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The Impacts of Eucalyptus Expansion on Food Security in Meta Welkite District, West Shewa Zone, Oromia Regional State, Ethiopia

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"The Impacts of Eucalyptus Expansion on Food Security in Meta Welkite District, West Shewa Zone, Oromia Regional State, Ethiopia"

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As thesis research advisors, we hereby confirm that we have read and reviewed the thesis titled " The Impacts of Eucalyptus Expansion on Food Security in Meta Welkite District, West Shewa Zone, Oromia regional state, Ethiopia" submitted under our supervision by URGAA GEDA MESKSLE. We recommend that it be submitted to complete the thesis requirement.

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As member of the Board of Examiners of the MSc. Thesis open Defense examination, we certify that we have read and evaluated the Thesis prepared URGAA GEDA MESKELE the candidate. We recommend that the thesis be accepted as fulfilling the thesis requirements for the degree of Masterof Science in field of Biological Sciences.

_____ _____ _____

Chairperson Signature Date

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The final copy of the Thesis must be submitted to the Council of Graduate Studies (CGS) through the candidate's department or school graduate committee (DGC or SGC) after it is approved and accepted.

DEDICATION

This thesis work is dedicated to my family for encouraging and supporting me in every aspect.

Acknowledgment

First of all I would like to thank my God who has helped me in all my work. Secondly, I have deep thanks for my advisor; Dr. Bikila Warkineh for his advice and help during my research. Thirdly, my thanks go to Department of Zoological Science for giving this chance and to all people these supported me by many materials. Lastly, I would like to thank my family for their unreserved support.

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Acronyms

S.P.S.S.	Statistical Package for Social Science.
S.D.	Standard Deviation.
FAO	Food and Agriculture Organization of the United Nations.
ADA	Agricultural Development Agencies.
Ha	Hectare
Vs-	Versus

Title: The Impacts of Eucalyptus Expansion on Food Security in Meta Welkite, District West Shewa Zone, Oromia Regional State, Ethiopia

Name: Urgaa Geda Meskele

Abstract

The fast-growing Eucalyptus tree is widely practiced and has become part of the farming system, particularly in the central highlands of Ethiopia. This study was designed to investigate the impacts of eucalyptus expansion on food security and crop production, the extent to which Eucalyptus plantation expansion on crop production and to examine farmers' (respondents') perception fears resulting from Eucalyptus expansion on Farmland and Food Security in the future in Meta Welkite District of the West Shewa Zone. For the study, samples from four Kebeles located within the Woreda were collected due to their large coverage of the dramatic expansion of Eucalyptus farming and hereby high Eucalyptus pole production, incidences of serious competition of eucalyptus with other uses, and the presences of road accessibility for data collection. The sample size was determined by Cluster random sampling and Stratified random sampling technique. Then the sample size was calculated using 10% for each four kebeles and half of the result is sample size was used. The data was gathered by mainly questionnaires, field observation, and interviews and analyzed by different statistical techniques (including frequencies, percentages, ranks and SPSS program).

The study through questionnaire, interview, and field observation proved that the farmers in the study area, preferred Eucalyptus plantation expansion on their fertile crop land than cultivating crops at a very fast rate because of the ability to grow in the diversified ecological zone, multi-purpose use, rapid growth and higher biomass production of the tree in a short period for the requirement of fire wood, construction materials and for its highest income generation than crop yields. These benefits which are obtained from the Eucalyptus plantation forced the farmers to expand the plant on their crop lands. Crop fields are decreasing from year to year which is resulting in the reduction of food crops in the locality. The Eucalyptus' expansion effects are Competition effects (rooting and shading impact on crops for nutrients, water, air, sunlight), allelochemicals effects (chemicals that influence the germination, growth, survival, and reproduction of other plants through interfering in cell division, energy metabolism, and nutrient uptake) and long rotation period to generate economic income resulted in decreased crop productivity and occurrence of food security then famine. If the plantation expansion continues in the present rate, the remaining could be covered in a short period. The future food security of the community as well as the next generation of the area would be under question.So all the concerned bodies in the area should take part in stopping of the expansion of Eucalyptus on fertile crop land.

Key Words: Eucalyptus, Expansion, Food Security Impacts and Land Use Change.

CHAPTER ONE

1. INTRODUCTION

1.1. Background of the Study

Eucalyptus is a group of tree species, which is one of the most planted woody species in the world next to Pinus and Cunninghamia (FAO**,** 2006; Onalaska, 2010). Eucalyptus belongs to the Myrtaceae family with three genera such as Eucalyptus, Corymbia and Angophora. There are about 900 species, unknown number of subspecies and hybrids of Eucalyptus globally (Boland**,** 2006; Oballa Phanuel O, *et al.*, 2010**)**. The term Eucalyptus has been derived from two Greek words, "eu" meaning "well" and "kaluptos" meaning "covered", a botanical reference to the trees, flowers and fruits (Boland *et al*., and FAO, 2006). More than 700 known Eucalyptus species are native to Australia (GOA**,** 2008**)**. A few species are naturally found in Philippines, Papua New Guinea, Indonesia and Timor. Outside its natural eco-region, Eucalyptus is expanding from 0.7 million ha in 1955 to more than 20 million ha in 2009, distributed to over 100 countries (Iglesias, 2008; Shi, 2012). It can grow in tropics, sub tropics and some temperate regions and covers 0.5% of the global surface forest area. Eucalyptus is rapidly expanding in India, Brazil, China, South Africa and Australia (Boland *et al.*, 2006).

The expansion of Eucalyptus from Australia to Europe began before 200 years in Portugal. Eucalyptus was introduced to United States in the mid nineteenth century. It further distributed to other parts of the world in the late 19th century and the beginning of 20th century when the demand for fuel and energy escalated in Europe, South America, Asia and Africa (Grupo, 2009; Bennett**,** 2011). Eucalyptus is one of the exotic tree species and most successful plant growing on different environments in Ethiopia and broadly in Africa (Zegeye, 2010).Eucalyptus was planted in Africa initially on the southern African plateaus in the early 19th century by the early 1970s to supply fuel wood (Beinart**,** 2003)**.**During the time, the country has small remnant natural forest thus the only option for fuel wood was Eucalyptus (Bennett, 2011). During the colonial time Eucalyptus was introduced to Rwanda, Kenya, Uganda, Sudan and Tanzania (Oballa Phanuel O, *et al.*, 2010). In the 1895 the Emperor (Menelik II 1868-1907) of Ethiopia introduced the tree *from Australia to address the prevailing fuel wood and construction material demand* (Breitenbach**,** 1961).Still today plantation establishment in Ethiopia is predominantly Eucalyptus

(Bekele**,** 2011). Farmers have the ownership right to trees growing on his/her homestead and cultivated lands, but needs to get permission from the local government to cut the trees. This hinders the participation of the farmers in woodlot plantation. The average land area owned by farmers are 1.2 ha, with 99 % of farmers owning less than 5 ha of land. Therefore the shortage of land are the main constraints for farmers to produce Eucalyptus since it takes a minimum of 5 years to harvest.

The tree of choice for the huge energy demand prevailing in Ethiopia by the time was Eucalyptus due to its fast growth and large biomass production. The ability to grow in diversified ecological zone, multi-purpose use, fast biological growth and large biomass production made Eucalyptus a preferred species often by many growers (Teketay, 2000). Plantation of Eucalyptus has been recently expanding into productive farmlands, homesteads, farm boundaries, grazing lands and open communal lands in Ethiopia. This review addresses the trends and extents of Eucalyptus planting.

1.2. Statement of the problem

Planting eucalyptus and replacing natural vegetation has an effect on the flora of an area. This effect may result from shading, competition for nutrients and moisture, site disturbance, allelopathic effects, or the cumulative effects of changes in the soil. Eucalyptus has a negative impact on other plants and on annual crops. Nair P.K.R., (1990) stated that "Some Eucalyptus species produce toxins which can inhibit the germination or growth of some annual crops". Agricultural crops cannot be cultivated on lands previously occupied by eucalyptus plantations or even on lands nearby (Lima, 1993). It is believed that eucalyptus can affect other plants directly through the inhibitory influences of leaf litter and root exudates or through the effect of litter on nutrient mineralization and soil microflora (Florence, 1986).

There is the habit of planting Eucalyptus near watersheds, rivers and streams, a natural forest, farmland, or in association with other crops to meet the demand for fuel wood, building construction, timber, charcoal production, and cushion farmers due to the societies are unfamiliar with their (Eucalyptus trees')side effects and ability to spread naturally within Meta Welkite District Community. To safeguard and maintain the sustainability of the food crops in the area, it is vital to assess the effects of Eucalyptus on food security.

1.3. Objectives of the study

1.3.1. General objective

- ✓ To investigate the impacts of eucalyptus expansion on Food Security and Crop production in the Meta Welkite District of the West Shewa Zone.

1.3.2. Specific Objectives

The specific objectives study:

- ✓ To assess the effects of Eucalyptus tree plantation on nutrient resources, water resources, status of light intensity, Climate, and Crop Yield.
- ✓ Identify the dominant Eucalyptus plantation expansion preference of farmers in the locality.
- ✓ Determine the extent to which Eucalyptus plantation expansion on crop production in the area adhered to.
- ✓ Compare the income generated from Eucalyptus plantation biomass with crops product of farmers in the study area.
- ✓ Identify whether the farmers have a concept about the negative impact of Eucalyptus plantation on food security or not in the area.

1.4. Research questions

- ✓ Do farmers of the study area prefer Eucalyptus plantation expansion to crop production on their crop field?
- ✓ Why are farmers of the locality devoted to expanding Eucalyptus plantation expansion than crop production?
- ✓ To what extent are farmers of locality expanding eucalyptus plantations over different crop varieties on their farm land?
- ✓ May farmers of the research area have enough recognition of the negative impact of Eucalyptus plantation expansion on their food security?
- ✓ Do farmers of the area generate more income from the sale of Eucalyptus biomass than crop yields?

1.5. Significance of the study

The outcome of this research would be beneficial to the local community, and experts at the district, zone, region, and national level. The findings also facilitate monitoring and evaluation of Eucalyptus tree plantation by regarding their effects on the crop plants in Meta WelKite District, west Shewa, Ethiopia.

1.6. Delimitation of the Study

This research was limited to Meta Welkite woreda. The emphasis of the study was on four Villages where the Eucalyptus plantation expansion is increasing at a fast rate and where there is more conversion of crop fields, natural forest area, and grazing land with Eucalyptus plantation. The researcher decided to do his work in these villages (kebeles) because he could collect sufficient information during his study.

CHAPTER TWO

2. REVIEW LITERATURE

2.1. The Expansion of Eucalyptus

The major planting of the Eucalypts, outside its native environment of Australia, the Malaysian region, and the Philippines, started in 1904 in Brazil. Today Eucalyptus plantations cover at least 12 million ha throughout the tropical zone, 90% of which have been established since 1955 (Turnbull, 1999). The genus was introduced to East Africa in the late 19th and early 20th century and by the early 1970s the area of eucalyptus in Ethiopia, Rwanda, Uganda, Kenya, and Sudan had reached 95,684 ha (FAO, 1979). The largest plantations at that time were in Ethiopia and Rwanda, at 42,300 ha and 23000 ha, respectively. Concerns began to be raised around this time about possible negative impacts of these plantations on the environment, which resulted in banning their planting on farmlands, stream banks, and catchment areas. Eucalyptus began to be used in plantations outside its natural distribution area over 200 years ago in Europe.

Among varies species of Eucalyptus, *Eucalyptus globulus* and *Eucalyptus camaldulenesis* are the two dominantly spreading species. In Ethiopia due to wood product scarcity, the genus was introduced during the region of Emperor Minilik II (1868-1907) in 1895 to full fill the construction and firewood requirements of people in Addis Ababa at the back of deforested native trees around the town (Getachew Admassu, 2016). Since then the plant has expanded to all corners of the country and concerns began to be felt around this time about the possible negative impacts of the plantation environment. He introduced the tree for its fast-growing feature. Its cultivation has gradually expanded throughout all of Ethiopia and is encouraged by academic research and development institutions including Alemaya Collage of Agriculture Development.

Eucalyptus growers in Ethiopia are smallholder farmers of the Southern Nations Nationalities and Peoples Regional State, Oromia Regional State, and Amhara Regional State. In addition, the growing of Eucalyptus was financially more profitable with a considerable positive net present value compared to the alternative crops (Tesfaye Teshome, 2009).

2.2. Adaptive Features of Eucalyptus

Rapid growth rates in Eucalyptus can be attributed to indefinite shoots (i.e. a growing tip that produces pairs of leaves at irregular intervals), and the fact that they do not develop resting buds.

Given these characteristics, Eucalyptus can grow both in height and length indefinitely under favorable conditions. Further, when a branch or shoot is damaged the "naked bud" or the growing tip, which can immediately produce a branch of the next order, quickly becomes a main bud. As the upper crown increases in height, the lower parts of the trunk are built up very rapidly producing large volumes of wood per hectare (FAO, 1979).

Eucalyptus growing in Ethiopia is mostly confined to the high lands where there are suitable moisture and temperature. Ethiopia is amongst the leading top five countries (Brazil, India, South Africa, and China) that grow Eucalyptus trees. The two eucalyptus species are normally altitude based with red Eucalyptus (*Eucalyptus camaldulenesis)* being for lower (warmer) altitudes, that is the upper Kolla and Woina Dega Zones, and the white eucalyptus (*Eucaiyptus globulus*) for the cooler (higher), Dega and Wurch Zones (Amare, 2002). Eucalyptus is one of the most successful trees, it adapts to a variety of habitats and it has evolutionary adaptive features such as tolerance of sever periodic moisture stress through xeromorphic leaves, stomata close when water potential deficits, the leaf is high wax coting, hairy juvenile leaves (some of the species), volatile leaf oils, deciduous in dry season (few species), tolerance of low soil fertility through adaptive capacity to soil with low nitrogen and phosphorus content. The species have specialized nutrient uptake systems of eco-and endo-mycorrhizae that increase phosphorus up take mainly but also zinc, copper, ammonium, tolerance of fire damage through lignotubers (underground organs) thick barks, dormant bud system, indeterminate crown, and tolerance of insect damage by oils and phenolic compounds (Haileab Zegeye, 2010). Rotations of the Eucalyptus are usually between 5-25 years. Since the Ethiopian highlands are suffering from severe deforestation and biomass fuel crises, *E.globulus* is the prominent tree in government and community state plantations because of its fast-growing ability through coppicing, resistance to browsing by livestock, and simple sawing and potted seedling propagation (Zewdie, 2008). Tending of Eucalyptus coppices is done to bring up second and subsequent generations of Eucalyptus. Coppices form from dormant buds on the cambium of cut trees. Coppice shoots, which are dominant and have the best form and good attachment to the stump, should be selected for retention (Kaumi, 1983).

The selected shoots should also be as low down the stump as possible and as wide apart as practicable. Shoots on the windward side should be preferred. The root crowns of some Eucalyptus species are lingo tuberous, which enhances coppice production. Lignotubers are

swellings at the stem base that consist of a mass of tissue that assists the tree in sprouting in case the main stem dies. However, there are two valuable timber species, *Eucalyptus delegatensis* and *Eucalyptus regnans* that hardly regenerate from coppices (Konuche, 1989). Despite its greater importance and the potential for Eucalyptus to improve rural livelihoods and national development initiatives; *E.globulus* is undermined by several scientists and communities related to the belief that "there are significant negative environmental externalities associated with Eucalyptus trees". Most criticisms are based on a range of technical, ecological, and socio-economic arguments (FAO, 1988). For example in Ethiopia, *Eucalyptus globulus* has usually been harvested at 5-7 years for pole and construction wood while maximum wood production is commonly attained at 18 years (Gessesse and Tekilu, 2011).

2.3. Effects of Eucalyptus Plantation on Soil Organic Carbon Stocks

Soil organic carbon (SOC) is an important component in soil that contributes to soil fertility, crop production, and soil sustainability (Datta *et al.*, 2015). Forests are stores of carbon and can be either sinks or sources depending upon environmental circumstances. Tree-plant can act as go under the outside from side to side the course of action of tree enlargement and resulting organic carbon appropriation. Thus, better than ever, the quantity of foliage can potentially un-hurry the accretion of impressive carbon (Brown, 2007).

2.4. Allelophatic Effects of Eucalyptus

Allelopathy is a biological process in plants which is producing one or more chemicals that influence the germination, growth, survival, and reproduction of other plants. Eucalyptus trees have allelopathic and inhibiting effects on undergrowth plant regeneration and growth by secreting different types of chemicals, from their leaves, stems, and roots such as phenolics terpenoids (Ahmed *et al*., 2008; Zhang, 2009; Lisanework and Michelsen, 1993; Poore and Fries, 1985). For instance, EI-Amin *et al*., (2001) in Sudan reported that Eucalyptus caused crop yield reduction due to nutrient depletion and production of toxic exudates (allelochemicals). Similarly, the above and underground extracts of *Eucalyptus camaldulensis* could affect germination and early seedling growth of undergrowth plants and crops (Saberi *et al.*, 2013). Moreover, the leaf area, plant height, and leaf chlorophyll of Eucalyptus species significantly repressed the growth of under growth plants (Ahmed *et al.*, 2008; Zhang, 2009; Lisanework and Michelsen, 1993; Poore and Fries, 1985). Molina *et al.*, (1991) reported that Eucalyptus releases toxic

allelochemicals into the soil system mainly through litter decomposition products. In this piece of evidence, Eucalyptus plantations affect crop production by releasing toxic allelochemical. Such allelochemicals can be present in soils, leaves, stems, roots, flowers, and seeds. They are released into the environment by several mechanisms, such as leaching from the above-ground parts, root exudation, volatilization, and residue decomposition. They can affect the germination and growth of crops through interference in cell division, energy metabolism, and nutrient uptake. Consequently, reduces the output of crops. Fast-growing Eucalyptus tree plantations affected hydric resources which in turn led to diminished macro-invertebrate richness and diversity (Cordero–Rivera, 2017). This kind of practice poses an environmental impact and compromises the food production system by threatening the agro biodiversity.

2.5. Impact on Water Resources

Farmers in the Ethiopian highlands perceive that Eucalyptus plantations have affected the flow rate and even dried up springs when planted around them. Eucalyptus tree species lower the ground water table as a result of the high rate of evapotranspiration it has, and aggravates desertification (FAO, 2009). The rate of water uptake by the Eucalyptus plantation is expected to be high at a young age due to its fast growth habit. Eucalyptus has three times fine root biomass in the surface soil compared to mixed plantations; which indicates that planting herbaceous crops in association with and adjacent to Eucalyptus may lead to water competition stress on crops (Gindaba, 2003). In the study of Davidson (1989), the competition for soil water between trees and crops is said to be the predominant reason for stunted growth and decreased yield of the agricultural crop in the transition zone between Eucalyptus plantations in agricultural fields tree roots absorb vast quantities of water to replace loss due to transpiration and metabolic activities and water use efficiency per unit of bio mass vary among different species and highly dependent on plant development stage, stand density and environmental condition.

2.6. Impact on Nutrient resources

Eucalyptus trees have been shown to deplete soil nutrients when it was integrated into the agro-forestry system (Jagger and Pender, 2000), and this characteristic is believed to aggravate the stress of competition when the trees are planted adjacent to crops. Chanie, (2009) found out that there was a 10-fold difference in the biomass of maize between the 1 and 20 m distance from Eucalyptus tree bole. The nearer the crops to the Eucalyptus canopy were, the lower the crop

yield and biomass production. An other similar study by Alebachew *et al*., (2015) showed that with distance from the tree stand (2 to 20 m), plant height of maize, biomass, and plant count were increased as compared to the control in Amhara region, Ethiopia. This may indicate the influence of the tree on the yield and yield components of maize which could be associated with soil nutrient depletion close to the unmanaged Eucalyptus trees plantations.

Moreover, due to the fast growth and short rotation time, there is a high chance of mining the soil nutrient by Eucalyptus tree plantation stand. In contrast to other commonly used afforestation and agro-forestry species such as *Leucaena spp*. and *Acacia spp.,* Eucalyptus species do not fix nitrogen and are less likely to restore the land with essential elements sustainably (Jagger and Pender, 2000). The yield of wood products is higher from Eucalyptus and therefore expected to have taken more nutrients too (Bajigo, 2017).

2.7. Shading on Crops

Since they are fast-growing, plantations of exotics (Eucalyptus) are usually taller than other plants of equal age, and their shade may affect nearby crops by reducing the sunlight needed for growth. Because of shading and competition for water, the yields from crops close to Eucalyptus plantations are sometimes not as good as they are further away from the edge (Demel Teketay, 2000). Eucalyptus trees may reduce crop yields on plots adjacent to wood lots or rows of trees and the allopathic effects of eucalyptus and competition for nutrients when planted adjacent to food crops or intercrops with cereals or vegetables may lead to a loss in food crop production that may affect house hold food security and income.

2.8. Effect of Eucalyptus Trees on the status of Light Intensity

A highly significant difference ($p < 0.001$) in light intensity at different distances from the Eucalyptus stand was found for all measurement times. The trees caused serious light intensity reduction up to 5 and 10 m distances at 9:00 am and 12:00 am in the west direction, up to 10 m at 12:30 pm in the north, and up to 15 m at 3:00 pm in the east direction. At 4:00 pm, the Eucalyptus trees shade effect extended to 20 m in the east direction.

2.9. Effects on Climate

Among the criticisms against eucalypt plantations is that they promote a change in the local climate. This is because of their very high evapotranspiration rate, which drains water from the

soil leading to a lower water table. This high evapotranspiration rate is claimed to adversely affect local rainfall levels, resulting in possible desertification of the area (Lee**,** 1980).

Effects on Rainfall

Areas with trees have high rainfall because as the wind blows over trees, it collects moisture from transpiration by leaves. The collected moisture when forced upward by a hill, cools, condenses, and falls as local rain. This increased rainfall in this region recently is believed to have been influenced to an extent by Eucalyptus. This increased rainfall is therefore going to increase water erosion and further soil degradation.

Effects on Temperatures

Natural trees, as well as Eucalyptus, act as shade because in times of intensive sunshine, the leaves and branches prevent solar rays from reaching the ground directly, thereby reducing excessive heat.

2.10. Effect of Eucalyptus Plantation on Crop Yield

Eucalyptus plantation affects crop production by utilizing readily available nutrients for rapid growth, which leads to reduced available minerals for crops (Jagger and Pender, 2003; Gindaba, 2003; Kidanu *et al*., 2004; Chanie *et al.*, 2013; Khybri *et al.*, 1992; Malik and Sharma, 1990). Seedlings of Eucalyptus are vulnerable to severe water stress unlike the seedlings of different tree species in Ethiopia (Gindaba *et al.*, 2004). This indicates that Eucalyptus trees need more water and compete with neighboring plants for the availability of water in the soil. For example, the total biomass of crops grown near the Eucalyptus stand was reduced due to the decline of soil nutrients and the shading effect of the eucalyptus (Chanie *et al.*, 2013; Kidanu *et al.*, 2004). In line with this low water availability occurs in the soil in the tree-crop interaction land as compared to mono-cropping system (Kidanu and Stonier, 2004). The nearest crop plants were wilted, unlike the farther stands since Eucalyptus competes for moisture even deeper in the soil. Similarly, light availability and intensity had a significant effect on crop biomass as compared to water availability (Kotowskil *et al.*, 2000).

Furthermore, studies in Sudan reveled that high crop yield reduction was recorded nearby Eucalyptus stands due to nutrient depletion and production of toxic exudates (allelochemicals) (EI-Amin *et al.,* 2001). Watson, (2000) also stated Eucalyptus leaf extracts have inhibited the germination of several plants. Bisal *et al*., (1992) reported that Eucalyptus has harmful effects on the germination and seedling growth of wheat, barley, lentils, chickpeas, and mustard.

CHAPTER THREE

3. MATERIALS AND METHODOLOGY

3.1. Study Area and Period

3.1.1. Description of the Study Area

The study area was the Meta Welkite District of the West Shewa Zone. It is located 103km West of Addis Ababa in the Oromia region on 50180 hectares of land. It has population of 86714 (males: 43319 and females: 43395) (Meta Welkite District's Population Counted Number, 2000), 21 Villages(18 Rural Kebeles,3 Towns), 9857 Household farmers, Altitude 1500-2780 above sea level, Temperature ranges from 15 ^{o}c -32 ^{o}c and average annual rainfall of 967mm-1217mm (Meta Welkite Agricultural of Natural Resource, 2016).

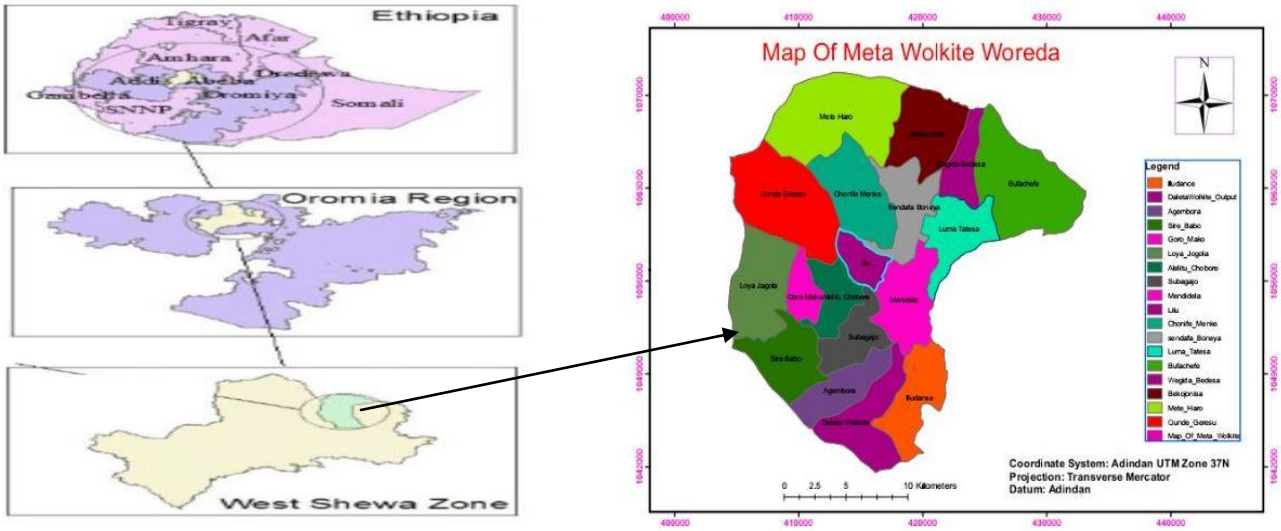

Figure 1 map of the study area

3.1.2 Study period

The study was carried out from January up to August of 2024.

3.2. Methods

3.2.1. Research design

The study tried to describe the alternate planting area for Eucalyptus trees rather than planting

the tree on crop fields if it is a selected plant kind based on its fast growing. Thus purposive survey approach was used as it enables the researcher to describe the existing planting activity preference of the community in the study area. In this study, the researcher has mainly used a quantitative method design (while analyzing the data gathered through a questionnaire because it is the main instrument to answer all research questions) and a qualitative design to some extent while analyzing the information gained through observation and interview because they were used as a supplementary instrument for confirmation. The coverage of Eucalyptus tree plants and different food crops on farmer's crop fields was described in percent.

3.2.2. Population of the Study and Sampling Technique

The population of the study was house hold farmers of the District's Kebeles with 9857 population (8651 male household farmers and 1206 female households) (Meta Welkite Agricultural of Natural Resource, 2016). For the study, samples from four Kebeles located within the Woreda were collected. The selected Kebeles (2004 male household farmers) were Alelitu Chobere (420 male household farmers), Suba Gajo (430 male household farmers), Mende Ela (514 male household farmers) and Agemsa Bora (640 male household farmers). Due to females mostly not participating in Eucalyptus planting, female householders (267 females) were not included. These Kebeles were purposefully selected due to the large coverage of the dramatic expansion of eucalypts farming and hereby high eucalypts pole production, incidences of serious competition of eucalyptus with other uses, and the presence of road accessibility for data collection**.**

3.2.3. Sample size determination

Since it is too vast to collect data from all Woreda's Kebeles household farmers (9857 farmers) Cluster random sampling technique (The District's household farmers were grouped to their each Kebeles and among the Kebeles four Villages were selected) and Stratified random sampling method [by which the Kebeles' male householder farmers (2004 farmers) were listed and the sample size was calculated using 10% (Percentage size of a sample is determined using the population size and sample size that is obtained by dividing the sample size by the population size and multiplying by 100. That's 200 divided by 2004 times 100, which is equal to 10) for each four kebeles] were used.

Among the total male house hold farmers (2004 farmers), 200 sample farmers were represented. Then (10%) of sample farmers from each village (kebeles) 42,43,51 and 64 individuals for Alelitu Chobere, Suba Gajo, Mende Ela, and Agemsa Bora respectively were selected according to their household farmers by stratified random sampling method since it ensures representative. The reason why the researcher used this sampling technique was to give an equal chance for the population.

The sample size was calculated using the finite sample size formula.Sample size formula for a finite (known) population is given as:

Finite Sample Size= SS/ [1 + {(SS − 1)/Pop}]

Where,

SS = Sample size=200

Pop = Population=2004.

Therefore;

SS=200/ [1 + {(200− 1)/2004}]

=200/ [1 + {199/2004}]

=200/ [2004 + 199/2004]

=200/ [2203/2004]

=200/ [1.0993]

=200/1

=200

3.2.4. Data Gathering Instruments

Mainly questionnaires, field observation, and interviews were employed as instruments to collect data by translating into Afan Oromo. Different materials and Internet services were used as a reference to gather information for the study. To confirm the information gathered through questionnaires about the Eucalyptus plantation expansion on crop land and its impact on crop production, some photographs were taken during field observation as supplementary information from planted farmers' farm land.

3.2.5. Data Collection Procedure

Before the questionnaire was distributed, the purpose of the study was explained to the participants. How to complete the questionnaire was presented orally to have meaningful data about the problem. They were also informed that the items were completed individually. The instructions were given by the researcher. In this way, all the participants were got the purpose of the study and were voluntarily to complete the questionnaire without any hesitation.

At the same time, the participants were provided with a questionnaire to complete it with their practice in the mentioned plant and their crop-producing conditions**.**

3.2.6. Data Processing and Analysis

The collected data on the impacts of eucalyptus plantation expansion on food security was analyzed by different statistical techniques. The analysis included a quantitative and qualitative approach in analyzing and interpreting the data. In this case, descriptive statistics (Statistical Package for Social Sciences (SPSS) was used. The data were summarized and descriptive statistical analysis (including frequencies, percentages, ranks, and SPSS program) was used to see the mean, S.D., and percentage differences among the respondents. Moreover, the analysis included a qualitative approach while analyzing the information gained through observation and interview.

CHAPTER FOUR

4. DATA INTERPRETATION, RESULT, DISCUSSION, CONCLUSION AND RECOMMENDATION

This chapter has two parts; the first part deals with the characteristics of the respondents and the second part presents the analysis and interpretation of the main data. The data gathered through interviews was supposed to complement quantitative data.

The questionnaire was distributed to 200 respondents and all copies were returned. In addition, 1 Agricultural Development Agencies (ADA) was interviewed successfully.

4.1. Result and Discussion

4.2. Characteristics of the respondents.

The descriptive statistics analysis table 1 showed that among the total respondents (200 house holders); about 154 (77%) and 46 (23%) with mean=100 and S.D=76.36 were males in the age range of 35-65 and 20-34 years old respectively. This informed that as most of the respondents are householders, participating in Eucalyptus plantation and familiar with when Eucalyptus plantation was started in the study area.

Table 1: Statistical summary of the Ages of the respondents (n=200).

Age and sex	Frequency	Percent	Mean	S. Deviation
M 20-34	46	23		
M 35-65	154	77		
Total	200	100	100	76.36

As shown from table 2, the respondents in education level: 14 (7%) respondents are illiterate, 78 (39%) are these can read and write, 62 (31%) are grade 1-4, 22 (11%) are grade 5-8, 16 (8%) are grade 9-12 and 8 (4%) are above grade 12 with mean=33.3 and S.D=29.19.The respondents these can read and write (39%) is the expected data means farmers due to lowness of standard deviation (29.19) and data value (39%) tends to the mean (33.3).

Table 2: Statistical summary of the Educational background of the respondents (n=200).

Educational Status	Frequency	Percent	Mean	S.D.
M—Illiterate	14	7		
M Reading and Writing	78	39		
M 1-4	62	31		
M 5-8	22	11		
M 9-12	16	8		
M >12	8	4		
Total	200	100	33.3	29.19

As shown in table 3, Majority of respondents about 125 (62.5%) are engaged in mixed farming (crop cultivation and livestock rearing) and some of them 75 (37.5%) are engaged in crop cultivation with mean 100 and standard deviation 35.36.

Table 3: Statistical summary of Occupation of the respondents (n=200).

Occupation	Frequency	Percent	Mean	Standard Deviation
Crop cultivation	75	37.5		
Mixed farming (Crop and livestock)	125	62.5		
Total	200	100	100	35.36

In table 4, the respondents were asked how many hectares they have, and then they responded most of them 112 (56%) relatively between 0.5-2 hectares, Some 81 (40.5%) have between 2.5-4 hectares, 4 (2%) have 4.5-6 hectares and 3 (1.5%) have 6.5-8 hectares with (X= 50 and S.D. =

55.17). This indicates that most farmers in the area consist of small landareas which is not sufficient for both crop production and plantation of trees in the locality.

Table 4: Shows the (%) of land owned by farmers (n=200).

Width of farmers' land in hectare.	Frequency	Percent	Mean	Standard Deviation
0.5-2	112	56		
2.5-4	81	40.5		
4.5-6	4	2		
6.5-8	3	1.5		
Total	200	100	50	55.17

Respondents asked whether the community in the locality satisfied their demand for their fire wood with (X=100 and S.D. = 93) respectively. 96.5% of the respondents' reports show that as the community depending up on tree planting for their firewood, one cause for the Eucalyptus plantation expansion by farmers in the study area was to fulfill their fire wood consumption because there was no other choice for an energy source to cook food in the study area.

Table 5: Statistical data of tree plantation for fire wood in percent (%) (n=200).

Sources for firewood	Frequency	Percent	Mean	S .D
Tree planting	193	96.5		
Others	7	3.5		
Total	200	100	100	93

Table 6; the respondents rated whether the community in the locality was planting Eucalyptus trees rather than other tree species with (X=100 in and S.D=95) respectively. 97.5% of the respondents answered that the Eucalyptus tree is the most planted tree in the study area rather than other tree species. The plantation of other plant species was very low about (2.5%) which includes Pine tree plants. This is because of the profitability of the Eucalyptus; its multiple uses

and its generation quick return than other tree species, it is also easily cultivated and gives high biomass for firewood, construction, and income generation,it regenerates after coppicing. In line with FAO, (1988), Tesfaye, (2000), Amare, (2002),Gesse and the Teklu, (2011) .This merit of the plant devoted farmers of the locality to expand the plantation of Eucalyptus on their fertile crop land in fat rate since its introduction to their area. In line with Kidanu et al., (2005), FAO, (1979), FAO, (1985), FAO, (2005).

Table 6: Shows the type of tree planted in the area (%)(n=200).

Planted tree	Frequency	Percent	Mean	S .D
Eucalyptus	195	97.5		
Pine tree	5	2.5		
Total	200	100	100	95

As understood from Table 7, 56 (28%), 51 (25.5%), 44 (22%), 26 (13%), and 23 (11.5%) of the respondents with (X=40, S.D=14.82) responded that they plant Eucalyptus for the source of income, construction materials, source of firewood, rapid growth and higher biomass production and fertilizer deficiency respectively.

Table 7: Shows for what purpose the respondents plant the Eucalyptus (%)(n=200).

Eucalyptus plantation purpose	Frequency	Percent	Mean	S.D
Source of income	56	28		
Construction materials	51	25.5		
Source of firewood	44	22		
Rapid growth and higher biomass production	26	13		
Fertilizer deficiency	23	11.5		
Total	200	100	40	14.82

In table 8, the respondents asked when the Eucalyptus plantation expansion was started in the location with (X=50and S.D= 44.65) respectively. Few respondents 7 (3.5%) answered as the plantation was started during emperor Hailesilasie, In line with Demel (2000), and Turn Bull (1999) but from the result 91 (45.5%) more Eucalyptus plantation expansion seen at present time.

Since then the expansion was taking place in a fast condition on fertile crop land. This indicates that Eucalyptus plantation expansion is increasing from year to year in Meta Walkite Woreda still today.

Table 8: Statistical data representing the time when Eucalyptus plantation started in the area (n=200).

Plantation started time	Frequency	Percent	Mean	S.D
during Mengistu	86	43		
During Menilik ii	16	8		
During emperor Haile Selassie	7	3.5		
During 2015/2023	91	45.5		
Total	200	100	50	44.65

In table 9, the respondents asked whether the Eucalyptus plantation expansion is very slow, slow, fast, or very fast. In line with Sangninga, *et al*., (1992), Jouquet *et al*., (2007) Lane et al (2004) In this case, the farmers of the samples about 171(85.5%),20(10%) and 9(4.5%) with (X =66.67) and S.D.=90.52) responded as Eucalyptus plantation expansion occurring in very fast rate, fast rate and slowly in the study area respectively. From this information, one can conclude that the Eucalyptus plantation expansion rate is rapidly increasing on cropland in the area.

Table 9: Shows the rate at which Eucalyptus plantation takes place in percent.(n=200).

Planting rate	Frequency	Percent	Mean	S.D
Slowly	9	4.5		
Fast	20	10		
Very fast	171	85.5		
Total	200	100	66.67	90.52

In table 10, the respondents asked whether the farmers in the study area used their land for crop production or for planting trees, with (X=66.67 and S.D=31.89), 58 (29%)of them used all their land 148.5ha (32.96)for plantation of Eucalyptus trees, 102 (51%) of them were answered as

they used201ha (44.62%)for cultivation of crops and 40 (20%) of them used 101ha (22.42%)for grassing. From the respondents' total land (450.5ha); 148.5ha which is about 32.96 % was converted to Eucalyptus plantation. This conversion of crop land to this tree plantation can result in the reduction of food crops in the study area this information leads to conclude that farmers need to lead both crop cultivation and planting trees side by side but their idea seems that crops are produced for the consumption of the families where as the tree plantation is for income generation, firewood, and construction.

Table 10: Shows the (%) of land used by farmers (n=200).

Usage of land	In hectare vs Frequency	Hectare Percent (%) Vs Respondents' %	Mean vs Respondents' Mean	S.D vs Respondents' S.D
For Tree Plantation	148.5 vs 58	32.96 vs 29		
For Crop production	201 vs 102	44.62 vs 51		
For grassing	101 vs 40	22.42 vs 20		
Total	450.5vs200	100vs100	150.16vs 66.67	50 vs 31.89

As shown in table11, the respondents were asked how much land they planted in Eucalyptus and then, their response were 0.5-1 hectare 186 (93%); 1.5-2 hectare 9 (45%); 2.5-3hectare 3 (1.5%); 3.5-4 hectare 2 (1%) with X=50 and S.D=90.7 .This shows that the farmers in the study area planted Eucalyptus trees relatively at least half a hectare and mostly one hectare of their land. Based on this information, there was no respondent without the Eucalyptus plantation on his land; from the respondent's total land (450.5ha); 148.5 ha which is about 32.96 % was converted to a Eucalyptus plantation. This conversion of crop land to this tree plantation can result in the reduction of food crops in the study area. In line with Dvidso .J, (1989), Ei-amin. *et al.,* (2001), Pamela, Jagger and John Pender (2000), YU *et al.,* (2006), Hall *et al.,* (1981), Selam Yihun and Struder, (2004) The remained of their land was about 201ha (44.62%)and 101ha (22.42%) were the lands for crop production and for grassing respectively. So plantation of the Eucalyptus tree is the burning issue of the community in the research area and this practice causes a shortage of food crops.

Table 11: Shows the percentage of respondents on land occupied by Eucalyptus tree(n=2000).

Land in hectare	Frequency	Percent	Mean	S.D
0.5-1	186	93		
1.5-2	9	4.5		
2.5-3	3	1.5		
3.5-4	2	1		
Total	200	100	50	90.7

As indicated in table 12, respondents were asked whether they have the recognition about the effect of Eucalyptus on their crop production, most of the respondents 197 (98.5%) with (X=100 and S.D=97) answered that Eucalyptus plantation expansion hurts crop production, this indicates as they have indigenous knowledge about the impact of Eucalyptus plantation expansion on food crops. Even if most of the respondents seem to have recognized the negative impact of Eucalyptus on the production of food crops, farmers in the locality were attracted to the tree plantation following only a time benefit; for this case, they initiated to expand of eucalyptus plantation on their farm land rather than cultivating crop plants because of the highest cost of the eucalyptus tree biomass has. Additionally, once planted eucalyptus can regenerate after coppicing again and again for years but crop cultivation requires much energy, time, cost for cultivation year to year.

Table 12: Shows whether Farmers have a Concept of the Eucalyptus tree impact on Crop production (n=200).

Farmers' Recognition	Frequency	Percent	Mean	S.D
Yes	197	98.5		
No	3	1.5		
Total	200	100	100	97

Respondents confirmed (responded) that the conversion of cultivated land to Eucalyptus plantation resulted in different problems such as decreased crop productivity and occurrence of famine 83 (41.5%), rooting and shading impact on crops land 64 (32%), reduced soil fertility, reduced soil water availability and reduced spring flow 42 (21%), and long rotation period to generate economic income 11 (5.5%) with(x=50, S.D=30.93) (Table 13). Due to growing fast in a short period, the Eucalyptus tree utilizes more water even from the deepest soil depth through its deep root system. Depletion of water quantity and drying up of water springs adjacent to Eucalyptus plantation is quite common in the study area. Farmers who produce crops do not cut the roots of adjacent Eucalyptus trees. This result is in agreement with a similar study, local farmers responded that the negative impacts of Eucalyptus were attributed to the decline in crop and forage production due to its allelopathic effect and the reduction in groundwater availability (Jagger and Pender, 2003).

Table 13: Shows respondents' perception fears resulting from Eucalyptus expansion on Farmland and Food Security in the future.

Fears may have occurred	Frequency	Percent	Mean	S.D
Reduction of soil fertility, soil water availability, and spring flow	42	21		
Rooting and shading impact on cropland	64	32		
Long rotation period to generate economic income	11	5.5		
Decreasing of crop productivity and occurrence of famine	83	41.5		
Total	200	100	50	30.93

As understood from table 14, the respondents were asked how much money they generate from Eucalyptus biomass per year, then they responded as many of them 124 (62%) gain about 12000 money income relatively from their plantation with X=40 and S.D=48.36 In line with Assaye A, (2002), Tesfaye T, (2009).This implies that most farmers in the area generate more income from selling of Eucalyptus biomass than crop yields which is planted on a similar size of land

plot per year. This selling cost initiated the farmers to give attention to the fast plantation expansion of Eucalyptus trees.

Table 14: Statistical summary of respondents on income generated from Eucalyptus trees per year (n =200).

Cost in birr	Frequency	Percent	Mean	S.D
12000	124	62		
14000	33	16.5		
16000	12	6		
18000	4	2		
>20000	27	13.5		
Total	200	100	40	48.36

As mentioned in table15, to compare the income generated from teff yield with the income generated from Eucalyptus biomass produced on similar size of land, the majority of the respondents 96 (48%) answered that the income from teff was relatively about 8000 birr with(X=40 and S.D.=35.11). They also explained as environmental conditions are not suitable for the cultivation of teff, then the community choice the Eucalyptus tree plantation that resulted more income per year than teff.

Table 15: Statistical data representing the cost of Teff in (%) in the year (n=200).

Cost in birr	Frequency	Percent	Mean	S .D
8000	96	48		
10000	44	22		
12000	37	18.5		
14000	3	1.5		
>16000	20	10		
Total	200	100	40	35.11

As observed from Table 16, the income generated from Wheat yield per year by respondents 84 (42%) with the (X=40 and S.D=30.89) responded was 9000 birr that indicates farmers interested in converting their farmland to Eucalyptus plantation because of the income generated from eucalyptus biomass is much greater than the cost of Wheat.

Table 16: Statistical data representing the cost of wheat in (%) per year (n=200).

Cost in birr	Frequency	Percent	Mean	S.D
5000	12	6		
7000	40	20		
9000	84	42		
11000	54	27		
>13000	10	5		
Total	200	100	40	30.89

To identify whether the annual income generated from bean products was preferable or not than eucalyptus biomass income, the researcher asked the respondents how much money they gained from the yield of beans per year, then 86 (43%) of the respondents (X=40 and S.D.=27.18) responded relatively as they gain 10000 birr. This indicates the income generated from beans is not satisfactory just like the income generated from Eucalyptus biomass which was planted on an equal size of land cultivated with beans.

Table 17: Statistical data representing the cost of beans in (%) per year (n=200).

Cost in birr	Frequency	Percent	Mean	S .D
4500	32	16		
5000	18	9		
6500	23	11.5		
9000	41	20.5		
>10000	86	43		
Total	200	100	40	27.18

The income generated from maize yield per year as respondents 78 (39%) with the (X=40 and S.D.31) responded was 8000 birr that indicates farmers are interested in converting their

farmland to Eucalyptus plantation because the income generated from eucalyptus biomass is much greater than the cost of maize in Meta Welkite.

Table 18: Statistical data representing the cost of Maize in (%) per Year (n=200).

Cost in birr	Frequency	Percent	Mean	S .D
4000	69	34.5		
5000	24	12		
6000	13	6.5		
7000	16	8		
>8000	78	39		
Total	200	100	40	31

The annual income from sorghum to the local farmers 76 (38%), with the (X =40and S.D.=24.04) was relatively 5500 birr. This indicates that the annual income from sorghum of the local community in the study area is much less, but from the equal size of land on which they produce Eucalyptus, is more than ten times greater than income gained from sorghum yield cost according to the information given from the respondents.

Table 19: Statistical data representing the cost of Sorghum in (%) per year (n=200).

Cost in birr	Frequency	Percent	Mean	S .D
4500	16	8		
5500	76	38		
6500	36	18		
7500	22	11		
>8000	50	25		
Total	200	100	40	24.04

Additionally, the information collected from A.D.A. workers in the four villages (kebeles) matched the data gathered through other data collection tools. They replied "The farmers are

converting their farmlands to Eucalyptus plantation because the selling cost of Eucalyptus tree biomass in the area is much greater than the selling cost of crop yields, even if, the awareness is given to them about the negative impact of the Eucalyptus on the environment. Field observation was made by the researcher (me) to see if the Eucalyptus plantation expansion is still an ongoing practice or not in each village. The real evidence for the practice was seen in farmers' crop fields.

Interviews in this study revealed the negative impacts that Eucalyptus trees (Eucalyptus globules and *Eucalyptus camaldulensis)* have an effect on crops and crop yields that were explained in terms of competition for nutrients and water, killing of other vegetation (allelochemical (acidic) from *E. globulus* tends to kill the vegetation beneath the canopies and around the *E. globulus*) and late or slow decomposition (the leaves and branches of *E. globulus* and *E. camaldulensis.* Respondents ranked *E. globulus* as the most harmful to crops. It was discovered that Eucalyptus species dry out the land and compete with crops for nutrients and water. The respondents' opinions in this study confirm studies conducted in Ethiopia by Kidanu *et al.,* (2005) and Nyssen *et al*., (2009), which showed that competition for water, soil nutrients, and allelopathic effects between Eucalyptus and annual crops may occur close to the tree rows and that tree species such as Eucalyptus spp. In a study conducted by Tafere and Nigussie, (2018) in Sidama, both farmers and extension workers confirmed that the planting of Eucalyptus affected adjacent crops. Tafere and Nigussie, (2018) also established that Eucalyptus takes up a large amount of water and nutrients from the soil, which may affect crops planted next to it.

Thus the findings in the present study are in line with findings from related studies. Many Eucalyptus seedling plantations were observed as intercropped with crop varieties such as Teff, Wheat, Bean, Maize and Sorghum.

CHAPTER FIVE

5. CONCLUSION AND RECOMMENDATION

5.1. Conclusion

In the central highlands of Ethiopia, coverage of Eucalyptus plantations is increasing from time to time. Particularly a considerable cultivated land is being converted to Eucalyptus plantation. This study analyzed the effects of Eucalyptus plantations on crops by comparing adjacent cultivated land across three different slope positions (upper, middle, and lower) and two soil depths (0-20 cm and 20-40 cm).

In the study area, farmers prefer Eucalyptus plantation expansion on their fertile cropland than cultivating crops at a very fast rate because of the ability to grow in the diversified ecological zone, multi-purpose use, rapid growth, and higher biomass production of the tree in a short period for the requirement of firewood, construction material and especially for its highest income generation than crop yields. On the other hand farmers in the area which is not so much sufficient for grassing, tree plantation, and crop production. Even if their land is small sized about 101ha (22.42%) is used for grassing and 148.5ha (32.96 %) of their land is covered with Eucalyptus plantation but only 201ha (44.62%) is for crop production in the study site. If the plantation expansion continues at the presenting rate the remaining could be covered in a short period. The future food security of the community as well as the next generation of the area could be affected because of its adverse effect and the competition for crop fields. Some dwellers give suggestions about the negative impact of the Eucalyptus plantation expansion on the environment, but most of them practicing the plant expansion still now. The farmers are only following the income generated from the selling of the biomass of this plant and its relative advantages. They never give attention to the ecosystem degradation which is resulting from Eucalyptus plantation and the reduction of food crops in this area year by year.

5.2. Recommendations

- ✓ There should be a focus on awareness creation to farmers to manage the spacing of Eucalyptus and crop better, site selection as well as management strategies to minimize the negative impacts of Eucalyptus trees. It is more essential if the Eucalyptus is planted areas such as Mountains, Hills, Rocky Land and Steep Slopes.
- ✓ There should be a supply of improved indigepenous tree species such as *Cardia africana, Croton macrosttachys, Ekbergia capensis* and *Acasia spp* that are used as timber, fuel wood, and animal fodder and simultaneously make available fertile soil and water to crop plants.
- ✓ Eucalyptus is the major source of fuel in the study area. In addition to Eucalyptus, 3.5% of the respondents use cow dung as a source of fuel wood. However, using animal dung as a source of fuel should be discouraged since it has a significant advantage in fertilizing the soil. Instead of Eucalyptus and Cow dung it is encouraged to use Biogas, Solar energy and others means of available energies.
- ✓ Furthermore, the future researcher should focus on the interaction of Eucalyptus plantations with soil microorganisms and related issues experimentally to manage Eucalyptus plantations in harmony with crop production as well as to maximize food security.
- ✓ To be more benefited from Eucalyptus plantation, improved management of Eucalyptus plantation should be promoted and should be studied further.

Figure 2: Pictures that show the expansion of Eucalyptus tree in the study area:

Photo by Urgaa Geda 2024 No. 1

Photo by Urgaa Geda 2024 No. 2

Photo by Urgaa Geda 2024 No. 3

Photo by Urgaa Geda 2024 No.4

Photo by Urgaa Geda 2024 No. 5

Photo by Urgaa Geda 2024 No. 6

Photo by Urgaa Geda 2024 No. 7

Photo by Urgaa Geda 2024 No.8

Figure 3: Pictures that show the crops these not present near eucalyptus on farm land:

Photo by Urgaa Geda 2024 No.1 Wheat

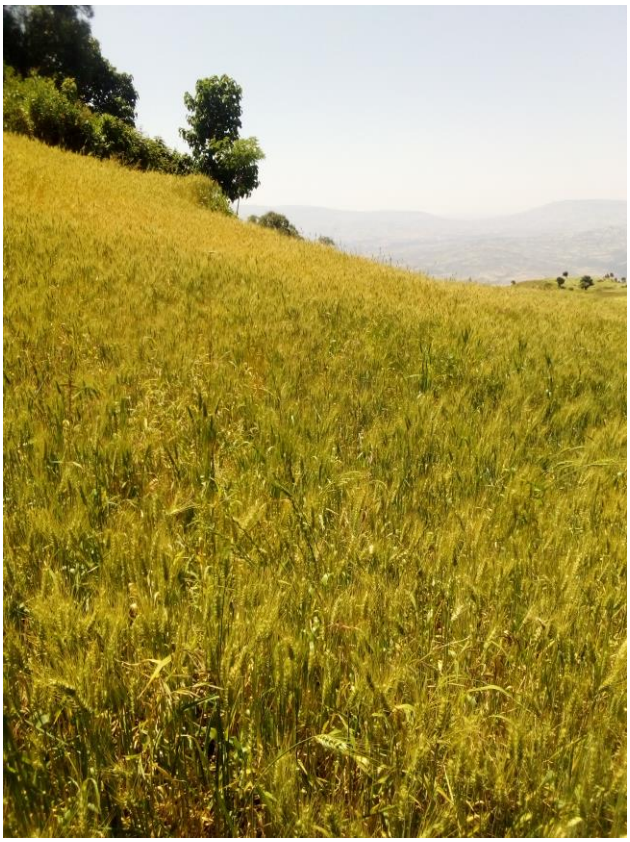

Photo by Urgaa Geda 2024 No 2.Wheat

Figure 4: Pictures that show expansion of Eucalyptus on farm land and its Effects on Crops:

Photo by Urgaa Geda 2024 No. 1 Wheat

Photo by Urgaa Geda 2024 No. 2 Teff

Photo by Urgaa Geda 2024 No. 3 Wheat

Photo by Urgaa Geda 2024 No. 4 Bean

Photo by Urgaa Geda 2024 No. 5 Sorghum

Photo by Urgaa Geda 2024 No. . 6 Maize

Photo by Urgaa Geda 2024 No. **7** Maize

Photo by Urgaa Geda 2024 No.8 Sorghum

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APPENDIX I

Research Questions

Questionnaires to survey the Environmental impact of Eucalyptus plantation expansion on Food Security in Meta Welkite District. To obtain necessary and accurate information, your honest co-operation is highly appreciated in answering the question. The responses that you are giving will be used only for academic purposes.

District…….....

Date ----------

Data collector: _____

I. Personal Information:

1. Sex: Male ☐

Female ☐

2. Age: _____☐

3. Educational status of the households head:

Illiterate☐ Read and Write ☐

Grade: 1-4 ☐ 5-8 ☐

9-12 ☐ > 12 ☐

4. Occupation: Crop cultivation Livestock rearing ☐

Mixed farming ☐

Other (specify) _____

5. Land holding size _____ (ha)

Questions that will be asked to study the impact of Eucalyptus plantation expansionon food security in Meta Welkite.

1. How does the local community satisfy demands for fire wood?

A. Animal manure B. By tree planting C.by fuel gas D. Other

2.Wich tree species do most people plant in this locality?

A. Eucalyptus B. Pine tree C. Acacia D. others

3. If your response is Eucalyptus, for what purpose do you plant the tree?

4. When do you think Eucalyptus tree planting was started in this locality ?

A. During emperor Mengstu B. During emperor Haileselasie

C. During emperor Menelik ii D. During 2015/2023

5. How eucalyptus planting expanded in this area? A.Very slowly B. slowly C. fast D. very fast

6. For what purpose(s) do you use your land?

A. For crop production B.for tree plantation C. for grassing

7. How much land do you plant in Eucalyptus? ----------

8. Do you think that Eucalyptus trees have effect on your crop production?

A. Yes B. No

9.If eucalyptus plantation expansion continues at present rate in your locality, your fear to farmlands and what do

you think about the future food security of the community?

Please explain your feeling----------

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10. What measures could be taken to maximize crop productivity and the advantage

Eucalyptus in your locality? ----------

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11. How much money you may generate each year from Eucalyptus? ----------

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12. How much cash you may generate each year from crop yields which is produced on the same size of land occupied by your Eucalyptus plantation? From Teff----------

From Wheat-------From Bean---------- From Maize----------From sorghum

Thank you in advance for your time and co-operation!

APPEDIX II

Interview for Agricultural Development Agency (D.A.):

Interview to survey the impact of Eucalyptus plantation expansion on food security in Meta Walkite District.

Date: ----------

Gender :----------

Village [location]: ---------- Age: ---------- Education: ----------

1. How does the local community fulfill their wood demand?----------

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Why do you think that the local community plants eucalyptus trees rather than indigenous trees?----------

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2. Do you think that farmers have enough awareness about the effects of Eucalyptus tree on the environment as well as on food crops?----------

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3. What forces farmers to plant Eucalyptus trees on their farmland instead of cultivating crop plants? ----------

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4. If the Eucalyptus plantation expansion continues at the present rate in your locality what do you think about the future food security of the community? ----------

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5. What measures could be taken to maximize crop productivity and the advantage of Eucalyptus in your locality?----------

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