Ethiopian highlands is unlikely.

Therefore, the land and tree tenure policy of the country should be changed to reward the farmers who invest in agro forestry and forest plantations, which require long gestation periods. The government should introduce land and tree tenure policy changes to

promote agro forestry and tree planting in the country. Land and tree tenure should give landowners and farmers the guarantee to plant and own the forests. Without clear land and tree tenure policy, it is difficult to give incentives to farmers and landowners to grow trees. Active laws are needed to save the land and the environment. This requires suitable legislation and institutions to implement the laws. Also, commitment from the government is needed to implement forest policy that will fully consider the crisis of environmental degradation and stagnation of agriculture (Silenat and Fikadu, 2018)

2.7.7.2. Site conditions

Site conditions, including the soil characteristics and climatic conditions, affect the success of tree planting. Not all sites are suitable for tree planting or for all species; hence it is crucial to match the species with the site conditions. On the other hand, tree planting can often be a feasible option to make a use of marginal lands where agricultural crops are not suitable, and in fact tree plantations are generally relegated to such marginal lands (Hyman, 1983; Evans, 1992; Cossalter and Pye-Smith, 2003).

Tree planting can also have a negative effect on the site, and degrade the site quality, for example if it decreases the soil fertility or reduces the water availability in the watershed (Evans, 1992; Cossalter and Pye-Smith, 2003; Holden *et al.*, 2003).

2.8. Factors influencing tree plantation and species selection

When tree planting is considered an attractive investment within the farm fields, species should be selected. Depending on the characteristics of the farming system different tree species can be selected, for example for subsistence or marketing purpose, for improving the soil or for other ecological advantages of the trees (Leakey and Simons, 1998). Multipurpose trees are often selected as they can meet multiple demands while investments are generally low. The ecological value and application of a tree is what is important for the selection of specific tree species and related tree management practice, but also rules, market possibilities, household preference and the local environmental conditions are important. Specific characteristics of tree species can be important for selection, following criteria ranging between the utility, drought resistance, compatibility

with crops and improvement of soil fertility (Roothaert and Franzel, 2001; Bannister and Nair, 2003).

In case of the use of trees in combination with livestock, the palatability and effect on the condition of livestock (health, milk production and growth) can be important (Roothaert and Franzel, 2001). Trees are furthermore differently applied within farm fields such as in home gardens, as shelterbelts and windbreaks and in alley cropping (Nair, 1991; Long and Nair, 1999), for which different tree species have different qualifications. The choice for trees in a system also depends on household characteristics, differences in ethnicity of the population (Boffa, 1999) and local perceptions on the value of trees.

The study attempts to analyze the factors that affect tree plantation practice and its contribution to livelihood to households'. According to Scherr (1977) the analysis of farmers integrates trees in to their farming systems require a comprehensive analytical frame work. The underlying principle of the frame work propose that the decision of farmers to allocate their agricultural lands for retaining or planting and manage tree can be affected by a wide array of factors that are internal to farmers including age, land size, family size, availability of seeds, labor, gender, education of household head and annual incomes (Mekonnen, 2009). The above factors were used as input to analyze their effect on tree plantation practice of farmers on their farm lands.

However, the presence of exotic trees such as eucalyptus has immensely reduced the pressure on remnant indigenous trees by substituting for fuel, construction material and income source. Hence, many argue that it is important to educate farmers to plant and conserve indigenous trees beside exotic ones. Several studies have been carried out on indigenous tree propagation methods, establishment and habitat requirements. The establishment of demonstration site and field research centers (for example, Gulele subcity of Addis Ababa and Center for Indigenous Trees Propagation andBiodiversity Development at Tulu Korma, Addis Alem, in West-Shewa Zone of Oromia Regional State) are evidences for indigenous tree conservation and propagation efforts (Keneni *et al*.,2021).

According to Keneni***et al*.,** **(2021),** in the past decades awareness creation through public media and trainings has been attempted. Different rural developmental bodies such as rural development agents, researchers, NGOs have tried to support and advice rural communities to reduce the rate of deforestation and promote plantations of indigenous trees. Moreover small-scale plantations in home garden agroforestry and farmlands were indicated to contribute to the conservation of useful tree species and in providing supplementary food, fuel and fodder (Assefa and Bork, 2014; Mekonen *et al.,* 2014). In the vicinity of woreda cities of Sidama zone, Ethiopia, where this study was carried out, the trees and the indigenous knowledge is under threat from urbanization and introduction of new tree species. In the Sidama Zone of Ethiopia no thorough study has been done to assess the role of farm trees, attitude, knowledge and skills of farmers in planting, propagating and conserving indigenous and exotic trees.

2.9. Factors influencing tree utilization and tree management practices

In order to encourage the integration of trees on farms there is a need for understanding local tree management in the context of household livelihood strategies, local opinions on the value of treesand the wider external factors influencing local tree utilization (Arnold, 1997; Zubair and Garforth, 2006). Changes in tree utilization and management practices in different farm fields occur as a response to local needs and opportunities (Arnold, 1997; Long and Nair, 1999), related to changes over time in the environmental, economic, political, social and institutional settings(Bruijn and Dijk, 2004). Use of trees in farmland systems is also influenced by a mixture of biophysical factors and social objectives (Long and Nair, 1999). Factors influencing tree utilization and tree management practices has been broadly divided into internal- and external- to the household (Ite, 2005; Degrande et al., 2006), rational- and irrational- motivations (Sood and Mitchell, 2004) and economical situations, household characteristics and farm plot characteristics (Schuren and Snelder, 2008).

Concerning tree utilization and tree management practices of trees integrated in farm fields and factors influencing dynamics in these practices has resulted in the following categorization of influencing factors: Farming system, household characteristics;

Economy of trees and tree products; Rules and regulations, ecological and climatic circumstances and tree characteristics

These categories cover all factors which can influence tree utilization and local tree management practices of trees integrated in the farm fields. Annex I presents a table with the articles reviewed and the specific factors mentioned as influencing local tree utilization and tree management practices. This table also shows that most literature concerning dynamics in tree management practices focuses on tree planting practices within the farm fields. Several studies have indicated the importance of farmers' perceptions on influencing factors determining local tree management practices (Sood and Mitchell, 2004; Ite, 2005; Zubair and Garforth, 2006).

Tree planting and management requires specific skills and knowledge of many silvicultural practices, including which species or provenances to select for a specific site, and when, and how to conduct planting, weeding, fertilizing, pruning, thinning, harvesting and plantation protection (Evans 1992). It is important to note that silvicultural techniques recommended for large-scale tree planting cannot necessarily be adapted to smallholder plantation systems (Byron 2001). In addition, the need for silvicultural management depends on individual farmers' objectives for planting trees

2.10. Contribution of tree to livelihood

Over thousands of years all over the world relied on forest as resource for their rural livelihood and remained food forest (Vinceti, 2008) forest and tree outside forest contribute to rural livelihoods of more than 1.6 billion people (FAO, 2010). The literature has documented that non- timber forest product (NTFP) provide wide range of subsistence and cash income to a large number of house hold in many countries (Narian, 2005). Some scholars (Angelsen, 2014) indicate that cash and non cash income from NTFPs range up to 60%of total household income. Also there are now numerous empirical studies showing the proportional income from NTFPs is typically markedly higher for the poorest household within community (Paumgarten, 2009). They use tree in natural forest or on the farm, to generate food or cash (Angelson, 2014). Small scale forest plantations provide a range of benefits to rural communities, including fuel wood,

fodder and wood for building and daily uses, as well as environmental and amenity benefits (FRA, 2010; Nawir et al., 2007). Yet small scale producers and poor households still reap only a small portion of the commercial benefits from plantation derived wood and processed wood products, even though plantations in developing countries produce billions of dollars' worth of these products annually. There has been also a consistent bias against smallholder forestry in most developing countries with regard to technical support, market structure and government policies (Byron, 2001).

Tree plantation provides benefit and key resource, able to help satisfy many human needs such as socio economic needs, example as employment, food, health etc and material needs such as timber, paper etc (Richardson, 2005). Rural households are often involved in harvesting, collecting, processing, consuming and selling tree plantation product and resource to compliment out puts from agricultural activates. For some household tree plantation based income generating activities can be major source of income.

In addition, there are several indirect benefits attributable to tree plantation (HAM, 2000). There are also costs associated with tree plantation that are often borne by poor rural communities sited in tree plantation area. Globally, there are growing strong concern about house hold welfare and dependence on tree plantation (Fonta, 2011).Trees were a critical recourse for the livelihood of rural people and especially small scale farmers. They maintain soil fertility and can help control erosion, provide fuel wood or charcoal energy for cooking and medicines as well as being a source of food products such as well as being a source of food products such as fruits and insects.

Tree planting has also significantly contributed to the production of non-timber forest products (NTFPs), such as honey and beeswax production. Harvesting honey and beeswax from forests has been a long-time, indigenous tradition in Ethiopia (Hartmann 2004). Ethiopia ranks fourth in the world in beeswax exports, and tenth in honey (Abebe et al. 2008), and tree planting could substantially enhance the production of these NTFPs and the country's role in the export market. Tree planting also provides food; construction materials for traditional farm implements, houses, and household furniture;

medicine; and fodder for animals. Trees can have different functions within similar or different circumstances. They are integrated in rural livelihood systems to meet people's demands (Arnold, 1997; Long and Nair, 1999; Lengkeek, 2003; Wiersum, 2004; Cedamon et al., 2005), and trees in farming systems provide directly consumable products as well as generate income and enhance the local ecological situation such as through soil improvement and their effect on micro-climate (Arnold, 1997).

The function of trees can be broadly divided into productive-, ecological- and cultural-religious functions (Wiersum, 1996).Although the primary purpose of tree plantation is to secure the demand of fuelwood and charcoal production, it is also used for construction materials, input for farm tools, environmental improvement and many other purposes at the global scale (Rahmato, 2001).

Forestry and Agriculture are two key sectors and drivers for poverty reduction, improved nutritional outcomes and inclusive growth in rural areas. They are also important for meeting food and energy demand in urban areas and critical for reversing natural resource degradation and rehabilitating degraded landscapes. In addition to agriculture-based employment and income, non timber forest products (NTFPs) play an important role in rural livelihoods and household income (MoFECCC, 2017). Ethiopia has diverse NTFPs and the development and commercialization of these products are from natural forest and woodlands across different regions

The most commercially developed NTFPs are gum Arabica, incense, honey, shade grown coffee, beeswax, and bamboo. Though there are efforts by the government and private sector in improving the productivity of these products to increase the volume of supply and income, more actions should be taken to improve NTFP production, quality assurance, value addition, marketing strategies, and efficiency in sourcing from smallholder farmers in the forest areas. The production and utilization of NTFPs can be boosted by properly surveying, mapping and understanding the resource base and their potentials for commercial utilization. Plans can then be created to improve extension services and access to input financing, introduce quality standards and to develop value

chains through establishing farmers' cooperatives to create inclusive and sustainable supply chain for effective and structured market channels.

As cited in previous study conducted by Keneni *et al*., (2021) in Ethiopia tree conservation has been part of indigenous farming system. Small-scale tree plantation is believed to play a role in solving problems associated with sustainable use of agricultural land, to reverse the adverse effect of lost forest, and to fulfill the livelihood and energy requirement of the ever increasing population.

Moreover, tree plantation ranges from purely monoculture to a complex agroforestry system. Small-scale plantations in domestic home garden agroforestry and farmlands have contributed to the conservation of useful tree species and provide supplementary food, fuel and fodder (Mekonen *et al.*, 2015).

On the other hand, Trees such as eucalyptus and other exotic tree plantations have played a role in alleviating the economic, fuel and construction material problems of the country . In countries such as Ethiopia where more than 90% of the energy is derived from wood and biomass and no other energy alternatives exist, it is not fair to discourage eucalyptus and other exotic tree plantations (Danyo*et al*., 2017; _Teshome, 2009).

Different researchers recommended to take care to avoid the unanticipated results of exotic tree plantations because there are reports suggesting that exotic plantations support much lower biodiversity are vulnerable to pathogenic fungi and cause allelopathic and other adverse effects on natural and agricultural ecosystem. Moreover signs of die-back were also observed (Gezahgne *et al*., 2004;Robertson*et al.,* 2002 andLegesse, 1995**)**.

2.11. Interaction between peoples and trees

Trees are used by people for their different functions, and trees on their turn may benefit from management practices of people. Interaction between people and trees depend on the specific tree functions and people's needs and desires, concerning both trees in- and outside- forests (Shepherd, 1992; Arnold, 1997; Degrande et al., 2006). Local people-

tree interactions are reflected in different tree utilization and tree management practices which can be analyzed from a tree perspective as well as from a landscape perspective. In order to facilitate the use of specific trees they are actively integrated in private farm fields (Boffa, 1999) with the purposes of restoring, enhancing or preserving the physical environment and their contribution to a rural household economy by securing the availability of tree products (Arnold, 1997; Wiersum, 2004).

Trees are most often integrated for their ecological- and productive- function for individual use within the farm fields, and trees with a cultural-religious function can be located on private land but the practical use for cultural-religious purpose is often a community activity. Trees can also be part of livelihood systems of farmers without managing them on private farm fields. The use and management of the trees from (communal-) forest areas contribute significantly to rural livelihoods, like the active extraction of timber or non-timber forest products for domestic use or marketing purposes. However, forest trees are outside the scope of this research as they are not spatially integrated in farm fields. Depending on the special purpose of trees, their integration in farm fields can result in a specific spatial distribution. Integration of trees with crops on private farm fields is defined as agroforestry (Nair, 1985; Nair, 1991; Sanchez, 1995), within which a distinction is made between agroforestry parklands (Augusseau et al., 2006), and trees in home-gardens and forest-gardens (Wiersum, 2004) which vary in tree density and location. Integration of trees at a broader scale, going beyond tree-crop interactions, is a result of different levels of intensity related to differences in wider institutional arrangements and peoples' preferences, resources and organization.

Trees in farm fields as a part of livelihood practices are subject to different underlying objectives and influencing factors. Analyzing the intensity with which trees are integrated in farm fields, taking into account the purpose, location and density of trees, a division can be made into six different categories ranging between scattered trees on non-arable or fallow land and tree plantations (Arnold, 1997). Even though the integration of trees in farm fields is encouraged for the provision of ecological services, they do not provide the same ecological services as trees in forests for biodiversity

conservation (Noble and Dirzo, 1997; Schulze *et al*., 2004). Therefore, trees in farm fields are rather considered in the context of rural livelihood strategies than as forest resource (Arnold, 1997). Trees on farm fields do not recreate forests (Arnold, 1997) but do contribute to land scope based biodiversity (Boffa et al., 2009).

2.12. Tree management practices

Tree management practices are carried out in order to enhance and secure the trees' function now and in the future, and are interdependent with tree utilization. Indigenous tree management practices are an expression of the indigenous knowledge concerning usefulness and harvesting techniques of trees, and the local livelihood strategies (Wiersum, 1996). According to Wiersum (1997) local tree utilization and management practices can be divided into controlled utilization, purposeful regeneration and domestication. However, the actual use of these trees for their ecological and cultural-religious functions is not taken into account. Therefore, a distinction is made between controlled harvesting and tree utilization. Controlled harvesting is an important tree focused management practices to obtain tree products, and tree utilization is the use of trees for human benefit as a result of their productive, ecological or cultural religious function. Although utilization is an important aspect determining intensity of management practices, it is not considered a tree management practice as it is a human focused practice rather than a tree focused practice. However, tree utilization and tree management practices are inseparable. The categorization of tree management practices into controlled utilization, purposeful regeneration and domestication is a manifestation of an evolutionary perspective on tree management practices in forested areas (Wiersum, 1997). This mainly results in the analysis of increasing the input of human energy in tree growing practices until trees are actively planted in farm fields. The intensity of the tree management practices are highly dependent on wider institutional arrangements. Going beyond this perspective on the domestication of trees in farming systems a pragmatic perspective is taken to increase the understanding of the local situation and dynamics in tree management practices in a little forested area. Drivers of why dynamics in tree management practices exist are widely studied (Arnold, 1997), resulting in analysis of factors driving tree planting. The practices of tree management concerning facilitation of

natural regeneration, protection and maintenance and controlled harvesting in private farm fields and changes there in, have received much less attention in the literature. A pragmatic perspective on current tree management practices taking into account purposeful regeneration, protection and maintenance and controlled harvesting will broaden the understanding of how trees are integrated in farm fields and how and why dynamics in these practices exist

Tree management practices in Ethiopia are as old as human age and indigenous culture among the people of Ethiopia. Smallholder farmers protect many woody plant species in and around their farmland and homesteads, and in turn derive ecological, material, and economic benefits from them (Hussien *et al.,* 2015). According to the authors, Knowledge of the reciprocal relationships between people and plants in general and smallholder farmers and woody plants of the agricultural landscape in particular is critical for understanding the benefits that one offers to the other. Such knowledge belongs to the indigenous knowledge domain that farming communities maintain and that does not surface very easily. The indigenous local knowledge held by local farmers of trees in farmed landscapes is important alongside modern science to manage, develop, conserve, and use on-farm trees.

Indigenous knowledge of plants and their uses is best studied by applying the methods of ethno botany/ ethno ecology, the science that deals with the study of the relationship between people and the plants they know and use in their environment (Gerique, 2006). Thus, ethno botanical studies are very much required in order to explicate the socioeconomic and cultural roles and impacts, farmers' criteria for selection, preferences, and adoption of woody species for on-farm maintenance, and market development and expansion (Van Damme and Kindt, 2012).

Indigenous local knowledge required for proper understanding, care, and use is mostly held by the community as a whole as their common and/or shared knowledge rather than by individuals, which necessitates undertaking broad surveys. Smallholder farmers, who are also owners and custodians of indigenous knowledge in Ethiopia generally, have

good understanding about the multiple uses of trees on-farm. However, the current protection of trees and planting of new ones is not encouraging (Kassa *et al.*, 2011).

Indigenous knowledge of plants and their uses is best studied by applying the methods of ethno botany/ ethno ecology, the science that deals with the study of the relationship between people and the plants they know and use in their environment (Gerique, 2006). Thus, ethno botanical studies are very much required in order to explicate the socioeconomic and cultural roles and impacts, farmers' criteria for selection, preferences, and adoption of woody species for on-farm maintenance, and market development and expansion (Van Damme and Kindt, 2012

3. RESEARCH METHODOLOGY

3.1. Description of the Study Area

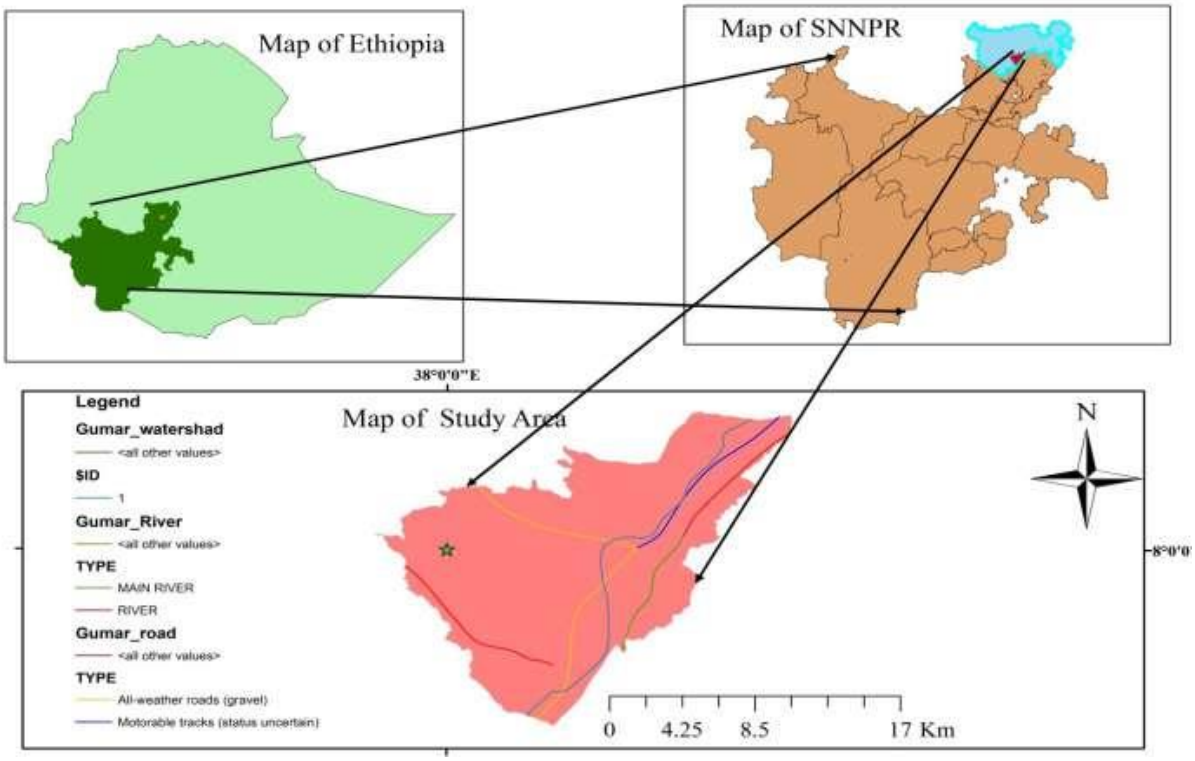
The study was carried out in Gummer Woreda, Gurage Zone, Southern Nation Nationalities People Regional State of Ethiopia. Gummer Woreda lies between 7° 54' 59" and 8°5' 59"North latitude and 38° 04' 60" and 38°12'00" East longitude and has an elevation range of 2400-3400m above sea level. The total area of this Woreda is about 24,604.78 hectares. The Woreda was named after one of the sub-groups of the Sebat Bet Gurage. It is found of 60 kilometers to the capital city of the Gurage zone and bordered on the southeast by the Silt'e Zone, on the southwest by Geta Woreda, on the northwest by Cheha Woreda, and on the north by Ezha Woreda and it comprises 18 kebeles. The administrative town of this Woreda is Arekit which is found at 220 kilometers to the south west of Addis Ababa, the capital city of Ethiopia.

Agro-ecologically, Gummer Woreda is classified as Dega (high altitude) climate zone (Ministry of Agriculture, 1998). The mean annual rainfall obtained from the monthly data on the bases of ten years records at the Gummer Woreda Agricultural Office was about 1200-1400 mm. The average maximum and minimum temperatures from 2004 to 2020 were 30°C and 13°C, respectively (Gummer woreda Agricultural office, 2021).

The total populations of the woreda is about 96,203 according to the projection made in population census of 2007, and of which female accounts for 53.3% (51,266) and male 46.7% (44,937) (CSA, 2007). It is one the most densely populated area in the country with an average of 408 peoples living per square kilometer.

The income generation and livelihoods of the population is mostly dependent on agriculture. Barley, potato, faba bean, pea, wheat, enset, different types of trees and vegetables like cabbage and carrot are the crops that grow in the area. Barley is the first leading crops in production of area coverage and it is the second most economically important crop next to potato production. Besides this, enset (*Ensete ventricosum*) was the permanently growing plant (crops) and it has a great importance in the area as the source of food for human consumption and for income generation as well as for animal feed and roof thatching.

The dissemination of agricultural information mostly takes place through advisory service, training and demonstration with the help Development Agents (DAs). Thus, DAs' are the main information provider to farmers next to telephone and radio. Even though, farmers are nowadays has access to own mobile phone, the application of mobile phone to access agricultural information is at its infant stage. Generally, in the area, the main modes of information dissemination were the traditional means.



Map of study area (Google source)

3.2. Climate and Annual Rain Fall

The mean annual rain fall of Gummer ranges between 1200-1400mm. the area have two rainy seasons: between June-September and February-April. Mean temperature of Gummer range between 16-21^{o}C(Getu et al., 2019).

3.3. Topography and Land Use

The study area predominantly traverses through flat to rolling topography, occasionally encountered rugged mountainous terrain section towards the last section at the border of the Silte Zone. Topography classification of the land is estimated as 64% flat, 30% rolling and 6% mountainous including built-up area in town and villages. There are also different small rivers and lakes (Arekit Lake).

The dominant land use and cover of the area is characterized by intensively cultivated and settled rural settings. There are annual crops like barely, bean, pea, wheat and maize, potatoes etc. Perennial crops like Enset and fruit trees are intensively cultivated along the area. Beside this, the area is known in its vegetable production such as cabbage, beat root, carrot and potatoes. On the other hand, the local communities planted different trees such as eucalyptus, acacia and other timber producing plants. The major soil types observed along the area are silt loam soil and it is the main ingredients for planting home garden plants.

3.4. Tree Plantation in the Study Area

Gummer woreda is one of the densely inhabited woredas of the country and most of the land escapes are found on the sides of the road and with cultivated home garden. One of the common features observed in the study area is tree plantation (both indigenous and exotic trees) which is located in farmers' own land and it is called homestead plantation, and hence, quite well protected. The most commonly planted trees include *Grevillearobusta,Eucalyptus* spp. (bahirzaf) and *Juniperusprocera* (tid). Most of these tree species are found in farmers' home garden and are well protected.

3.5. Target Population

The target population for this study were the farmers (households) living in Gummer woreda, DA'sin different kebeles, agricultural extensions workers and other stakeholders such as agricultural sector officers, service providers, and land management offices in the study woreda.

3.6. Sampling Design

3.6.1. Sources of data

In this research, both primary and secondary data were collected. The primary data were collected through interview (through interviewing selected households and key informants), focus group discussion and field observation. Secondary data were collected from recorded documents and reports of tree plantation at the kebele and woreda levels and published and unpublished materials concerning tree plantation in the study area.

3.6.2. Sampling techniques

Gummer Woreda has 18 rural administrative kebeles among which two are town kebeles. From the 18 kebels found in the woreda, three kebeles were purposively selected based on the information that was collected from Rural Development Office and/or Development Agents (DAs'). These kebeles were selected based on their overall scarceness of natural vegetation cover and trees planted by the community (the households residing the study area) compared to the other kebeles in the study Woreda. The sample kebeles are highly degraded as a result of erosion compared to the area in the woreda. The communities in these areas refrain from planting tree at previous years due to different demographic and natural factors.

Besides this, purposive sampling was employed to select key study informants in order to get the right respondents who are capable of giving the relevant and accurate information based on the practical experience they have concerning the issues under study. This method allows the researcher to use judgment to select cases that was best enable the research to answer the research question(s) and to achieve the objectives (Sanders *et al.*, 2009). Accordingly, 36 key informants who believed to have good knowledge about tree plantation practices in the woreda in general and in the selected kebeles in particular were selected. On the other hand, after the sample determination, simple random sampling technique was used to select the households from the three selected kebles for interviews.

3.6.3. Sample size determination

After knowing the number of household farmers (data from Woreda Rural Development Office and Kebele Managers and DAs') of the three selected kebeles, the sample size (n) of the households for interview was calculated using the formula of Yamane (1967) (Equation 1).This method is important to determine manageable sample size from large number of the study population with similar characteristics.

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

Where “n” is thesample size (the number of households from which the data were collected), “N” is the population size (total number of households in the three kebeles) and “e” is the level of precision. Accordingly, the 95% confidence level and ±5% precision, e=0.05was used to determine the sample size of the households for the interview (Table 1).

Accordingly, 282 households were sampled from the total household population of the three selected kebeles by using the proportions of the household in each kebele, employing Equation 2 (Table 1).

$$k = \frac{n * Pi}{N} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

Where: n is the total sample size selected from the three sample kebeles, in this case 282 household heads, Pi is the number of household population of the respective kebeles, N represents the total households of the three selected kebeles and k is samples of households of each kebele.

Table1. Selected kebeles, total population and sample size.

Name of selected kebeles	Total number of household	Number of sampled household
Arekit	310	92
Abeke	355	104
Abesuja	290	86

3.7. Data Collection Procedures

In order to collect relevant information for the study, different data collection tools were used. The selected households were interviewed using semi-structured questionnaires. Moreover, focus group discussion, key informant interviews and field observations were conducted to collect relevant data

3.7.1 Household Interviews

Totally, 282 randomly selected households were interviewed. Face to face interviews of the households were made to collect the primary data using the semi-structured questionnaire prepared in English (Appendix I). The questions were translated to the local language, Gurage languages, during the interview. The main parts of questions for the interview included the demographic characteristics, income and wealth status and tree plantation practices of the households, and the contributions of tree plantation to soil conservation, environmental protection and to the livelihood of the household.

3.7.2. Focus group discussion

Focus group discussions (FGDS) were conducted with twelve purposively selected farmers. Each FGD involved four household farmers from a selected kebele based on the information from Kebele managers and DAs. The purpose of conducting FGDs was to collect data concerning land size own by the household farmers in the woreda in general and those of the selected kebles in particular, current tree plantation status, contribution of trees to the livelihood of the farmers and actual trees plantation for prevention of soil erosion and compare with the information collected using the interviews. Discussion was

made based on checklist prepared in English and orally translated to the local language during the discussion.

3.7.3. Actual field observation

Actual field observation of the plantation of 36 purposively selected household farmers (12 farmers from each of the three kebeles) was made to collect relevant data and compared it with the tree plantation information collected from the households using semi-structured interviews. Field observations were performed with the help of Kebele Experts (Some people from Worda Forest and Rural Developments experts and the three Kebele Managers and Kebele Development Agents) as well as interviewee in the study area.

3.7.4 Key informants

Totally, 36 purposively selected households were interviewed. The purpose of using key informant was to collect data concerning land size own by the household farmers in the woreda in general and those of the selected kebeles in particular, current tree plantation status, contribution of trees to the livelihood of the farmers and actual trees plantation for prevention of soil erosion and compare with the information collected using the interviews. Face to face interviews of the households were made to collect the relevant data using the semi- structured questionnaire prepared in English (Appendix I)**.**

3.8. Data analysis

The collected data were recorded, cleared, organized and analyzed quantitatively by using statistical methods and qualitatively using narratives. After the interview, the questionnaires were checked for completeness in which the complete ones were coded, and the data were recorded, cleared, organized and analyzed using SPSS version 22. The qualitative data obtained for open ended questions were logically analyzed and interpreted by narratives. The association between the independent variables such as age, land size, gender, family size, educational levels and marital status of the households, and house hold income, availability of seedlings, market availability and distance of plantation from the road with tree plantation practices were checked using the chi-square (X^2).

4 RESULT AND DISCUSSION

4.1. Demographic characteristics of the households

Table 2 shows demographic characteristics of the sample households. As it can be seen from Table 2, 72% of the households were males and the remaining 28% were females. This indicated that, the majority of the selected households were male-headed. The current result is in agreement with results of the study by Mekore and Yaekob (2018)and Eyasu(2020) who reported that households in Ethiopia are predominantly male headed, while only about 25% or less of the households are headed by females and this is a common feature of most African countries (Munene, 2003).Based on the age grouping used in the current study, the maximum number of households were in the age range of 41-50 which accounting for 39 % followed by age range of 51-60 which accounting 26.6 %. Households with the age ranges of 31-40, 21-30 and above the age of 60 were 18.1%, 11.3% and 5% of the selected households, respectively. This data revealed that from the selected households, the older households (those with age more than 60) were less in number (Table 2). Therefore, the majority of the selected households were the working-age group.

In terms of marital status, the majority of the households were married 67.4 % followed by the widow which accounting about 27 % of the households while the remaining 5.7% were either single or divorced (Table 2).With respect to their educational status 46 % of the households had no formal education, 28.7 % learned primary education, 10.6 % of the households learnt up secondary education and the remaining 14.6% households had certificate or diploma and above. As it can be seen from Table 2, households having the family size of 1-3, 4-5 and 6and above were, 36%, 37% and 27%, respectively. These data demonstrated that 35.1% of the households own small family size 37.5% about average family size and considerable number of the household (27.4%) own the family size greater than the national average household size is (4.6) (CSA, 2016).

Table 2. Demographic characteristics of the respondents

Sex of the house hold		
Sex category	Frequency	Percent
Male	202	71.6
Female	80	28.4
Total	282	100.0
Age category of the respondent		
Age category	Frequency	Percent
21-30	32	11.3
31-40	51	18.1
41-50	110	39.0
51-60	75	26.6
>60	14	5.0
Total	282	100.0
Marital status of the house holds		
Marital status	Frequency	Percent
Married	190	67.4
Divorced	4	1.4
Widow	76	27.0
Single	12	4.3
Total	282	100.0
Educational level of the house holds		
Education	Frequency	Percent
Illiterate	130	46.1
Primary	81	28.7
Secondary	30	10.6
Certificate	23	8.2
diploma & above	18	6.4
Family size of the house holds		
Family size	Frequency	Percent
1-3	99	35.1
4-5	106	37.5
6 and above	77	27.4
Total	282	100

4.2 Socioeconomic Characteristics of the Households

4.2.1 Farmland holding size

Table 3 shows the estimated farmland holding size by households. As it can be seen from Table 3.32% the household farmers owned the farmland that was less than 1 ha while 39%

the households owned 1-1.5 ha farmland. Households who owned 1.5-2, 2-3 and >3 ha farmland accounting 14.1, 11.3 and 3.5% of the total selected households. These data demonstrated that the majority(71%) of the sampled households owned the farmland less than 1.5 ha and were the smallholder farms as they owned farmland smaller than 2 ha and are mainly managed with family labor (Rapsomanikis, et al., 2015). In Ethiopia, the average farm size of smallholder farmers was about 0.9 (FAO, 2015)

The average farm sizes in different parts of Ethiopia vary. For example, in less populated areas like Oromia (average farm size: 1.15 ha) and Amhara (1.09 ha) is larger than that of the densely populated Southern Nations, Nationalities, and Peoples' Region (SNNPR) (0.49 ha) (Taffesse, et al, 2013), It has been predicted that smallholder farming systems will continue to dominate the agriculture sector and that average farm sizes will continue to decline, since the further expansion of cropland will become more difficult, while the population will continue to increase (Headey, et al., 2014; Zersa et al., 2021).

Table 3. Estimated farmland holding size by households

Areas of land owned (ha)	Frequency			Percent
	Male	Female	Total	
<1	63	27	90	32%
1-1.5	70	40	110	39%
1.5-2	29	11	40	14.1%
2-3	30	30	32	11.3%
>3	10	0	10	3.5%
Total			282	100%

4.2.2. Livestock holding size

In this study, livestock holding size of the selected households was assessed in order to identifying current income and wealth status of the farmers. It was found that the common livestock types in the study areas were cattle, sheep, donkey, horse, goat and chickens, which totaling to about 3621. Out of these, cattle accounted the highest number 1261 (34.8%) followed by poultry 1100 (30.4%) and sheep 900 (24.8%) and the least

were horses which number 112(3.1 %). According to the households, cattle provide multiple benefits in rural livelihood diversification, including source of income, source of food (milk, milk product and meat), dung for fuel and fertilizer and also used to plough the land. According to (Behnke and Metaferia, 2011), about 80% of Ethiopian farmers use animal traction to plough their fields. In different part of Ethiopia, sales of larger and smaller domestic animals are used as an adaption strategy to livelihood risks such as buying food items during unpredictable crop failure, purchase of seeds and fertilizers and to meet some social obligations (Gezahegn Abebe, 2021).

Table 4.Livestock holding size of the households

Types of livestock	**Size**	**Percent**
Cattle	1261	34.8
Goat	48	1.3
Sheep	900	24.8
Poultry	1100	30.4
Donkey	200	5.6
Horse	112	3.1
Total	3621	100

4.2.3. Incomes of households

Households in the study are generated income from various sources (Table 5).The households who selected crops, trees and their products, domestic animals, daily work and trade as the main source of incomewere25.5, 24.8, 18,12.7and 10.6%of the sampled households, respectively. This shows that agriculture, daily work and trade were the main sources of income for the majority of the households in the study area. In line with the current result, USAID (2005) and Dendir and Simane (2019) reported that in the 'Highland Zone' (locally called 'Dega') of Gurage zone which include the highland parts of Ezha, Enemor and Ener, Sodo, Gummerand Mehur Aklil woredas, the main sources of income for the households are the sale of crops, migratory urban employment (trading), local employment (daily work) and the sale of livestock. Moreover, as it can be seen from Table 5,the households' ranked income from trees and their products asthe second

most important in contributing to their livelihood. In the highland woreds of the zone, apart from crops, land is used for eucalyptus plantations which are not only providing firewood for domestic purposes but also for income generation (USAID, 2005).

According to the local wealth differentiation that depends on the total asset ownership of the households, about 155 (55%), 99 (35%) and 28 (10%) of the households were categorized as low income, middle income and high income, respectively (Table 5). This result showed that the majority of the households belonged to the low income classes whereas high and middle-income households were relatively smaller. In the study area land holding size, livestock holding size, having multiple sources of incomes and the estimated total assets are the main factors the local managers used to categorize the households to the three economic classes.

Table 5.Major source of household incomes in the study area.

Variables	**Categories of the variables**	**Frequency**	**%**
Major source of income	Crops	72	25.5
	Trees and their products	70	24.8
	Domestic animals	51	18
	Daily works	34	12.7
	Trade	29	10.6
	Salary	21	6.7
	Others	5	1.7
Economic status	Low (less than100,000 Birr)	155	55
	Middle ((100,000-250,000 Birr)	99	35
	High (above 250,000 Birr)	28	10

4.3. Factors affecting tree plantation practices

In the current study, the selected households were asked to choose the main factors that affecting tree plantation practices in the study area form the list of potential factors. Table 6 shows factors affecting tree plantation practice in the selected kebeles of

Gummer woreda as perceived by the households. As it can be shown in Table 6, from the total interviewed households, 94.7% selected that land size is one of the main factors that affect tree plantation in the study area. Households 'income, availability of seedlings, labor (family size), availability of market, government supports, age of the households and genders were also selected by 76.2%, 67.4%, 63.1%, 45%, 42.6%, 39.4% and 23.4% of the households as the factors that affect tree plantation practices of the farmers in the study area.

In the study area, land holding sizes are relatively small similar to most highland of Ethiopia and this might highly affect the tree plantation practices in the study s area. According to Ajayi (2003) land size has a positive association with farmers' decisions to plant trees on their farms. According to Salam (2000), tree planter farmers own relatively larger land compared to non-tree planters. It is evident that farmers with large areas of land tend to plant and manage trees more than the farmers with limited land (Amacher, 1993).

Farmers with larger farm size are probably able to plant trees compared to farmers with small farm size who are unable or unwilling to plant trees. Limited land influence agro forestry practice and therefore deserves particular attention when planning and implementing agro forestry development. Similar reports of positive effects of farm size on tree planting were also reported in Tigre, Ethiopia (Gebreegziabher & Mekonnen, 2010; Mekonnen & Damte, 2011). Farmers with less access to resources, particularly land, may focus on the cultivation of a few staple food crops for their subsistence production, depending on their individual relative benefit (Melaku and Asfaw, 2020).Similarly, a study carried out in Shinyalu Sub-County of Kenya identified land size as the first and main factors influencing adoption of on-farm tree planting (Khalwale et al., 2018). According to the study, the land sizes in Shinyalu Sub-County were very small with majority of the respondents having less than 0.8 ha and they opted to plant food crops and rear livestock for milk production in order to feed their families(Khalwale et al., 2018).

According to Zerga, et al. (2021), the drivers for the expansion of eucalypts in Gurage Zone particularly, in Western Gurage Zone Watersheds, are population growth, increased access to markets and economic factors, such as the growing need for fuel wood, construction materials, and growing need for money. It was reported that it seems that the cost and benefit on the use of eucalypts is known by farmers. For farmers, eucalypts mean "living bank account" (Turnbull, 1999; Teketay, 2000) that can be used when one is in need of money for different purposes, such as to pay land or agricultural taxes, yearly celebrations of Meskel and Arafah , and for supporting social institutions, such as Mahiber (religious shindig) , wedding, Eekub (rotating money funding system among individuals) and Idir (monthly money collection system for funeral service). Even when a farmer needs to cultivate own farmland, one has to have enough money so as to pay for daily laborers and to purchase food items such as teff, coffee, meat and local drinks. The money required for such and others expenses comes from the sale of eucalyptus poles of different sizes (small, medium and big) in addition to selling some cash crops (Zerga, et al., 2021).

Table 6. Factors affecting tree plantation practice as perceived by the selected households.

Factors	Number and percentage of households			
	Male	Female	Total	%
Land size	193	74	267	94.7
Household income	162	53	215	76.2
Availability of seedling	140	50	190	67.4
Family size	135	43	178	63.1
Availability of market	90	37	127	45.0
Government support	89	31	120	42.6
Age of household	89	32	111	39.4
Genders	30	36	66	23.4
Lack of awareness	33	11	44	15.6
Others	25	15	40	14.2

According to Zerssa et al. (2021), due to growing population pressure and the limited availability of unexploited land the size of farmland has been decreasing in Ethiopia. Farm size plays a critical role in the adoption of new technologies and planting trees. Farmers with larger farms were found to be more likely to adopt climate smart agriculture (CSA) practices, since they could use one part of the farm for trying new techniques and the other part for conventional practices. In contrast, farmers with small farms are hesitant to apply new technologies, since they are afraid of the uncertainty of obtaining the claimed benefit.

As it can be seen from Table 6, the age of household head also affect tree plantation practice. The respondent who perceive that age of household head is important factors for tree plantation suggested that older farmers are more likely to participate in tree planting practices because their opportunities to be employed or engaged in other farm activities is relatively limited compared to younger people who tend to have more employment choices. Gender as a factor that affects tree plantation practices was also selected by considerable proportions of households (about 23.5%). The households who selected gender as one of the factors that affect tree plantation suggested that it is the husband (the male, household head) who is in charge of anything to do with the land and the available resources.

4.4 Criteria used to select trees for plantation

In the study area, the household farmers select trees they plant based on various criteria. Fig. 1 shows the criteria the households use to select trees for plantation and the percentage of sampled households that select trees based on the respective criteria for plantation. As it can be seen from Fig. 94%.of the households replied that they select trees for plantation based on the suitability for firewood and construction. Moreover, 83.3% of the households select trees for plantation based on the income they generate, 64.9% based on the seedling establishment, 60.9% based on growth rate, 21.3% for ecological service they provide and 16.3% households select tress based on other criteria such as availability of seedling and pervious experiences. According to Richardson, tree plantation provides benefit and key resource, able to help satisfy many human needs such as socio economic needs, example as employment, food, health etc and material needs such as timber, paper etc (Richardson, 2005). Rural households are often involved in harvesting, collecting, processing, consuming

and selling tree plantation product and resource to compliment out puts from agricultural activates. For some household tree plantation based income generating activities can be major source of income. In addition, there are several indirect benefits attributable to tree plantation (HAM, 2000). There are also costs associated with tree plantation that are often borne by poor rural communities sited in tree plantation area. Globally, there are growing strong concern about house hold welfare and dependence on tree plantation (Fonta, 2011)

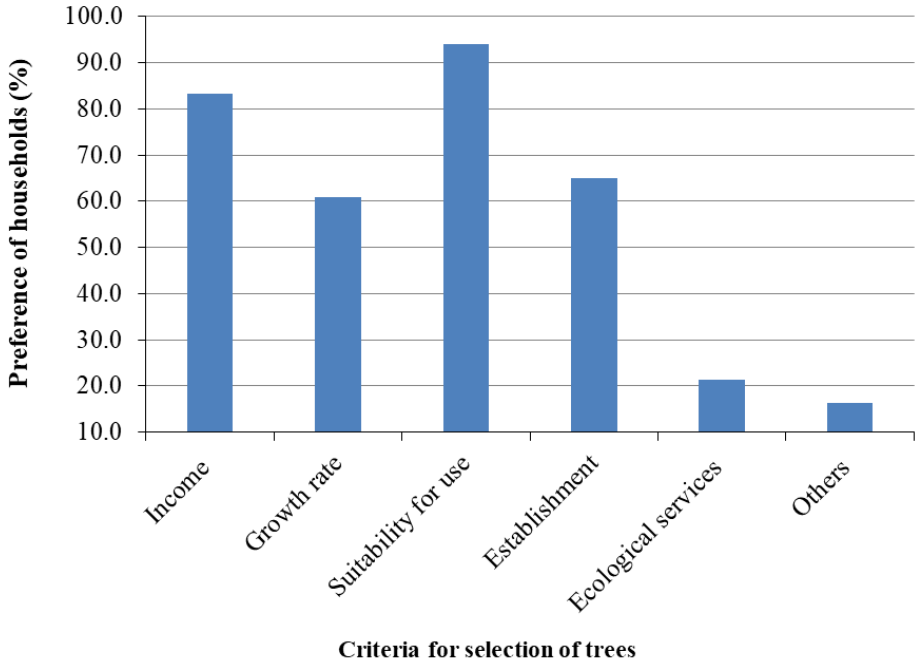


Figure 1. Criteria the households used to select trees for plantation

Table 7 shows the preference of the household to prepare tree seedling for plantation. As it can be seen from Table 7, majority of the household 63.5% showed that they prefer planting exotic trees while only 36.5% preferred to plant indigenous ones. Concerning selection of tree types for seedling preparation, 39.7%, 32.9 and 27.3% of the households indicate that they prepare seedlings of exotic, indigenous and both types, respectively. Moreover, 56.7% of the sampled household suggested that indigenous trees need more care for establishment/ and grow than the exotic ones (Table 7). These results revealed that in the study area, the households prefer planting exotic trees than the indigenous ones as the HHs perceived that seedlings of exotic trees could be easily prepared, and

their seeding establishment is also superior compared to the indigenous ones. Moreover the presence of exotic trees such as eucalyptus has immensely reduced the pressure on remnant indigenous trees by substituting for fuel, construction material and income source. Hence, many argue that it is important to educate farmers to plant and conserve indigenous trees beside exotic ones. Several studies have been carried out on indigenous tree propagation methods, establishment and habitat requirements. The establishment of demonstration site and field research centers (for example, Gulele subcity of Addis Ababa and Center for Indigenous Trees Propagation and Biodiversity Development at Tulu Korma, Addis Alem, in West-Shewa Zone of Oromia Regional State) are evidences for indigenous tree conservation and propagation efforts (Keneni *et al*.,2021).

Table7. Preference of tree seedling preparation for plantation

Variables	Number and percentage of households		
	Exotics	Indigenous	Both types
Types of trees the HHs prefer most to plant	179 (63.5%)	103 (36.5%)	0
Types of tree seedlings the HHs prepare for planting	112 (39.7%)	93 (32.9)	77 (27.3%)
Tree seedling prepared more easily	130(46%)	107 (38%)	45 (16%)
Types of trees need more care for establishment/grow	122 (43.2%)	160 (56.7)	0

4.5. Associations between Various Factors and Tree Plantation Practices

4.5.1. Gender, educational level and market and seedling availability

Association of gender, educational level and market and seedling availability and tree plantation practices of the households were determined based on the average tree seedlings planted by the households per year (Table 8).

Association of gender and tree plantation

Out of the sampled 282 households, 202 were males and 80 were females (Table 2). Among the male headed HHs, 83% were averagely planted about 150-200 trees per year while 17% planted 201-500 trees per year (Table 8).From the total sampled female headed HHs, 80% averagely planted 150-200 trees per year whereas 20% did not plant trees. In the study area, there is no farmer (household) who planted averagely more than 500 tree seedlings per year. The coefficient of the independent variable (β) for sex related factors affecting plantation of tree in the study area was 0.064 with p-value of 0.00. Other factor remains constant, a one or more increase in gender difference results in 0.064 increase in tree plantation on average. Gender related factors in the study were found to be significantly ($p \leq 0.05$) affected tree plantation since the p value of the variable is less than 0.05(0.000). A study by Pattanayak (2003) found that gender related factors significantly ($p \leq 0.05$) affected tree planting activities, with male headed household and family with more male member being found to be more active in tree planting

Table8. Association between gender, educational level and market and seedling availability and tree plantation

Types of Factors	**Number of trees planted per year**				**B**	**P**
Gender	150-200	201-500	Never plant	Total		
Men	168	34	0	202	0.064	0.000
Women	64	0	16	80		
Educational level						
Illiterate	130	0	0	130	0.47	0.00
Primary	80	1	0	81		
Secondary	12	18	0	30		
Certificate	0	19	4	23		
Diploma &above	0	6	12	18		
Market availability						
Available	222	28	0	250		

Medium	0	16	6	22	0.35	0.02
Non available	0	0	10	10		

Seedling availability

Available	162	22	4	188	0.31	0.001
Medium	30	22	7	59		
Non available	30	0	5	35		

Where p is the significance level used ($p \leq 0.05$) and β refers to coefficient of the independent variable

Association of educational level and tree plantation

Educational level is one of the factors that determine tree plantation. As it is known that tree plantation improves environmental climate change and it is acquired through formal education beside indigenous knowledge. Formal education helps to acquire the capacity to access knowledge and skills relating to tree plantation tools through different extension services. As presented in Table 8 out of the total respondents, 46% of the households had no any formal knowledge while the remaining 28.8%, 10.7%, 8% and 6.4% had primary school education, secondary, hold certificate and hold diploma/degree respectively. In this study, although formal education has positive effect on tree plantation, 46.1% households who were illiterate planted between 150-200 trees per year. This implies that, the local farmers in the study area used their indigenous knowledge and their previous tree planting habit as well. On the other hand, 21.5% of respondents planted more than 200 tree seedlings per year (those who had formal education). Furthermore, 32.7% of the households participating in tree planting (150-200 seedlings per years) in their nearby lands (those who have primary and secondary education) and the remaining 5.7% of the respondents of never planted tree seedling in their surrounding due to Different socio-economic factors such as lack land and very small land size and other many. Unfortunately, the statistical association was significant at the 0.05 level between educational level and tree plantation practices since the

p value of the association is less than 0.05(0.00). Education related factors (EDU) have positive and significant effect on tree plantation of the study sites or study area. The coefficient of the independent variable (thesis power educational level of the respondents) is 0.475) with the p-value of 0.000. Other factor remain constant a one or more increase in educational level of the respondents results a 0.475 (47.5%) increase in tree plantation on average. Similarly Blaug (1972) revealed that education is positively associated with probability to adopt tree plantation practice. Those who are learned have more knowledge on the proper ways to plant trees, the best quality of seedling and the right species to plant.

Association of market availability and tree plantation

From the findings, market availability was one of the key factors affecting tree plantation. In this regard, market availability initiates the households to plant a lot of tree seedling per year. Out of the total respondents, 78.7% of the households planted about (150-200) tree seedling due to market availability. Moreover, 88.6% of respondents practices in tree plantation because of market availability in the study area. On the other hand, 7.8% of the households practices tree plantation (planted between 201-500 tree seedlings per year) due to medium market availability. This shows that, market availability in this area encourage the households to plant tree seedling while the other 5.7% of the respondents never plant tree seedling at their nearby environment (table 8). The association of market availability and tree plantation in the study area is very strong. Beside this, the statistical evidence clear out the condition and shows that, market availability had significant effect on tree plantation since the p value is less than 0.05(0.02).

Association of seedling availability and tree plantation

Of the 282 households who were participating in this study, 66.6% of the households were planted tree seedling due to availability of seedling. In addition to this, 21% of the households planted tree seedling because of medium seedling availability. While other, 5.7% of the households never plant and they replied that they were fail to access seedling in their surroundings (table 8). The overall response of the households revealed that, seedling

availability highly determine tree plantation in the study area. Therefore, in the current study, there was strong association ($p \leq 0.05$) between availability of seedlings and household tree plantation practices.

4.5.2. Effects of age, family size, household income, distance from road and marital status

Table 9 show the effects of age, family size, household income, distance from road and marital on tree plantation practices of the households. The associations of each factor with tree plantation practices of the households were discussed hereunder.

Effect of age related factors on tree plantation

Age have a positive and significant effect on tree plantation of study area. The coefficient of the age related factors is 0.086 and p value of 0.017. Other factor remains constant a one or more year increase in age of the respondents results a 0.086 increase in tree plantation on average. In this study older house hold were highly participated in planting tree than those younger family members. Similarly other studies shown that, Older farmers are more likely to participate in on-farm tree planting because their opportunities to be employed or engaged in other livelihood activities is more limited compared to younger people who tend to have more employment choices. In Vietnam, according to Thoai and Rañola (2010), age, which reflects upland farmer's farm experience, is one of the most important factors affecting the decision of upland farmers to participate in on-farm tree planting. It was also supported by Lwayo and Maritim (2003).

Table9. Effects of age, family size, household income, distance from road and marital status on tree plantation

Factors	B	p value
Age of respondents	0.86	0.017
Family size of the respondents	-.063	0.223
Household income	0.071	0.011
Distance from the road	-.576	0.000
Marital status	0.026	0.490

Where p is the significance level used ($p \leq 0.05$) and β refers to coefficient of the independent variable.

In contradict with this, Alassaf (2011) found that age have negative effects on decision of farmers to participate in on-farm tree planting. The age of the farmer affects knowledge and awareness of activities in the surrounding environment. The study conducted in Western Uganda found that, younger household heads are more likely to adopt on-farm tree planting compared to the older farmers (Thangata 1996). This is probably because the younger households are ready to take risk relative to older households and thus likely to adopt on-farm tree planting. Adesina, *et al.* (2001), also agreed with this study by reporting adoption of tree planting decreases with advanced age. Age has largely been found to be significant in deciding whether to continue with the technology or not (Ajayi, *et al.*, 2006). Older farmers were not willing to continue with the technology as compared to younger ones.

Effects of family size on tree plantation

Family size has negative and insignificant effect on tree plantation of the study. The coefficient of the family is (-0.063) with the p-value of 0.223. This implies that one or more increase in family size will results 0.063 decreases in tree plantation on average. But the finding is not significant since the p value of the variable (FS) greater than 0.05. Similarly the study conducted by Thalma(2018) found that family size had negative impact on tree plantation in Kenya. In kneya, family size was rated as a very important factor influencing adoption of on-farm tree planting. Most of the respondents with family sizes of 10 members and above had the lowest mean number of trees planted on their farms 65.9, family sizes of 7-9 members had a mean of 78 trees, family sizes of 4-6 members had a mean of 83.6 trees planted on their farms. This shows that the larger the family size, the fewer the number of trees planted. This can be explained by the cultural belief that sons in the home have to be sub-divided part of their father's land. Households that have more children will therefore plant fewer trees because the land that would have been used to plant trees will be allocated to the male children (Thalma, *et.al.* 2018).

Effects of Marital status on tree plantation

The effect of marital status (MS) in this study is insignificant. The coefficient of the marital status was found to be (0.026) with the p-value 0.490. The effect of the marital status was not visible or insignificant here since the p-value of the variable (MS) was greater than 0.05(p-value=0.490).

Effects of House hold income on tree plantation

House hold income (HHI) is one of the major factors affecting tree plantation in Gummer woreda. In this study house hold income has positive and statistical significant impact on tree plantation in study area. The coefficient of the house hold income is found to be (0.071) with p-value of (0.011). Other factor remain constant a one or more birr increase in house income results a 0.071 increase in tree plantation on average.

Effects road distance on tree plantation

The result of model in study showed that road distance had negative relationships with the tree plantation, and statistically significant (p-value = 0.00) at 1% level. This implies that every one percent change (increase or decrease) in the distance of road keeping the other thing constant had a resultant change of (-0.576) on the tree plantation on opposite direction. The results also suggested that the longer the distance, the fewer seedlings it will plant. The possible reason is that, distance increase the house hold frequently fail to care the plant as result they prohibited from planting trees at longer distance.

4.6. Major Trees Planted by the Households

In this study, guide filed observation of the farmlands and tree plantation practices of 36 purposively selected households was employed to collected relevant data on frequently planted trees in the study area. The field observation was carried out in the presence of the selected farmers, GAs and kebele managers to facilitate the activity. During observation, the common names of trees planted by the farmers, in the local language (Guragigna) and Amharic, was recorded and the identification of the trees (at the families, genera and species levels) was made by using the photographs, Google search, by referring to a previous ethno-botanical study by Ahmed (2021) and by consulting experts (including the supervisor of the MSc student).

The trees planted by the selected smallholder famers in the study area are presented in Table 10. As it can be observed from Table 10, the selected farmers planted 13 tree species which were classified under 13genera and 10families. These trees have various socio-economic values for the communities residing the area. Regarding their values trees in study area used for treating human and livestock diseases, prevent soil erosion, improve soil fertility, serves as food and fodder, fuel and charcoal, construction and timber production were mentioned by the households. Small scale tree plantations provide a range of benefits to rural communities, including fuel wood, fodder and wood for building and daily uses, as well as environmental and amenity benefits (FRA, 2010; Nawir et al., 2007). Tree plantation provides benefit and key resource, able to help satisfy many human needs such as socio economic needs, example as employment, food, health etc. and material needs such as timber, paper etc. (Richardson, 2005).

Table10. Major type's tree grown in the study area.

No	Scientific name	Family	Local name (Guragigna)	Uses
1	*Acacia species* Hochst.exBenth	Fabaceae	Girrar	Prevent soil erosion, charcoal and fuel
2	*Afrocarpus falcatus* (Thunb.) C.N. Page	Podocarpaceae	Zigba	Prevent soil erosion, construction, timber production and fuel
3	Highland bamboo (*Oldeania alpina*)	Poaceae	Enet	To prevent soil erosion, construction, and fuel
4	*Erythrina brucei*	Fabaceae	Burat	To prevent Soil erosion and medicine
5	*Cordia Africana* Lam.	Boraginaceae	Wanza	Used in agro forestry, firewood, timber, shade, soil fertility improvement and prevent soil erosion
6	*Eucalyptus globulus* Labill.	Myrtaceae	Eche	Charcoal and fuel, construction, prevent soil erosion
7	*Cupressus lusitanica Mill.*	Cupressaceae		Construction, firewood, prevent soil erosion
8	*Euphorbia ampliphylla*Pax	Euphorbiaceae	Kulkual	Medicine, prevent soil erosion
9	*Hageniaabyssinica* (Bruce) J. F. Gmel	Rosaceae	Chima	Medicine, fuel, timber and construction
10	*Juniperus procera* Hochst. ex Endl.	Cuppressaceae	Det	Timber, charcoal and fuel, construction
11	*Olea europaea* subsp. *Cuspidate*	Oleaceae	Weyra	To treat diseases, fuel, soil conservation
12	*Prunuspersica* (L.) Batsch	Rosaceae	Kok	Food, medicine, fuel and construction
13	*Grevillea robusta* A. Cunn. ex R. Br.	Proteaceae	Greviliya	Charcoal and fuel, construction, prevent soil erosion

4.7. Ecological and Economical Contribution of Tree Plantation

In the study areas, stallholder farmers plant different tree species which have different value. The farmer select trees for plantation mainly based the benefits they contribute. The major uses of trees in the study area are discussed below.

Table 12 sows the contributions of tree plantation to soil conservation and livelihood of the households in the study area. As it can be seen from Table 11, 92.9% and 7.1% of the households strongly agreed and agree to the reduction of soil erosion by tree plantation, respectively. This implies that, the households (the farmers) in the study area had good understanding concerning the benefits of trees to reduce soil erosion. There is no respondent who disagreed with the reduction of erosion by tree plantation. Moreover, majority of the respondents (95.7%) had strongly agreed that tree plantation improves soil fertility while 4.3% agreed to the same statement. This result revealed that the households of the study area had very good awareness toward tree plantation to improve soil erosion. According to Acharya (2006) trees provides important economic and environmental benefits. In addition, small wood lots on agricultural land play similar roles and are increasingly recognized for their contribution to solving energy problems, enhancing biodiversity conservation, addressing deforestation and mitigating climate change.

Table 11. Contributions of plantation of different types of trees to soil conservation and the livelihood as rated by the households.

Variables	SD (%)	D (%)	US (%)	A (%)	SA (%)
Tree plantation reduce soil erosion				7.1	92.9
Tree plantation improves soil fertility				4.3	95.7
Tree negatively affect the yield of nearby crops				6	94
Indigenous tree more preferable to prevent erosion and maintains good climate than exotic ones			10.3	21.3	68.4
You usually plant tree for the purpose of soil conservation			15	40	45
You plant tree for this purpose only on hilly /sloppy area			4.6	49.3	46.1
Most farmers in your kebele know that planting tree prevent soil erosion and maintain good climate		7		65	28
Exotic trees increase soil fertility than indigenous ones	45	45	10		
Income from trees are the key to the livelihood of the households			2	69	29

Where SD refers to Strongly disagree, D = Disagree, US = Unsure, A = Agree and SA = Strongly agree.

According to the results in Table 11, the majority of the interviewed households (94%) strongly agreed that tree negatively affect the yield of nearby crops and the remaining 6% of the respondents agreed to the same statement. Regarding the negative impacts of trees on the yield of nearby crops, the households mentioned that some species of trees reduce the growth and yield of some crops and vegetables grown nearer to them. Among these, most of the exotic trees such as *Eucalyptus globulus and Cupressus lusitanica* andsome indigenous ones*(Juniperusprocera,Afrocarpusfalcatus* and *Hageniaabyssinica) have such*

*properties.*According to the respondents, some of the crops and vegetables that are mostly affected if planted nearer to aforementioned trees are *Allium cepa, Allium sativum, Beta vulgaris, Brassica carinata, Daucus carota, Enseteventricosum, Hordeum vulgare and Solanum tuberosum.* The possible reason they suggested was that trees had long and large horizontal roots that would compete with crops for nutrient particularly minerals and water. These trees do also produce larger branches and many leaves that forms shades on the crops and reduce the rate of photosynthesis. Moreover, the respondents mentioned that leaves and barks of those trees may fall on the crops and damage shoots of the crops. Furthermore, leaves that fall on the soil and water drops from *Eucalyptus globulus* and *Cupressus lusitanica* have inhibition effects on the growth of the crops when the crops were grown under the shade of these trees.

As it is depicted in Table 11, the majority of the households (89.7%) were strongly agreed/agreed that indigenous tree are more preferable to prevent erosion and maintains good climate than exotic ones. The possible reasons the respondents forwarded were that indigenous trees are more adaptable to climatic changes, cause less harm to crops and other plants grown nearer to them and are suitable using in agro-forestry than the exotic ones.

Regarding tree plantation and soil conservations measures, about 85% of the households showed that they plant trees for the purpose of soil conservation, one of the reason they plant trees on sloppy and hilly areas is to reduce soil erosion. About the 95.4% of the respondents agreed that they plant trees for the purpose of reducing soil erosion on hilly /sloppy areas (Table 11). Moreover, about 93% of the interviewed households strongly agreed/agreed that most farmers in their kebele know that planting tree can prevent soil erosion and maintain good climate (Table 11).

Concerning improving soil fertility, about 90% of the households disagreed to the statement says that exotic trees increase soil fertility than the indigenous ones. Concerning this, interviewed households and the key informants argued that indigenous trees are more preferable in keeping the soil fertility. The leaves of most indigenous trees can fall on the soil, decay and increase the soil fertility while the leaves and water drops from the leaves of some exotic trees such as eucalyptus inhibits and sometimes burns the leaves of some crops

and newly growing seedlings, Thus, the farmers of the study area more prefer indigenous trees for improvement of soil fertility and soil conservation compared to the exotic ones.

According to interviewed households, tree plantation in the study area provides several benefits to farmers. From the responses of interviewed farmers and key informants, it was noticed that trees are the one of major income sources for local communities. The study area is very productive in terms of some tree species such as *Juniperusprocera, Hageniaa abyssinica, Eucalyptus globulus, Cordia Africana, highland bamboo (Oldeania alpina, Acacia abyssinica and Afrocarpusfalcatus,* and these trees were considered as the major income sourcesinn the studied keels. They are important source for timber, poles and other construction materials, sources of lumber for furniture making, sources of charcoal, firewood and others. This means, in addition to home-based consumption, the farmers earn money by selling trees and tree product, and then use the money for various purposes. On this regard, about 98% of the interviewed households agreed that income from trees is the key to the livelihood of the households (Table 11). Also there are now numerous empirical studies showing the proportional income from trees is typically markedly higher for the poorest household within community (Paumgarten, 2009). They use tree in natural forest or on the farm, to generate food or cash (Angelson, 2014). Small scale for tree plantations provide a range of benefits to rural communities, including fuel wood, fodder and wood for building and daily uses, as well as environmental and amenity benefits (FRA, 2010; Nawir et al., 2007).

From the key informant interview and discussion with the households, it was noticed that although the local communities are dependent on trees and cut trees frequently, the elder peoples frequently advice the community by saying that" cutting tree has greater pain than killing. Thus, the elder recommend not cutting trees, particularly, the indigenous ones, without replacing them ahead of time.

5. CONCLUSION AND RECOMMENDATION

5.1. Conclusion

This study was conducted to determine factors that affect small-scale tree plantation practices of the farmers in Gummer Woreda, Gurage zone and the benefits of trees to improve the livelihood of the smallholder farmers. The results showed land holding size, household income, availability of tree seedlings, labor (family size), availability of market, age and genders of the household heads were the main factor that affect small scale tree plantation in the study area. The results also revealed that land holding size in the study area is small and majority of the farmers (about 71%) owned less than 1.5 ha farmland. The main sources of income for the households of the study area were crop cultivation, trees and their products, domestic animals, daily work and trade. Based on local wealth differentiation, majority of the households (90%) were categorized under low and middle income. Farmers of the study area mainly select trees for plantation based on the suitability for use, the income it generates, seedling establishment, growth rate and ecological service they provide. In the study area, farmers commonly plant 13 tree species which were classified under 13 genera and 10 families. The most frequently planted trees were exotic trees which include *Eucalyptus globulus*, *Cupressus lusitanica and Grevillea robusta.* Benefits of trees to the livelihood of the farmers of the study area include, providing poles, timber, lumber and other materials for construction and furniture making, providing charcoal and firewood for home-based consumption and sale, as the second source of income next to crops, providing ecological services such as reducing soil erosion, improving soil fertility and maintain good climate and providing herbal medicine for the local community.

5.2 Recommendation

- The results of the study farmers most frequently plant exotic trees although indigenous trees are less common but, less affect the crops and vegetables planted around them. Therefore, it is recommended that the governmental and non-governmental organizations should encourage the farmers through trainings and supplying indigenous tress seedling to plant in addition to the exotic ones.

- The results of the study showed that educational level had positive effect on tree plantation. Therefore, it is better to give trainings to the farmers concerning tree plantation and their uses could more intimate the farmer for tree plantations.

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APPENDICES

Appendix I. Semi-structure interview questions administrated to sampled households

Dear respondent,

This interview questions are designed to collect data for the MSc Thesis research entitled "Factors Affecting Tree Plantation Practices and Contribution of the Plantations to the Livelihood of Farmers in Gummer Woreda, Gurage Zone, Ethiopia". The questions are prepared only to collect information related to tree plantation practices and the contributions of plantations to the livelihoods of the farmers in the indicated district (woreda), and the data collected is also used only for this purpose. Therefore, would you please, feel free and give your generous responses to the questions.

General Information about the Respondent

Date of data collection: _____

Name of the respondent: _____

Name of the enumerator: _____

Name of the kebele/village:_____

Household's Characteristics

Sex of the respondent: a. Male b. Female

Age of respondent (in completed years) _____

Religion _____

What is your highest level of education?

No education/never been to school e. Diplomat and above

Primary education f. Non-formal (adult education)

Secondary education

Certificate

4. Marital status: a. Married b. Divorced c. Widowed d. Single

Total household size _____

i) a. No.of children _____b. No. of adults (> 18 years) _____

ii) a. No. of dependents _____ b. No. of independents _____

Income and Wealth (encircle the correct choice or fill in blank spaces)

Estimated total area of land owned (in hectare): a. No plot of land at all b. < 1 ha c. 1-1.5 ha c. $1.5<x \leq 2$ ha d. $2<x \leq 3$ ha e. $3<x \leq 4$ ha f. > 4 ha

For how long have you owned the land in question No.1? _____ (years).

Respective size of land (ha) used as: a. Homegarden _____ b. Outside of homegraden _____

Do you have rented plot of land from other farmer(s)/shared land for tree plantation or crop cultivation? a. Yes .b. No

If your answer for question No. 4 is yes: a) Area of land rented/shared (ha) _____ b. The rented/shared land is used for crop cultivation/tree plantation (choose one) _____

What types of major trees/crops do you produce? (Underline all that apply)

Eucalyptus, Wanza,Zigba , Cupressus (Yeferenjtsid), Acacia, Moringa, Bamboo, Grevillea, Croton (Bisana), others

_____

Ensete, Coffee, Chat, Banana, Avocado, Zytun, Sugarcane, Mango, Papaya, others _____

Maize, Haricot beans, Broad beans, Peas, Sorghum, Lentils, others _____

Cabbage, Potato, Sweet potato, Beetroot, Carrot, Tomato, Garlic, Boyina, others _____

Does your household have livestock? a. Yes b. No

If 'Yes', specify the number of each type listed below.

Oxen _____ Cows: _____ Calves _____ Heifers _____

Bulls _____ Goats : _____ Sheep _____ Chickens _____

Donkeys _____ Horses _____ Mule s _____ Others _____

Table1. Rank the following sources of income for your household from 1 to 7 (in Table below).

No.	Types of your household income	Rank of income(from 1-7)
I	Crops (Coffee, Chat, Maize, Haricot bean, Sorghum, Sugarcane,, etc)	
i i	Trees and their products (Eucalyptus, Wanza, Zigba, Yebahirtsid, etc)	
i i i	Domestic animals (Goat, Sheep, Chickens, Cows, Oxen, Donkeys, etc.)	
i v	Daily work (as daily laborer)	
V	Trade (specify the type of trade here)	
v i	Salary (specifythe type of work here)	
v ii	Other (specify).....	

What is the estimated value of your current total assets? Birr _____

Based on your current income & wealth, to which group of the community/farmers do you belong to? a. Low income b. Middle income c. High income

What is your estimated average expenditure on tree plantation inputs per year? Birr _____

Tree Plantation Practices

What are the factors that affect tree plantation? (You can choose more than one).a. land size b. availability of tree seedlings c. laborer/ family size d. household income e.Lack of government support f. Lack of awareness g. Other _____

Where do you mostly plant trees? (You can choose more than one alternatives).

a. in home-garden b. in farmland c. on degraded land, d. on roadside e. on separated land for trees f. on fences g. on boundaries of your land h. other (specify) _____

What are the most important criteria you use to select trees for plantation?

a. Income it generates b. Rate of growth c. Suitability for firewood & construction d. Seedling establishment d. Ecological service it provides (e,g, as shed, not to affect other plants, erosion protection, soil fertility, etc.) f. Others (specify) _____

Generally,which type of trees do you more prefer to plant? a. Indigenous trees b. Exotic

Why do you prefer indigenous or exotic? (Simply write/tellyour own opinion). _____

Usually, you get tree seedlings from: a. a market b. by growing it yourselfc. friends as gift d. gift from GO /NGO e. from forest areas f. Other _____

Choose the supports you get from Agricultural & Rural Development Agents/Offices concerning tree plantation. (You can choose more than one). a. Advice/trainings of

nurserypreparation& care for trees b. Seedlings as gift/ with lower price c. Other (specify) _____

If you prepare seedlings by yourself, which types of tree seedlings do you germinate most? a. Indigenous trees b. Exotic trees c. both in equal proportion

Which tree seedlings can be prepared more easily? a. Indigenous trees b. Exotic trees c. both d. preparation of both tree seedlings is difficult

Which trees need more care for establishment/grow? a. Indigenous trees b. Exotic trees

What are your frequent practices for best establishment/growth of trees? A. fencing b. watering c. mulching/shading d. other (specify) _____

From your HH, Who does/domostly make decision on tree plantation and consumption?

a. the husband b. wife c. children d. based on agreements of all family members

From your HH, who is more responsible for caring for planted trees (watering, hoeing, fencing, etc)?

a. famales b. malesc. all family members d. hired labor

How many tree seedlings (estimated) do your plant every year (on average)?

i. No of indigenous tree seedlings = _____ ii) Exotic tree seedlings = _____

Estimated percentage of seedlings established from those planted:

i. % of indigenous tree seedlings =_____ ii) % exotic tree seedlings = _____

Table2.Sizes of land used for only crop cultivation, tree plantation or mixed (ha) (from total land owned).

	Types of farmland based on use	Size (ha)

I	Typical farmland (only for crop cultivation)	
i	Only for tree plantation (fully covered with trees)	
i	Agroforestry (mixed, both crop & trees)	
i	Others (specify) ……	

Table 3.List the most common trees that you grow together on the same land

i	Types land	Names of trees/crops grow together
1	In home-graden	i .
		i i .
		i i i .
		i v .
2	On farmland (outside home-garden)	i .
		i i .
		i i i .
3	On land used only for tree plantation	i .
		i i .
		i i i .

Table 4.List the most commonly grownand most marketable trees, respectively(for your household) in ranks (1 indicates the most commonly planted/marketable). Trees you list & rank may includeWanza, Zigba, Besana, Acacia, *Ficus*spp. (Sholla), Moringa, Bamboo, Birbira, Eucalyptus Yeferenjtsid, Grevillea, Neem, ……..etc.

i	Most commonly grown trees	i	Most marketable trees
1		1	
2		2	
3		3	
4		4	
5		5	
6		6	
7		7	

8		8	
9		9	
1 0		1 0	

1. Table 5. List in rank the most commonly planted and most marketable plants (for your household). Plants to be ranked may include Avocado, Mango, Zytun, Casmir, Coffee, Birtukan, Chat, Papaye, Ensete, Banana, Sugarcane, …….. etc.

Rank	Most commonly grown plants	Rank	Most marketable plants
1		1	
2		2	
3		3	
4		4	
5		5	
6		6	
7		7	
8		8	
9		9	
1 0		1 0	

2. List five most useful (multipurpose) trees you plant on your land in rank (from i to v):

   i. _____

   ii._____iii._____iv._____v._____

3. Is there communal land in your locality/kebele? a. Yes b.No
4. If the answer to question No. 14 is yes, is there plantation on the communal land? a. Yes b. No
5. If your answer is yes, list names of trees planted in common land (from most common to the least).

i. _____ ii. _____iii. _____iv. _____v._____

6. Who do mostly participate in plantation program in your kebele? (You can choose more than one). a. land owners b. youths c. people formed formal/informal associations d. laypeople in the kebelee.Others (specify)

   _____

7. From your observation of the trend of tree plantation of the local famers and your HH, is size of tree plantation increasing or decreasing? _____. Why do you think that it is increasing or decreasing?

   _____

B. Contributions of tree plantation to soil conservation and environmental protection

1. Table 6.In the following Table, statements related to contributions of tree plantation to soil conservation &environment protection are listed. Based on your opinion& practices of your household, choose the degree of your agreement or disagreement to the statements. ((SD = Strongly disagree, D = Disagree, US = Unsure, A = Agree & SA = Strongly agree) using a tick mark.

No.	Statements related to planting trees for soil conservation & environment protection	SD	D	US	A	SA
1	Tree plantation reduces/prevents soil erosion					
2	Tree plantation improves soil fertility					
3	Tree plantation maintain good climate of the area					
4	Trees negatively affect the yield of nearby crops					
5	Indigenous trees more preferable to prevent erosion & maintain good climate than exotic ones					
6	You usually plant trees for the purpose of soil conservation					
7	You plant trees to prevent erosiononly where erosion is common					
8	You plant trees for this purpose only on hilly/slope areas					
9	Exotic trees increases soil fertility than indigenous ones					
10	To prevent soil erosion, you practice other methods (e.g. terracing) rather than tree plantation					
11	Most farmers in your kebeleknow that planting trees prevent soil erosion and maintain good climate					

2. If you plant trees to prevent erosion (for soil conservation), list the names the trees you plant mostly in rank. (Number i is the most commonly planted, v is the least).

i. _____ii._____iii._____iv. _____v. _____

3. Do you have any land that has been rehabilitated from erosion as a result of tree plantation? a. Yes b. No
4. If your answer to question 3 is yes, indicate: a. the area of the land improved (ha) _____ b. year of plantation _____ c. year in which improvement observed _____. d. list of trees planted _____

C. Contributions of tree plantation to household livelihood

1. List the main purpose (benefits) of planting trees by your household in rank (from i to v):

i. _____ii._____iii._____ _____

iv. _____v. _____

2. From your household yearly income or needs for livelihood, what percent is (approximately) covered by the income/services from trees? About _____. a. < 20% b.about 20-25 % c. 26- 50% d. about 51-75%e. more than 75%
3. Who do get moreeconomic benefits (benefits such asfuel, income) from the experience of your household and your neighbors? a. Women b. Men c. Children d. Youth e. All family members get equal benefit
4. In the following Table, contributions of trees to your household (HH) livelihood (LH) are listed. Based on your opinion &experiences of your household, choose the degree of your agreement or disagreement to the statements. ((SD = Strongly disagree, D = Disagree, US = Unsure, A = Agree & SA = Strongly agree) using a tick mark

No.	Contribution of trees to your household livelihood	SD	D	US	A	SA
1	Income/services from trees are the keyto the LH of HH					
2	You purchase most food crops by selling trees					

3	Your family get about 10% food directly from trees you have planted(edible fruits, leaves, etc)					
4	Income from trees is secondary or tertiary to your livelihood					
5	Crop cultivation on a plot lands is more profitable thanplanting trees					

5. Generally, what is the estimated yearly income you earn by selling trees?_____

Note:

I. Checklist for observation of tree plantation & discussing its contribution to the livelihood of selected farmers or key informants (12*3=36 purposively selected households from the selected Households. These Key Informant farmers will be model farmers, farmers; Female led Household, some famers from High Income, Medium Income and Low Income farmers.

1. Measuring (estimating) land size of each 36 household
2. Counting (estimating) the total number of tree species on the total land (homegrden and plantation area, respectively) + estimating the individual trees of each species

- *If the collection of data of number of species is well managed, this will help you to calculate the species diversity and species abundance indices.*

3. Observing the actual trees planted for prevention of soil erosion and marketing
4. Current status of tree plantation compared to the responses given during the interviews and the status of prevention of soil erosion
5. Taking photographs of tree plantations, trees planted for soil erosion, structures constructed for prevention of soil erosion and rehabilitated lands from erosion, etc. **Taking photographs during interviews and photographs of different plantations are also very important for your research.

II. Interviewing some Woreda and Kebele Experts (Some poele from Worde Forest and Rural Developments experts and the three Kebele Managers and Kebele Development Agents) is also very important.