



SCHOOL OF GRADUATE STUDIES
COLLEGE OF NATURAL AND COMPUTATIONAL SCIENCE
DEPARTEMENT OF ENVIRONMENTAL SCIENCE
MSc Thesis

ASSESSING FARMERS PERCEPTION ON THE CAUSES OF TERMITE
INFESTATION, CROP SENSITIVITY AND ITS CONTROL PRACTICE IN
NEDJO DISTRICT, WEST WALLEGA ZONE, OROMIA ETHIOPIA.

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OCTOBER, 2024
NEKEMTE, ETHIOPIA

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A THESIS SUBMITTED TO THE COLLEGE OF NATURAL AND
COMPUTATIONAL SCIENCE, DEPARTMENT OF ENVIRONMENTAL
SCIENCE IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE
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BY

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As members of the Board of Examining of the Final MSC thesis open defense, we certify that we have read and evaluated the thesis prepared by Wakgari Temesgen Terfasa entitled “Impact of Termite Infestation On Grass Land and Cereal Crop Production & Its Control Practices In Nedjo District, Ethiopia” and recommend that the thesis be accepted as fulfilling the thesis requirement for the Degree of Master in environmental Sciences.

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DEDICATION

This thesis manuscript is dedicated to my beloved friends and my colleagues for their unbound love, tolerance and support that helped me in bringing the researcher up to this stage.

STATEMENT OF THE AUTHOR

By the signature below, I declare and affirm that this MSC thesis is my own work. I have followed all ethical and technical principles of scholarship in conducting this study, data collection, data analysis, and compilation of this thesis. Any scholarly matter included in the thesis has been given recognition through citation. This thesis has been submitted in partial fulfillment of the requirements for the Degree of Master of Environmental Sciences at Wallaga University. The thesis is deposited in the Wallaga University Library and is made available to borrowers under rules of the Library. I solemnly declare that this thesis has not been submitted to any other institution anywhere for the award of any academic degree, diploma, or certificate. Brief quotations from this thesis may be made without special permission provided that accurate and complete acknowledgment of sources is made. Requests for permission for extended quotations from or reproduction of this thesis in whole or in part may be granted by the School of Environmental Science when in his or her judgment the proposed use of the material is in the interest of scholarship. In all other instances; however, permission must be obtained from the author of the thesis.

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BIOGRAPHICAL SKETCH OF THE AUTHOR

The author, Wakgari Temesgen Terfasa was born in June 1977 E.C around Nedjo town, West Wollega Zone, Ethiopia. He attended his primary education at Burka Chochi Elementary School(from grade 1-6) and Lalisa Alaltu medium elementary school (from grade 7-8). He also attended his secondary education at Nedjo Senior Secondary School in Nedjo town, West Wollega Zone. He joined Ambo University and graduated with Bachelor of Science (BSc.) degree in chemistry in September 2015. After graduation he took his job under the Ministry of education at Nedjo district as a teacher and has been teaching chemistry in the district. Finally, he joined the Postgraduate Program of Wollega University in October, 2021 to pursue his graduate study in Master of Environmental Sciences.

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LISTS OF ACRONYMS

AC.....	Agricultural Crops
CRV.....	Central Rift Valley
DA.....	Development Agent
FCS.....	Food Consumption Score
FGD.....	Focused Group Discussion
FYM.....	farmyard manure
IPM.....	Integrated pest management
NGO.....	Non-Governmental Organizations.
PA.....	Peasant Association
RH.....	Rural Houses
SPSS.....	Statistical Package for Social Science
VGT.....	Vetiver Grass Technology
WFP.....	World Food Program.
YTP.....	Young Tree Plantations

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ABSTRACT

The main objective of the study was to assess impacts of termite infestation on grass land and cereal crop production & its control practices in Nedjo district, Western Ethiopia. Descriptive survey study designs along with mixed approaches were used. Eighty-four participants were selected from district using Kothari formula and questionnaire, interview, focused group discussions and observation were used to collect the data required from these populations. The data gathered through these tools were analyzed qualitatively and quantitatively. The study result indicated that cereal crops, oil seeds, cash crops, fruits and vegetables were highly sensitive to termite infestations. Termite infestation which was aggravated due to human factors and ecological factors highly affected farmers' cereal crop production and productivity in the study area. Farmers hardly used different mechanisms of controlling termite infestation in the study area. These results were closely related with the results reported by some of the prior researchers. However the study filled in the gap that none of the prior researchers tried to address how ecological related factors highly aggravated termite infestation in the study area. During the study period, several edible and cash crops in the study area were highly sensitive to termite infestation which in turn affected farmers' crop production and productivity as well as income generated from their productivity. Human factors highly aggravated termite infestation in the study area and ecological factors also contributed for the prevalence. Many efforts are required for eliminations of termite infestations in the study area. The community, the concerned officials and future researchers are recommended to try to alleviate the problems and threats from termite infestation in the study area.

Key words: termite, infestations, factors, control practices

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1. INTRODUCTION

1.1 Background of the Study

Termites are serious pests in tropical and subtropical Africa. They attack various field and horticultural crops. Termite damage pasture land which are primarily used for livestock production. Ethiopia is among the tropical countries where crops and pasture lands are severely damaged by termites. Many reports indicated that the problem is more severe in western Ethiopia (Gebeyehu, 2018; Aliyi, 2020).

In Ethiopia, there are 61 species of termites in 25 genera and four families, of which few are regarded as pests (Gebeyehu, 2018) report indicated that in the last 40-50 years, the damage caused by termites in western Ethiopia became more and more acute (Gebeyehu, 2018). Termites pose serious threat to a variety of agricultural crops, forestry, rangelands, houses and other wooden structures. Termite problem is particularly prevalent in the western part of the country, where it has persisted for many years and has received wide publicity (Daniel & Debelo, 2020).

Termites are social insects that belong to the *Isoptera* order. They are occasionally associated with severe damage to rangeland vegetation, particularly, in degraded arid and semi-arid ecosystems (Aliyi, 2020). Termite infestation is prevalent worldwide especially in the tropics where the distribution, problems and constraints result in livelihood threats particularly among rural small-scale farmers (Gebeyehu, 2018). The growing interest in sustainable agriculture and food security on the African continent highlights the need for a more integrated approach to termite control by integrating indigenous knowledge and practices with modern 'scientific' method. This is with the aim of preventing severe ecological damage and loss of ecosystem services provided by termites while using the available resources without exhausting them.

Atsbha and Hintsa (2018) also discussed as currently, many regions of the world are subjected to expansions and/or invasions of subterranean termites. In some areas, including Ethiopia, termite constitutes a significant pest problem in agriculture. In general, plants exotic to the specific area and water-stressed plants are most prone to attack by termites. They are serious pests of a wide range of crops, forest trees and buildings in Western Ethiopia.

Termite infestation and damage starts while plants are standing in the field. A soil infested with termite mostly resulted in distortion of soil structures and compactions. Hence soil becomes difficult to plough, this in turn results in a reduction of productivity of crops. Termites are devastating insect pests which caused 36 to 62% reduction in yields of hot pepper and maize, respectively (Atsbha & Hintsa, 2018).

Different data revealed that the intensity and amount of termite infestation is highly related to farmers' perceptions and practices they used to minimize its infestation. Farmers in Ethiopia perceive termite infestation as a significant threat to crop production, particularly affecting maize, teff, and sorghum. Studies from various regions highlight the widespread impact of termites on agriculture and the indigenous management practices employed by farmers. In the *Abedengoro* resettlement areas of Western Ethiopia, a study involving 240 farmers revealed that termites are considered a major pest, especially during the dry season. Maize, sorghum, and teff were identified as the most susceptible crops, with damage occurring year-round but peaking in the dry season. Similarly, in the Central Rift Valley, farmers acknowledged termites as significant pests, estimating pre-harvest yield losses of 18.02 kg/ha for haricot beans and 10.58 kg/ha for maize. Damage typically occurs during the maturity stage of crops. In Meta Robi district, central Ethiopia, termite infestation was reported to cause substantial crop yield reductions, affecting both the quantity and quality of produce. Farmers observed that maize is heavily attacked during the growing and lodging stages (Daniel & Emana, 2017).

In Ethiopia, termites are a significant threat to various crops, particularly during the dry season. While maize, teff, and sorghum are commonly reported as highly susceptible, other crops also experience notable damage. Teff (*Eragrostis teff*) is frequently identified as the most susceptible crop to termite damage. Studies in Mana sibu District and Meta Robi District have reported teff as the most seriously damaged crop, with damage occurring at various growth stages. Maize (*Zea mays*) is another crop highly affected by termites. In the Central Rift Valley, farmers estimated pre-harvest yield losses of 10.58 kg per hectare due to termite damage. Sorghum (*Sorghum bicolor*) is less affected than teff and maize, it still experiences significant damage, especially during the dry season. In Manasibu District, sorghum was found to be less affected compared to teff and maize. Wheat (*Triticum aestivum*) is also susceptible to termite damage. In Meta Robi District, wheat was reported as the second most severely affected crop, with significant

economic losses per household. Haricot Beans (*Phaseolus vulgaris*) in the Central Rift Valley, haricot beans were identified as a major crop affected by termites, with estimated pre-harvest yield losses of 18.02 kg per hectare. Beans (*Phaseolus vulgaris*) in Yem District, beans were reported as the most infested crop by termites, with a significant percentage of bean stalks affected (Abhishek *et.al*,2021).

Barley (*Hordeum vulgare*) is cultivated in some areas, and while specific data on its susceptibility to termites is limited, it is likely affected to some degree, similar to other cereal crops. Maize is one of the most popular crops grown in the world, ranking second next to wheat and followed by rice. Maize is among the leading cereal crops selected to achieve food self-sufficiency in Ethiopia (Tufa & Ketema, 2016).

Control of termites as forest pests involves both chemical and traditional methods. Current chemical control methods employed are soil treatment, treatment of seedlings before transplanting and baiting techniques and the chemicals currently used include *chlorpyrifos*, *imidacloprid* and *fipronil*. In addition to the current chemical control methods employed, there are a number of alternative, traditional control methods, largely relating to *silvicultural* practices or plantation management, which are also very important, and should be considered before chemical intervention is attempted (Daniel & Emana, 2017).

Use of some cultural control methods such as mounds distraction, removal of the queen, flooding water into the mound, use of hot ash and hot pepper independently, are not effective. As a result control methods heavily depend on synthetic chemicals especially *organochlorides*, which are currently abandoned from the world market due to their persistent toxicity. According to, dressing soil application and fertilizer dressing with *Aldrin* in two weeks before sowing were effective against termite (Daniel & Emana, 2017).

As it is stated by Ambash *et.al* (2019), in the past, *organochlorine* insecticides were assumed to be effective for the termites and other pest control. One application around a building could avoid termites attack over 30 years. Even now a day, efforts to avoid subterranean termite attack inside building has heavily depended on the applications of liquid *termiticide*.

Liquid *termiticides* are projected to provide a defensive barrier between the structure over ground and the termites in the soil. Though liquid *termiticides* have ability to overpower termite populations, they also have many limitations. First, excess use of toxicants cause's environmental concerns as well as termites can also develop resistance against these toxicants (Abdurahman, 2010).

Above all, the definitions provided above clearly indicated that termites had impacts on grass land and cereal crop productions. Additionally, with an excessive infestation of termites it had been indicated that crop production would make fluctuations. Thus, the current study tried to assess whether or not termite infestations had impacts on grass land and cereal crop production and the possible mechanisms controlling termite infestations with specific reference to Nedjo district.

Nedjo district is one of the districts found in West Wollega zone. It is characterized by having three atmospheric conditions namely cold climatic condition, moderate climatic condition and hot climatic conditioned areas. It is one of the well-known area in producing gold and gold products. It can also grow different types of vegetations including coffee. Different types of crops and cereals are cultivated and grown in the entire district. The community is hospitable and very attractive to accommodate others with respect and honor. It is found at a distance of 92 km west wards from Gimbi town. The rationale behind choosing this site for studying termite and termite infestation is that it is highly afflicted with mounds and piles of termite in particular and studying and recommending the intensity of termite infestation is seen as the other portion for dealing its control mechanisms.

1.2 Statement of the Problems

Nowadays, termite infestation is the key global challenges that threaten crop production and socio economic activities. In Ethiopia, termites are one of the main threats to agricultural crops facing severe problem in western part of the country. Nedjo District is one of the termite infested areas. This wide area infestation of termites have brought a different problem on the livelihood of human beings reside in the area. The main victim of the problem is the farming communities found in the rural areas in this District those depends on agriculture for their livelihood. Termites

destruct crops on the field starting from the early stage of sowing to the maturity stage of the crops and even at storage.

Termite infestation problem in the research site is varies among kebele. It infestation is depends on altitude, the crop Varieties and so on. In most area the land is over grazed and as a result land is exposed to wind, cattle leg, rain washing and they cutup the crop cultivated like maize, sugarcane, wheat. Due to these consequences, the surrounding soil losses the fertility and productivity.

The researcher was motivated to assess the impacts of termite infestation on grass land and cereal crop production and controlling mechanisms because as a resident of the woreda, there had been huge infestations of termites. Though attempts like burning the mound of termite pile and traditional methods like dumping and digging have been made for controlling and dismissing termite infestation in the study area, still farmers are under severe problems. So, it is on this particular juncture that the researcher was interested to conduct a study on this topic and recommend some possible ways of alleviating the problem under study.

Additionally, the researcher looked into some of the studies conducted so far and identified the gaps left untouched by the researchers. There were myriad number of studies conducted on the area of termites and their infestation on grass land and cereal crop production in different areas of the world. For convenience, the researcher used the following empirical studies that are closely related to this study.

Internationally, researchers like Mugerwa *et al.* (2008), Banjo *et al.* (2003) and Berg (2003) tried to asses controlling mechanisms of termite infestation in different parts of the world. These researchers disclosed that termites could be controlled both traditionally and technologically in different applications. These researchers did not incorporate the impacts of termite infestation on grass land and cereal crop productions and its controlling mechanisms. Thus, the researcher tried to fill in the gaps in varying direction from these studies by combing the impacts of termite infestation and its controlling mechanism with particular reference to Nedjo district.

Locally, researchers like Jiru (2006), Sileshi *et al.* (2008) and Tadesse (2007) conducted studies on multi-facets of termites and its infestation and disclosed that in rural areas of many

developing countries, including Ethiopia, for example, severe termite damage to vegetation, crops and forests are often tolerated because the management cost which means chemical cost is higher and beyond the capacity of individual farmer. Though the researchers tried to address control mechanisms of termite infestation on grass land and cereal crop production, none of them combined the impacts and controlling mechanism of termite infestation particularly. Thus, the current study filled in the gaps of prior researchers by combining the impacts of termite infestation on grass land and cereal crop production and its controlling mechanism in varying directions from the past studies. In general, this study tried to address the level of crop sensitivity to termite damage, factors that worsen termite infestation in the study area and controlling mechanism. There is however, yet a gap on addressing the causes, impacts and crops which are sensitive to termite infestation as well as controlling mechanism of termite infestation in the study area.

1.3 Basic Research Questions

This study attempted to address the following basic questions.

1. What are the major causes of termite infestation in the study area?
2. What are the levels of crops sensitivity to termite damage?
3. What are the impacts of termite infestation in the study area?
4. How can the impact of termite infestation on grass land and cereal crop production be controlled?

1.4 Objective of the study

1.4.1 General Objective

The general objective of this research was to assess Farmers perception on the causes of termite infestation, crop sensitivity and control practice in the study area

1.4.2 Specific Objectives

The following were the specific objectives of the study.

1. To assess the major causes of termite infestation in the study area.
2. To identify crops sensitivity to termite damage in the study area.
3. To identify the impact of termite infestation on crop production and productivity
4. To point out mechanism of controlling termite infestation in the study area.

1.5 Significance of the Study

This study may have several major significances. First it may give some guide line information to land use planners, decision makers, Non-Governmental Organizations (NGO) and environmental protection agencies in Ethiopia about existing situation of mound forming termite species. Second, the study may provide information on the magnitude of termite infesting in crop production and its control measures in the study area. The study may also service as a gap filling career for the future researchers who would be interested to conduct detailed and comprehensive studies on the magnitude of termite infestation on grass land and cereal crop production and its controlling practice in other areas of the region/state. On the other hand, the study may be used in advance for farmers and stakeholders to enhance their contribution in problem solving activities to reduce the magnitude of termite infestation on grass land and cereal crop production and its controlling practice in the study area.

1.6 Scope of the study

The study was conducted to see the causes and impacts of termite infestation on grass land and cereal crop production and its controlling mechanisms with specific reference to Nedjo district. The study was delimited in terms of concept and area. Conceptually, the study addressed the impacts of termite infestation and its controlling mechanisms. From the impacts of termite infestation, level of crops sensitivity to termite damage, the main factors that aggravates termite infestation and termite infestation control practice's were emphasized and addressed in this study.

Additionally, the study was conducted in Oromia regional state, West Wollega zone, Nedjo district. Methodologically, the study employed descriptive study design along with mixed research approaches/qualitative and quantitative/. The time scope of the study was from September up to June 2016 E.C.

1.7 Limitation of the Study

Even though the study was expected to address other areas in Nedjo district which were afflicted with termite infestations, it didn't touch each and every area for the study as there was insecurity in some of the areas of the study place. Additionally, data quality was the other limitation to the study as some of the respondents gave vague responses to the questionnaire. Moreover, the study demanded too much expenditure of finance and this also hindered the researcher to conduct the study clearly and appropriately. Though the researcher acknowledged that other sampling could

be used, usage of random sampling system to select the kebeles in the district was the other limitation.

1.8 Organization of the Paper

This paper comprises of five chapters. The first chapter deals with background, statement, objective, significance, scope and limitation. The second chapter deals with review of related literatures. The third chapter deals with methods and materials of the study. Under the forth chapter of the study, the researcher makes analysis of the data gathered for this study through different tools. The fifth chapter deals with the conclusion and recommendation made to the findings of the study.

2. LITERATURE REVIEW

2.1 Termites

Termites are social insects related to cockroaches and are scientifically classified under the order *Isoptera*. They have a highly evolved social organization and hierarchical structure. They are living in colonies of various sizes containing a number of different castes which include workers, soldiers, nymphs and larvae. The colony may have from a few hundred individuals to millions and each caste is vital to the viability of the colony and also has a different function. Termites undergo gradual metamorphosis: egg –nymph -adult. The young nymphs are fed and cared for by the workers. During molting the young nymphs gradually emerge into different castes. Although almost all termite species feed on dead plant material at different stages of decomposition, their food sources are diverse and also included soil organic matter, litter, dry grass or bark (Ulyshen, 2014).

This great variation of feeding substrate is linked to the diversity of their gut-associated microbes. All existing termite species have mutualistic relationships with flagellate *celulloytic* protozoa living in their guts except for the *Termitidae* family in which the flagellates have been lost and replaced by fungi in the *Macrotermitinae* sub-family or prokaryotes in other *Termitidae* (Eggleton, 2020).

About 330 of the 2,600 known termite species are obligatory dependent on the cultivation of a specialized fungus, from the genus *Termitomyces*, for food. *Termitomyces* is grown on termite feces in subterranean combs that the termites construct within the heart of nest mounds. Termites are mainly tropical in distribution, with highest species richness found in tropical forests where they are major decomposers. Of the more than 2600 described species of termites only a few hundreds are destructive feeders and consume homes and agricultural crops. Among them around 50 species are considered to be serious pests. Counterbalancing this is their significant role in the delivery of ecosystem services through improvement of soil physical, chemical and biological processes (Ogedegbe & Ogwu, 2015).

2.2 Cause of Termite Infestation

Termite infestation is caused due to numbers of causes. A collaborative study conducted by Abdulahi, Tadese and Dawd (2010) indicated that cause for termite infestation mostly in

Ethiopia where most people are agrarian are include deforestation (26%), soil degradation (24%), and overgrazing (16%), soil degradation (33%) and overgrazing (25%) . There is no significant difference among the different wealth groups in terms of perception on the reasons for termite infestation.

The report also reported that termite infestation has increased with deforestation because some termite eating rodents have migrated to other areas. Similarly, ants living under the grasses that eat termites have decreased due to overgrazing. Soil degradation does not only affect the crop cover, but it also leads to less decaying materials on which termites can feed. This report also emphasized that deforestation, and limited use of organic manure and blanket application of inorganic fertilizers and other chemicals have exacerbated the land and soil degradation problems (Abdulah *et al*, 2010).

The other study conducted by indicated that high moisture level is necessary for attack and establishment. Although soil contact is not necessary, wood-soil contact often leads to damp wood termite infestation. More often, wood that has become fairly saturated due to leaky pipes or poor gutters, or damp support beams due to poor ventilation, are the primary points of infestation for these pests. Rain-soaked firewood can also attract termites (Ogedegbe & Ogwu, 2015). They live in the wood they feed on they do not live in the soil. Once established, these termites can extend their activities into sound wood, even relatively dry wood. As colonies mature, they produce winged reproductive that leave the nest in swarming flights. These flights usually occur on warm evenings in late summer or fall, especially after rains (Eggleson, 2020).

Termites are not easily observed by the homeowner because they hide themselves to prevent moisture loss since they depend on moisture. Certain signs will give clues to the presence of a termite colony in the home. Termite swarms coming from the home are probably the most obvious sign (Ogedegbe & Ogwu, 2015).

2.3 Impacts of Termite in Africa

Termites are a group of *eusocial* insects found across the world in countries with varied climate and land cover systems (Ogedegbe & Ogwu, 2015). They have been reported in all the continents of the world but Antarctica (Eggleson, 2020). Termites feed on wood and other materials that contain cellulose.

However, they cannot independently digest cellulose, Termites are social insects of the order *Isoptera* with about 3,000 known species, of which 75% are classified as soil-feeding termites and also they will feeding activity is damage to plantations and manmade structures (Ulyshen, 2014).

Africa is ranked as the top continent in terms of termite species richness with over 70% of all the identified species (Ahmed *et al.*, 2011), indigenous communities have immense knowledge of these insects and have they are prominent in both tropical and subtropical ecosystems (Ulyshen, 2014). Termites are classified based on their feeding habits and under feeding groups there are wood feeders, soil feeders and fungus cultivating termites (Kudo, 2009). Based on habitats they can be earth dwelling having below ground or epigeal nests, wood dwelling or arboreal having nest on trees. Many types of earth-dwelling termites exist, such as the subterranean termites and mound building termites. The wood-dwelling termites on the other hand, restrict themselves to wood. Wood-dwelling termites are further classified as either dry wood termites which attack dry wood, or damp wood termites attacking damp/ wood usually decaying wood. Africa is the richest in the number of termite species known and identified (Ulyshen, 2014). The family *Termitidae* alone comprises of more than 664 African species. There are four known subfamilies under this family and they are listed as *Apicotermitinae* having 70 species, *Termitinae* with 272 African species (Eggleton, 2020).

Macrotermitinae so far records 165 African fungus growing termites (Eggleton, 2020) whereas *Nasutitermitinae* boasts of 56 species (Daniel & Debelo, 2020). The total number of species in the above subfamilies may surpass 90% of the world's known termite species (Ahmed *et al.*, 2011). Species diversity however varies within and between regions. For instance species diversity is lower in northern Africa compared to Eastern, Western and Southern region of the continent (Ahmed *et al.*, 2011). Dry climate has been cited as the contributing factor for the low number of species in the Northern region of Africa (Ahmed *et al.*, 2011). Termites are serious pests of agricultural crops and rural houses in Ethiopia. Some attempts were made to control termites on crops. However, termite problem on rural houses is a neglected area regardless of the intensity of the problem which at times results in total collapses of newly constructed houses. To collect preliminary information on status of termite infestation to rural houses, surveys were conducted in three districts of the Central Rift Valley (CRV) of Ethiopia in 2012. In western

Ethiopia termite have a long history of serious damage to annual and perennial crop production. Termites may attack timber anywhere in a building from below floor level to the highest point in the roof.

The workers of most subterranean species enter from the soil, either directly into timber, through cracks in concrete flooring or by constructing shelter tubes over brick or concrete footings and walls. The annual economic cost of structural damage to buildings from termites in urban areas is about \$ 15-20 billion dollars worldwide. In the majority of the local houses in developing country like Ethiopia, the wall is made of mud, while the roof is grass thatched which is conducive for termite infestation. It is a common practice in the region to build houses, stores and fences on untreated wood and grasses without proper stone foundations. Such structures provide favorable conditions for subterranean termite attack (Ambash *et.al*, 2019).

2.4 Economic Impacts of Termite in Ethiopia

Termites are serious pests of agricultural crops (AC) and rural houses (RH) in Ethiopia. Some attempts were made to control termites on different land use/land cover, particularly crops, cereal crops. However, termite problem on rural houses is a neglected area regardless of the intensity of the problem which at times results in total collapses of newly constructed houses. To collect preliminary information on status of termite infestation to rural houses (Daniel and Debelo2014). In western Ethiopia termite have a long history of serious damage to annual and perennial crops and range lands. They are very serious pests in several parts of Ethiopia, particularly in the western parts of the country. About 61 species of termites belonging to 25 genera and four families have been recorded in the country. They cause considerable damage on agricultural crops, rangelands, forest, and wooden structures such as rural houses, stores, fences and bridges crossing streams (Akutse *et.al*, 2012).

2.5 Ecological Impacts of Termites

Ecological dominance has long been displayed by termites due to their *eusocial* behavior (Beyene, 2022). This advanced sociality is characterized by the creation of cast systems where groups of individuals specialize in tasks. The cast system is often divided into reproduction/brood care, foraging, and defense with the latter two offering a competitive advantage when mobilized efficiently, capable of outcompeting other species (Beyene, 2022). Success has allowed thousands of living species of termites to exist (Beyene, 2022); therefore, it

is useful to group termites based on similarities in behavior. Feeding and nesting behavior are two common ways of classifying termites. The feeding habits of termites will help identify a cover system's propensity towards attracting termite populations, and to what extent their influence will be present.

The manner in which termites nest is important in determining what termites will likely have the greatest effect on performance of cover systems. Although in tropical and subtropical ecosystems they are the principal consumers of the most abundant bio molecule on land (cellulose and lignocelluloses) (Engel *et al.*, 2009), feeding behavior classes can be further subdivided. Termites live in close association with other wood-inhabiting animals, and they experience an altered subterranean climate that can decouple species' responses from climate change (Girma *et al.*, 2023). We synthesize the current understanding of temperate forest termite ecology and identify non-climate factors that might serve as predominant controls on their distributions and abundances. The magnitude of these controls will be important to test and quantify further, especially since regional termite abundances largely determine the extent of their ecosystem impacts (Bekama, 2024).

Termite diversity for northern Africa is low, about 11 species, represented by subterranean and dry wood termite groups. Termite diversity in western Africa is great; mound species dominate the landscape, although subterranean and dry wood species also occur. Little information is available on the tropical forests of central Africa and savanna and deserts of southern Africa. These areas also contain much termite diversity and ecology. Termite diversity in Eastern Africa is similar to Western Africa, especially among the abundant *Macrotermitidae* (Ashenafi *et al.*, 2021). Termites are very serious Pests in several parts of Ethiopia, particularly in the Western parts of the country. They cause considerable damage on agricultural crops, rangelands, forest and wooden structures such as rural houses, stores, fences and bridges crossing streams (Bekama, 2024).

2.6 Socio Economic Impacts of Termite

2.6.1 Destructive Effects of Termites

Termites are highly destructive and *polyphagous* pests of crop plants, which damage green foliage, forestland, wooden structures, and are destructive feeders (Upadhyay, 2013). Many

regions of the world are currently experiencing expansions of subterranean termites (UNEP, 2000). Termites enhance soil degradation and erosion by reducing the vegetation cover (Demissie *et al.*, 2019) and occasionally, spectacular effects of termite activity resulting in almost complete denudation and leading to accelerated erosion have been reported (Mengesha & Yewahalaw, 2025). A soil infested with termite mostly resulted in distortion of soil structures and compactions. Hence soil becomes difficult to plough; this in turn results in a reduction of productivity of crops (Gebreslasie and Meressa, 2018).

2.6.2 Termite Damage to Crops

In Ethiopia termite problem is more severe in western part of the country teff, wheat, maize, sorghum and barley are the five major cereals occupying almost three-quarters of total area cultivated, and represent almost 70 percent of total value added in recent years in Ethiopia (Mengesha & Yewahalaw, 2025).). Termite damage to standing crops is generally expressed as percentage of plants attacked or plant mortality. The most often damaged by termites (UNEP, 2000) and its susceptibility is attributed to its recent introduction into Africa by the Portuguese explorers in 1502 and has not been exposed to the range of termite life-history strategies of those species occurring in Africa (Ayuke, 2010). In parts of Africa, indigenous crops such as sorghum and pear millet, cowpea, Arabica coffee and teff are more resistant to termite damage because of evolution and selection by farmers over many centuries (Ayuke *et al* , 2010).

2.6.3 Termite Impact to Forest Land

Termites appeared in the region for the first time in 1904 at a specific place called Bafan Koreche around Kiltu Kara town in West Wallaga zone. From there, they spread in different directions to other areas and termite problem has increased from time to time and damaging natural vegetation they loss of biodiversity. Termites by no means confines their attentions to dead plant tissues such as wood and they are one of the major agro forest pests in the tropics (Nyeko and Olubayo, 2005). In western Ethiopia, termites cause severe devastations on the forest and thus soil remains bare and exposed to elements of soil erosion (Gebreslasie and Meressa, 2018).

Forest support the survival of living organisms through soil and water conservation, carbon sequestration, nutrient recycling, ameliorating environmental pollution and by supporting the life

of wildlife which form part of the ecological functions of an environment (Beyene, 2022). Termite attacks appear most acute and have caused serious problems in the development of nurseries and young tree plantations (YTP). Another phase of the problem is the susceptibility to termite of a popular group of tree species for the tropical planting, the Eucalyptus (Bekama, 2024). *Eucalyptus* preferred as compared to other plants such as *Cassia*, *Albizia* and *Gmelina* species because of its more rapid growth potential (Bekama, 2024).

The extent to which termites are problems to trees and the nature of loss they cause are very much related to the geographic region concerned. The main obstacle to afforestation in the dry areas of Africa is said to be the presence of termites. Wood feeding termites feed on wood and woody litter, including dead branches still attached to trees, and they may live in their feeding galleries which in some cases become colony centers. As a pest, they are capable of causing serious economic damage especially in the tropical and sub-tropical regions (ashenafi et al, 2021).

2.7 Termite Controlling Methods

Termites are devastating insect pest and have been implicated in damage to crops, forest and economic losses. The complexity of the termite problem justifies the use of various management options in an integrated manner, as no single control method is sufficiently effective against this pest. In the past, termite control campaigns including mound destruction and killing of termite queens were practiced in western Ethiopia. However, these control measures did not effectively reduce the damage due to lack of a holistic approach. Physical, biological and chemical controls of termites have been practiced for decades in western ONRS; unfortunately, none of these practices have been successful in reducing crop damage by termites (Negassa and Sileshi, 2018).

2.7.1 Cultural Method

In order to destroy the foraging tunnels and the workers present in the subterranean regions, deep summer ploughing is recommended before the onset of monsoon. Deep ploughing exposes termites to sun light/ desiccation and to avian predators, thus reducing their numbers. Left over stubbles of previous crop and other decaying matter should be removed from the field as they attract termites (Abhishek *et al.*, 2021).

Only well decomposed farmyard manure (FYM) should be applied to the field because partially decomposed FYM acts as an attractant to foraging workers due to the presence of cellulose and optimum moisture. Farmers should follow crop rotation especially including non-preferred crops. (Temesgen, 2022) studied the effect of intercropping maize with soybean, groundnut and common beans against termites and found a significant reduction in termite attack and increased nesting sites of predatory ants (*Myrmecaria* & *Lepisiota*) in maize fields.

The small scale farmers of sub Saharan Africa are practicing intercropping of maize and beans to reduce termite attack. Frequent irrigations should be used to avoid water stress conditions as it makes plant more vulnerable to termite attack. Application of wood ash around the base of the trunk of coffee bushes and date palms has been recorded as a preventive measure against termite infestation. Fertilization with nitrogen, phosphorus, and potassium in wheat, barley, and yam has been recorded to reduce termite incidence (Abhishek *et al.*, 2021).

Cultural management practices include clean cultivation, high-density sowing, soil management, balanced use of fertilizers, proper irrigation, weeding, mulching, timely harvesting, crop rotation and intercropping and so on. The area where termite attack is high, the crop field and surroundings must be cleaned by removing all plant debris to maintain crop protection from termite attack (Farhan *et al.*, 2019).

Termites mostly attack weak plants, such as diseased or insect-pest infected, mechanically injured or stressed plants. The proper and balanced use of fertilizer, well-decomposed farmyard manure, frequent irrigation and use of recommended agricultural practices increases plant vigor, which ultimately reduces termite attacks. Farhan *et al* (2019) described that timely optimum use of nitrogen, phosphorous and potassium reduces termite attack in field crops. However, the misuse or incorrect application of commercially available fertilizers may result in salt accumulation, runoff, leaching, plant damage and soil pollution.

The traditional methods used in Africa some are limited to certain countries depending on indigenous understanding while majority are ubiquitous across the continent. Traditional methods are simple to follow and conduct and cost effective especially in the African setup. (Sileshi *et al.*, 2018).

2.7.2 Biological Method

Termites have many predators because they provide a source of protein. Insects that eat termites include spiders, beetles, flies, wasps and especially ants. Other predators include frogs, reptiles, birds and mammals such as aardvarks, pangolins, bats and monkeys. Encouraging this kind of wildlife will help to reduce the number of termites. Bushes and trees are a home for many of these useful creatures. These areas of natural habitat can be left around fields where crops are grown. If these areas are destroyed then there is an imbalance between the populations of predator and pest (Mugerwa *et al.*, 2014).

2.7.3 Physical Control

It consists of breaking the mounds of the termites and removing the queen and the king. Sometimes termite mounds are destroyed manually in order to get rid of these pests.

The success of this measure depends on eliminating the queen, who may be hidden deep inside and is not easily found. Mechanical destruction of termite mounds can be recommended if they appear close to storage structures (Akutse *et al.*, 2012).

2.7.4 Use of Botanicals

Botanicals are natural insecticides, made from plant extracts. Botanical pesticides possess an array of properties including insecticidal activity, repellency to pests, insect growth regulation, and toxicity to agricultural pests. Plant parts and plant extracts can be used effectively. These can be removed from the plant and used as a natural insecticide by grinding up the relevant parts, placing in boiling water, stirring and leaving to soak. The mixture is then sprayed onto the infested crop (Asehanfi *et al.*, 2021).

2.7.5 Non-chemical

Termites have many predators because they provide a source of protein. Insects that eat termites include spiders, beetles, flies, wasps and especially ants. Other predators include frogs, reptiles, birds and mammals such as aardvarks, pangolins, bats and monkeys. Encouraging this kind of wildlife will help to reduce the number of termites. Bushes and trees are a home for many of these useful creatures. These areas of natural habitat can be left around fields where crops are grown. If these areas are destroyed then there is an imbalance between the populations of predator and pest. Planting the same crop on the same land year after year reduces soil fertility and structure. Crops growing in such conditions will be weaker and susceptible to termites. Crop rotation can play an important role in reducing termite attack. Crop rotation means that crops are

grown on a different piece of land each year. This can prevent pest and disease build up and also help the soil to recover nutrients (Mugerwa *et al*, 2014). As well as on deep cracking soils, the regular disturbance through cracking prevents termites from building extensive mounds. On the other hand soils artificial breaking up of mounds and galleries can have the same effect. Repeated digging and ploughing of the soil may reduce termite damage. Manual and explosive destruction of nests followed by the removal of the queen is also effective (Akutse *etal*, 2012).

2.7.6 Chemical Control Methods

Different pesticides have been used to control termites and has depended for the last 40 years on the use of *cyclodiene* organ chlorine insecticides namely *aldrin*, *dieldrin*, chlordane and heptachlor. Different methods of insecticide application were used for termite control in crops and environmental impacts and have since been banned due to their persistent toxicity and effects on non-target beneficial organisms and the environment (Demissie *et al.*, 2019)

Even though chemicals are hazardous to the environment, farmers all over the world use them extensively for the management of agricultural pests. Management of termites with termiticides is a difficult task as termites are *eusocial* insects and live in mounds or many inches below the soil surface to keep them-selves protected from outside threats (Farhan *et.al*, 2021).

However, some *termiticides* such as *imidacloprid*, *chlorpyrifos*, *fipronil*, *spinosad*, *chlorfenapyre*, *bifenthrin*, *cypermethrin*, *permethrin*, disodium *octaborate tetrahydrate*, calcium arsenate, *lindane*, *endosulfan* and *chlorantraniliprole* have been used worldwide for the management of termites. Generally, farmers use these *termiticides* during irrigation of the crops. However, injection of *termiticides* is also used for the control of termites in field crops, forests and buildings. Some fumigants such as carbon dioxide, methyl bromide, sulfur fluoride and phosphine are also used through fumigation methods for the control of termites attacking dry woods and stored grain products (Farhan *et.al*, 2021).

3. MATERIALS AND METHODS

3.1 Study Area description

Nedjo is one of the districts found in the West Wallaga Zone, Oromia, Ethiopia at 515km distances from the capital city (Addis Ababa) to the West direction. The study was conducted from October, 2023 to June, 2024 GC. The district has 35 peasant associations. The district is located at a distance of 75km west wards from Gimbi, the capital of west Wallaga Zone. The geographical location of the study are is at latitude and longitude between 8°47'18" to 8°58'20"N and 36°54' to 37°11'47" E. Major types of natural vegetation of the area are forest, woodland, Shrub& bush land, and savanna and their approximate areal coverage in hectares. The forest coverage of this area is 11839.35 hector's natural forest.

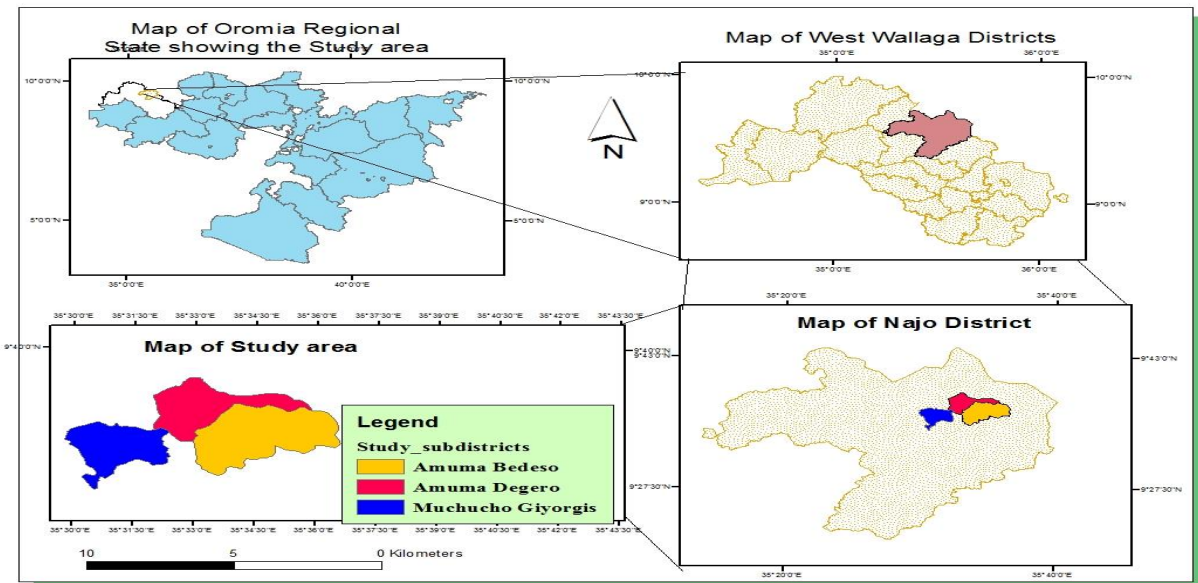


Fig.1.Map of the study Area

3.1.1 Population of the Study Area

Total population of the study district is about 102307 of which 12472 are male and 1643 are females (Census and housing, 2007).

3.1.2 Atmospheric Condition

The annual minimum and maximum temperature distribution it ranges from 10.4°C to 33.23°C (Meteorology Agency of Asosa, 2020). It receives maximum amount of rainfall during the summer rain fall season of June, July and minimum amount during the spring and autumn seasons. The rainfall follows uneven annual distribution with more than 42% of the annual rainfall during summer (Ganna) season. It is in this season the major agricultural activities such

as ploughing, sowing and weeding are performed. The average annual rainfall ranges from 7mm to 65.6mm. This is wrong data look again from meteorological agency. The consecutive 10 years of Annual temperature and rain fall data of Nejo district was collected from Assosa Metrological agency and presented.

3.1.3 Climate

The study area is characterized by having the cold, moderate and hot climatic conditions which in turn was named as the badda, badda-daree and gammoji in the local language of the surrounding community. The area with high altitude was seen under the cold climatic condition, the area regarded as the plain area was categorized under moderate climatic conditioned area and the lowland area is characterized by having hot climatic condition.

3.1.4 Temperature and Rainfall

According to the Metrological data from 2012-2023 G.C collected from the study site (Ethiopia Metrological Agency Nejo station), the climate of the area was long with summer rain fall (May to September) and winter dry season (December to March), with annual rainfall ranging from 850mm-2250mm. The mean minimum and maximum temperature is between 15⁰-28⁰C.

3.1.5 Soils

Basically soils originated directly and indirectly from the parent materials, climate, vegetation, latitude and the interaction of among physical factors. The major soil types in the Nejo district are brown (76%), red (15%) and black soil (9%). Nistols, Eutric, Cambols and arenosols (Nejo district Agricultural and Natural Resource Office, 2018).

Depending on the optimum condition provided by prevailing natural condition such as climate, soil type and altitude, vegetation can develop to its maximum stage. Climatic climax vegetation, therefore, is the vegetation that would develop in the absence of human influence. It reflects the optimum vegetation of an area determined by environmental condition only. The climatic climax vegetation of Nejo therefore, reflects the vegetation that should have developed if the distribution of vegetation by human had not taken place in Nejo district (Nejo district Agricultural and Rural Development Office, 2018).

3.1.6 Forest

Broad leaved forest is found in the most humid part of the district in the mean annual rainfall exceeding 1300mm and between elevations 1300-2500 meter. This forest covers almost the

whole portion of the district except very limited areas in the central part. The broad leaved forest consists of Ejersa, *Podocarpusfalcetus* (birbirsa), *Acokantherascbimperi* (Qaraaroo), *Syzygiumguineense* (Willd.) *pafromontanum* (Baddeessaa), *Ekebergiacapensis* (Somboo), *Ficusingens* (Qilinxoo), *Acokantherascbimperi* (Waddeessa). Grassland and wetland (marshes and swamps) are common types of climatic climax vegetation of the district. In the district there is no official park or reserved areas for wild life conservation. However, the district has ample potential of forest wildlife resources. The common wildlife found are lion, Buffalo, Hyena, antelope, Hippopotamus, Tortoise, Leopard, etc. they live in disintegrated forest. These wild animals directly or indirectly depend on wild plants (Nejo district Agricultural and Rural Development Office, 2018).

3.2 Methods

3.2.1 Research Design

The study was conducted on the causes of termite infestation and its controlling mechanism in the study district. In order to meet this objective, the researcher used descriptive research design, the researcher was collected data required for the study by interview and observation and described then using descriptive expressions since the purpose of the study was to describe the phenomenology. The cause of termite infestation and cereal crop production in kebeles found in the study area was appropriate to conduct the study. The researcher used the design because it had been agreed by scholars that it was appropriate when researchers were interested in digging out the existing issue and describe what existed using words and numbers. As it is explained by Ezeani (1998), the purpose of descriptive surveys study is to collect detailed and factual information that describes an existing issue under study.

3.2.2 Source of Data

The researcher collected the data required for the study both from primary and secondary data sources. Primary data were collected through interview, observation and focused group discussion from the target populations. The researcher collected secondary data from document found in Nedjo district agriculture and rural development office, recorded literatures, conference pamphlets, document files, from the District Agricultural office, Google scholars and published newspapers regarding the issue.

3.2.3 Sample and Sample Size Determination

The researcher used purposive sampling technique to select representative Kebeles among 35 rural Kebeles found in Nedjo district. Three kebeles were selected purposively because they were affected with termite infestation and the researcher was informed that there were losses of production and productivity in the selected kebeles. Accordingly, the researcher selected Amuma Degero, Amuma Badeso and Muchicho Giyorgis purposively. From these selected 3 kebeles the researcher only took 93 samples from target population of 1134. The target populations were taken from 3 Developmental Agent (DAs or worked as experts within 3 kebeles) and 3 kebele administrator and 3 office workers (works in district agricultural and irrigation) using purposive sampling techniques and the households using Kothari formula. Accordingly, 93 sample size were determined from the three kebeles' household population of 1125 in the study area using (Kothari, 2004) formula as follows.

$$n = \frac{Z^2 pqN}{e^2 (N - 1) + Z^2 pq}$$

- ❖ n is the desired sample size
- ❖ N is the size of household in the three sampled kebeles (1125); at a confidence level of 95% and 5% precision
- ❖ Z is the critical value containing the area under the normal curve =1.96;
- ❖ e is the desired precision level (5% precision = 0.05)
- ❖ p is an estimated proportion attribute present in the population (0.4)
- ❖ q = 1- p= (1 – 0.4 = 0.6).

By substituting these values in the above formula the sample size 'n' was calculated.

$$n = \frac{(1.96)^2 (0.4)(0.6)(1125)}{(0.05)^2 (1125 - 1) + (1.96)^2 (0.4)(0.6)} = 84 \text{ Sampled Respondents}$$

Table 3.1 Sample and sampling distributions of the study

No	Kebele	Total HH	Sampled HH	Sampled Techniques
1	Amuma Degero	385	25	Simple random sampling
2	Amuma Badeso	390	27	
3	Muchicho Giyorgis	350	23	
4	DA	3	3	Purposive sampling
5	Kebele Administrators	3	3	
6	Offices workers	3	3	
	Total samples	1134	84	Simple random sampling and purposive sampling

3.2.4 Methods of Data Collection

In order to collect the data required for this study, the researcher followed the following methods. First, the researcher visited Nedjo district agriculture and rural development office and obtained permission to conduct the study in the district on termite infestation and its impacts on agricultural production and productivity. The, the researcher immediately went to the study area and chose households, development agent workers in the kebeles and kebele administrators as respondents of the study. Next, the researcher clarified the objective and concern of the study and asked them politely to give the necessary data on the intensity, level of infestation and impacts from termite infestation in their areas. Additionally, the researcher also asked the respondents to give additional data on types and levels of crops sensitivity to termite infestation in the study area. In doing so, the researcher used interview, focused group discussion and observation as a method for collecting the data required for this study. After collecting the data, the researcher made modifications and reductions to the data gathered from the respondents for sake of making it simple and easily manipulated. Finally, the data added and reduced data were carefully entered into the software and analyzed.

3.2.4.1 Interview

The interview was conducted with 3 development agents (DAs), 3 Kebeles' administrators and 3 agricultural office workers. The researcher conducted a semi-structured interview with these interviewee based on their informed consents. The interview was conducted and recorded by the mobile phone of the researcher and further transcribed to suit with the objective of the study. The researcher conducted the interview to get data on the level of sensitivity of crops to termites, factors aggravating termite infestation and its controlling mechanisms as well as the type of mechanisms applied in the district if any. The interview was used to give additional responses to research questions number one, two and three.

3.2.4.2 Observation

The researcher was conducted an observation to the three kebeles selected in order to obtain first hand data on the termite infestation and its controlling practices undertaken in the study area. The researcher prepared observation check list based on the stated objective of study to enhance reliability and validity of data. The observation mainly focused on afflicted crop production areas of the actual physical infestation of termite and its socio-economic impacts of farmers in the study area.

3.2.4.3 Focus Group Discussion

In order to gather data from illiterate farmers involved in the study, the researcher made focused group discussions of whose crops production afflicted by termite infestation assigned from the 3 Kebele. The discussion was carried out at one level with 30 individuals in selected place from 3 Kebele. It helped the researcher to predict the problem of termite infestation on crops production to livelihoods.

3.2.5 Instruments of Data Collection

The researcher used questionnaire as the main instrument to collect the data required for this study.

3.2.5.1 Questionnaire

The researcher prepared questionnaire having both open and closed items and distributed them for the sampled households. Twenty questionnaire items were prepared and distributed for the sampled households in order to get data on level of crop sensitivity, factors aggravating termite infestation on grass land and cereal crop production, the status of their production and productivity due to termite infestations, and mechanisms they used to reduce termite infestation

on their crop production and productions. For favorable item, questions were presented using Likert scale time to make selected households their levels of agreements in the form of strongly agree, agree, undecided, disagree and strongly disagree. The questions were coded as 1,2,3,4 and 5 and the responses of respondents were also coded accordingly. The researcher used questionnaire to give answers to research questions one, two and three.

3.2.6 Data Analysis Method

The data collected for the study were analyzed using statistical package for social science (SPSS) version 24.0 and descriptive statistics, like frequency, percentage and mean to determine background information of respondents and quantities. In addition, descriptive statistics were used to assess the impact of termite infestation on crops production and its controlling practice. Data collected through questionnaire and interviews were converted into numerical formats for analysis.

Additionally, the data collected through observation, FGD and interview were analyzed through narration. The results of, statistically analyzed data were displayed by table; graph and pie-charts. Interpretation of the analysis followed the displayed data after analysis. Accordingly, both qualitative and quantitative data analysis methods were used to analyze and interpret data for this study.

4. RESULTS AND DISCUSSION

4.1 Description of Sample Household Characteristics

As it was discussed under the sampling part of the study, the researcher took households, developing agents in the selected kebeles, kebele administrators and agriculture and rural development officials as respondents for this study. The profile description and their stances were deployed in the following table.

Table 4.1. Description of Households selected from the selected kebeles(N=84)

No	Items	Category	Frequency	Percent
1.	Sex	Male	50	59.52%
		Female	34	40.47%
		Total	84	100%
2.	Level of Education	Illiterate	9	10.714%
		Primary education	30	35.714%
		10 th /12 th complete	36	42.857%
		Certificate	4	4.76%
		Diploma	4	4.76%
		BA degree and above	1	1.19%
		Others	-	-
		Total	84	100%
3.	Family size	<5 members	16	19.04%
		5-10 members	55	65.47%
		>10 members	13	15.47%
		Total	84	100%
4.	Income type	Agriculture	80	95.23%
		Trading	2	2.38%
		Mixed	2	2.38%
		Wage	-	-
		Others	-	-
		Total	84	100%
5.	Land owned	1-2 hectares	83	98.80%
		2-4 hectares	1	1.19%
		>5 hectares	-	-
		Total	84	100%
6.	Annual earnings	500- 10,000 ETB	80	95.23%
		10,000-50,000ETB	4	4.76%
		>50,000ETB	-	-
		Total	84	100%

Table 4.1 above summarizes the general characteristics of households selected as the study respondents. Accordingly, the result of the study shows 50(59.52%) of respondents were male and the rest 34(40.47%) of them were female respondents. This indicates that most of the participants of this study were male households. However, the researcher believed that respondents from both male and female sexes had participated in the process of the study.

Concerning educational status of respondents, the study result on Table 4.1 shows that 9(10.714%) of respondents were illiterate, 30(35.714%) of them attended primary education, 36(42.857%) of them completed grade 10/12, 4(4.76) of them had certificate and diploma and only 1(1.19%) of them were bachelor degree holders. None of the respondents were above degree holders in their educational levels. From these results, the researcher concluded that since respondents had varied educational levels, it was believed that they could give information on termite infestation from their experiences than the information they received from educations.

In the same way, Table 4.1 above illustrates family size of households participated in the study. Among 84 participants, 16(19.04%) of them had <5 family members, 55(65.47%) of them had 5-10 family members and the rest 13(15.47%) of them had >10 family members. This shows that most of the study participants (55 of them) had 5-10 family members followed by 16 and 13 participants in the study area. This indicates that most of the households held large family size and took the responsibility of feeding and taking care of them.

Table 4.2: Descriptive analysis's of developing agents, kebele administrators and office workers (N=9)

No	Items	Category	Frequency	Percent
1.	Sex	Male	6	66.66
		Female	3	33.33
		Total	9	100%
2.	Level of Education	Diploma	2	22.22%
		BA/BSc/BED	6	66.66%
		MA/M.Sc	1	11.11%
		Total	9	100%
	Experience	between 0-2 years	-	-
		between 3-5 years	2	22.22%
		between 6-8 years	3	33.33%
		between 9-11 years	2	22.22%

		between 12-14 years	1	11.111%
		>15 years	1	11.111%
		Total	9	100%

Table 4.2 above summarizes the general characteristics of respondents selected from developing agents, kebele administrators and office workers. Accordingly, the result of the study shows 6(66.66%) of respondents were male and the rest 3(33.33%) of them were female respondents. This indicates that most of the participants of this study were male developing agents, kebele administrators and district agriculture and rural development office workers. However, the researcher believed that respondents from both male and female sexes had participated in the process of the study.

Concerning educational status of respondents, the study result on table 4.2 shows that 2 (22.22%) of respondents were diploma holders, 6(66.66%) of them were bachelor degree holders and only 1(11.11%) of respondents were second degree (MA/MSC. degree/ holders. From these results, the researcher concluded that since most respondents were above bachelor degree holders they had the capacity to give the right responses to the questions given to them. In the same way, table 4.2 above illustrates working experience of participants in their professions. Among 9 participants, none of the respondents had between 0 to 2 years working experience, 2(22.22%) respondents had 3-5 years of working experience, 3 (33.33%) of the respondents had 6 to 8 years of working experience, 2(22.22%) of the respondents had 9-11 years working experience, and the rest 1(11.11%) of the respondents had between 12 to 14 years working experience and above 15 years working experience. This shows that most of the study participants had 6 to 8 years working experience followed by 3 to 5 and 9-11 years working experience in the study area. This indicates that most of the respondents were experienced to provide the required level

4.2 Causes of Termite Infestation

In order to collect data on factors aggravating termite infestation in the study area, the researcher used questionnaire, semi-structured interview and focused group discussions. The results obtained from these tools were analyzed and discussed below.

Table 4.3.Causes related to human activities (N=84)

No	causes of termite infestation	Alternative Responses						Total	M	SD
			1	2	3	4	5			
1.	Lack of knowledge and understanding about termite aggravates termite infestation. Ignorance	F	43	39	0	3	0	84	3.197	0.872
		%	51.19	46.42	0	43.57	0	100		
2.	Use of cow dung	F	38	45	1	0	0	84	3.127	0.9901
		%	45.23	53.57	1.19	0	0	100		
3.	Human waste	F	50	34	0	0	0	84	3.133	0.982
		%	59.52	40.47	0	0	0	100		
4.	Communities' inability to use appropriate waste management techniques causes termite infestation.	F	41	35	1	4	3	84	3.224	0.884
		%	48.80	41.66	1.19	4.76	3.57	100		
5.	Overgrazing and deforestation	F	30	36	2	11	5	84	3.166	0.74668
		%	35.71	42.85	2.38	13.095	5.95	100		
6.	Wood and woody litters decaying.	F	43	34	1	2	4	84	3.513	0.6338
		%	51.19	40.47	1.19	2.38	4.76	100		

Key: f= frequency; %= percentage; 1= strongly agree; 2= agree; 3= undecided; 4= disagree; 5= strongly disagree; M=mean; SD= standard deviation

Table 4.3 above summarizes causes for termite infestation that was related to human activities in the study area. In the table on item one, majority of participants indicated that lack of knowledge and understanding about termite aggravated termite infestations in the area with the respondents' mean score was 3.197 and deviated with standard deviation of 0.872 respectively which in turn indicated farmers' knowledge and understanding about termite and its infestation aggravated and maximized the amount of infestation in their environments. From these responses, farmers did not have clear cut image about impacts of termite infestation and its controlling mechanism and as a result, termite infestation was increasing from time to time.

In the table item two, overusing natural fertilizers like cow dungs and other composite materials aggravated termite infestation with average mean responses of 3.127 and standard deviation of 0.9901 respectively. From this item, overusing natural fertilizers specially cow dung and other composite materials also aggravated and boosted termite infestation in the study area.

Moreover, in the table item three, the participants revealed that lack of latrine and toilet and deviating every in the countryside aggravated termite infestation with the mean score of 3.133 with standard deviation of 0.982 respectively.

Furthermore, in the table item four, the participants showed that communities' inability to use appropriate waste management techniques caused termite infestation with the mean score of 3.224 and standard deviation of 0.884 respectively.

Additionally, in the table item five, the participants indicated that overgrazing and deforestation aggravated termite infestations with the mean score of 3.166 and standard deviation of 0.74668 respectively.

With the same token, in the table item six, the participants indicated that putting wood and woody litters everywhere extended termite infestation with the mean score of 3.513 and standard deviation of 0.6338 which indicated that putting and throwing wood and woody litters everywhere highly extended and aggravated termite infestation in the study area. Generally, different activities that were performed by human being on their day to day lives highly aggravated termite infestation in the study area.

The researcher also conducted a semi-structured interview with developing agents, kebele administrators and office workers to identify if human activities could aggravate termite infestation in the study area. The interviewee responded that human activities and lack of awareness about factors boosting termite infestation very highly aggravated termite infestation in the area. Additionally, they indicated that human beings did different activities knowing and unknowingly and these activities in turn affected the expansion and infestation of termites in the area. These results highly agreed with the results obtained from questionnaire with sampled households above. Therefore, from these results one can infer that there were several factors that were related with human activities that aggravated termite infestation in the study area.

Similarly, the results obtained from illiterate study participants' focused group discussion and researcher's own observation in different areas of selected kebeles indicated that termite infestations in the area were maximized due to human activities and these human activities were observed to attract huge numbers of termite infestations in the area. In general, factors related to human activities highly aggravated termite infestations in the study area.

Table 4.4. Causes of termite infestation related to ecology (N=84)

No	causes of termite infestation	Alternative Responses						Total	M	SD
			1	2	3	4	5			
1.	Soil temperature	F	55	25	0	4	0	84	3.3	0.88
		%	65.47	29.76	0	4.76	0	100	81	
2.	Loose soil	F	49	30	2	3	0	84	3.1	.705
		%	58.33	35.71	2.38	3.57	0	100	32	
3.	Availability of softer spring wood in the environment boosts termite infestation.	F	44	29	2	5	4	84	3.2	.829
		%	52.38	34.52	2.38	5.95	4.76	100	8	
4.	Topography	F	37	41	1	2	3	84	3.1	.681
		%	44.047	48.8	1.19	2.38	3.57	100	25	
5.	Lessen land cover	F	40	40	0	0	4	84	3.5	0.578
		%	47.61	47.61	0	0	4.76	100	21	

Key: *f*= frequency; %= percentage; 1= strongly agree; 2= agree; 3= undecided; 4= disagree; 5= strongly disagree; *M*=mean; *SD*= standard deviation

Table 4.4 above summarizes ecological related causes that aggravated termite infestation in the study area. In the table item one, majority of participants indicated that the nature of the land in the environment for encouraging soil temperature to termite forage aggravated termite infestation which in turn indicated that the convenience of the environment to provide forage for termite strongly aggravated termite infestation in the study area. From these responses, environmental accessibility to offer forage for the termites highly aggravated their infestations.

In the table item two, the participants indicated that land convenience to termite mounds aggravated termite infestation. From this item, it is possible to deduce that convenience of land for termite mounds were factors that highly aggravated termite infestation in the study area.

Moreover, in the table item three, the participants revealed that availability of softer spring wood in the environment boosted termite infestation with the mean score of 3.28 with standard deviation of 0.829 which indicated that prevalence of spring wood growing in the area which was convenient for breeding of termite highly aggravated termite infestation in the study area.

Furthermore, in the table item four, the participants showed that topology of the ground for securing necessary atmosphere moisture levels also encouraged termite infestation with the mean score of 3.125 and standard deviation of 0.681 which indicated that topology of the ground in the study area was considered to be one of the factors that highly aggravated termite infestation.

With the same token, in the table item five, the participants revealed that the structure of the land consisting of adequate food sources for termite boosted its infestation with the mean score of 3.521 and standard deviation of 0.578 which indicated that the structure of the land for outsourcing food and other necessities highly aggravated termite infestation in the study area.

For supporting the results obtained through questionnaire and triangulating them with one another, the researcher conducted a semi-structured interview with developing agents, woreda's agriculture and rural development office workers and kebele administrators on if ecology of the environment could be considered as factors aggravating termite infestation in the study area. For this question, all the participants indicated that the ecology of the area was believed to multiply termite infestation because it was convenient for offering food, basic needs and climate for termite infestation. Therefore, the researcher understood that the results obtained through interview highly agreed with the results obtained through questionnaire. Hence, one can infer that ecology of selected kebeles in Nedjo district could be considered to be factors highly aggravating termite infestations.

For more confirmations, the researcher also conducted a focused group discussions with illiterate study participants on if ecology of the environment could aggravate termite infestations. For this question, the participants indicated that termite infestation was aggravated due to convenience of the ecology in the study area. Generally, one can infer that ecology of the environment in the study was considered to be one of the major factors aggravating termite infestation.

4.3 Crops Sensitivity to Termite Damage

In order to gather data on the crops sensitivity to termite damage and farmers' level of production and productivity beside the termite infestation, the researcher used semi-structured interview, focused group discussions and observation in termite afflicted area.

Table 4.5. Respondents response on types of crops sensitive to termite damage (N=84)

N o	Crops sensitive to termite attack	sensitivity level						Total	M	SD
			1	2	3	4				
1.	Maize	F	44	38	1	1	0	84	3.4	0.623
		%	52. 38	45. 23	1.19	1.19	0	100	7	62
2.	Wheat	F	35	43	5	1	0	84	3.5	0.660
		%	41. 66	51. 19	5.95	1.19	0	100	27	61
3.	Barley	F	35	43	5	1	0	84	3.5	0.660
		%	41. 66	51. 19	5.95	1.19	0	100	27	61
4.	Sorghum	F	42	33	2	4	2	84	3.5	0.633
		%	50	39. 28	2.38	4.76	2.38	100	13	8
5.	Teff	F	42	33	2	4	2	84	3.5	0.633
		%	50	39. 28	2.38	4.76	2.38	100	13	8
4.	Peas	F	46	28	6	4	0	84	3.5	0.617
		%	54. 76	33. 33	7.14	4.76	0	100	43	21
	Beans	F	46	28	6	4	0	84	3.5	0.617
		%	54. 76	33. 33	7.14	4.76	0	100	43	21
3	Banana, etc	F	58	22	1	2	1	84	3.5	0.351
		%	69. 04	26. 19	1.19	2.38	1.19	100	66	87
	Orange	F	58	22	1	2	1	84	3.5	0.351
		%	69. 04	26. 19	1.19	2.38	1.19	100	66	87
	Pineapple	F	58	22	1	2	1	84	3.5	0.351
		%	69. 04	26. 19	1.19	2.38	1.19	100	66	87
	Apple	F	58	22	1	2	1	84	3.5	0.351
		%	69. 04	26. 19	1.19	2.38	1.19	100	66	87
	Papaya	F	58	22	1	2	1	84	3.5	0.351
		%	69. 04	26. 19	1.19	2.38	1.19	100	66	87
	Watermelon	F	58	22	1	2	1	84	3.5	0.351
		%	69.	26.	1.19	2.38	1.19	100		

			04	19					66	87
4	Onion	F	61	23	0	0	0	84	3.5	0.210
		%	72. 619	27. 38	0	0	0	100	74	
	Garlic	F	61	23	0	0	0	84	3.5	0.210
		%	72. 619	27. 38	0	0	0	100	74	
	Sweet potato	F	61	23	0	0	0	84	3.5	0.210
		%	72. 619	27. 38	0	0	0	100	74	
	Potato	F	61	23	0	0	0	84	3.5	0.210
		%	72. 619	27. 38	0	0	0	100	74	
	Red beet	F	61	23	0	0	0	84	3.5	0.210
		%	72. 619	27. 38	0	0	0	100	74	
	Pepper	F	61	23	0	0	0	84	3.5	0.210
		%	72. 619	27. 38	0	0	0	100	74	
	Rice	F	61	23	0	0	0	84	3.5	0.210
		%	72. 619	27. 38	0	0	0	100	74	
5	Oil seeds	F	53	30	1	0	0	84	3.6	0.212
		%	63. 09	35. 71	1.19	0	0	100	13	3
	Soya beans	F	53	30	1	0	0	84	3.6	0.212
		%	63. 09	35. 71	1.19	0	0	100	13	3

Key: f= frequency; %= percentage; 1= very high; 2=highly, 3= moderately 4= lowly 5= Not
M=mean; SD= standard deviation

Table 4.5 above summarizes level of crop sensitivity to termite infestation in the study area. In the table item one, the participants indicated that maize is highly sensitivity to termite infestation in the study area.

In the table item two, the participants revealed that wheat and barley were highly sensitive to termite infestation in the study area.

Moreover, in the table item three, the participants that sorghum was highly sensitive whereas teff was lowly sensitive to termite infestation in the study area.

Furthermore, in the table item four, the participants responded that peas and beans were highly sensitive in the study area.

In table 4.5 item five, the participants indicated that fruits were very highly sensitive to termite infestation in the study area.

In the table item six, respondents indicated that vegetables in the study area were highly sensitive to termite infestations. Similarly in the table item seven, the respondents showed that oil crops on farmers' yards were highly sensitive to termite infestations in the study area.

In order to triangulate the data obtained from the questionnaire, the researcher also conducted interview with DA, District's agriculture and rural development works and kebele administrators on the levels of sensitivity of crops to termite infestations in the study area. All of the interviewees indicated that there were high crop sensitivity to termite infestation in the area except strong crops like Teff and others.

Additionally, the participant in the focused group discussion responded that there were colonies of termites and the colonies produce myriad amounts of termites and disseminated them into the yards of farmers. Due to these termite infestations, several cereal, oil, cash crops and fruits and vegetables were highly sensitive and their level of sensitivity was very high. In general, the level of crop sensitive to termite infestation in the study area was very high and huge in the study area.

Similar results were also disclosed by Atsbha and Hintsa (2018) who disclosed that currently, many regions of the world are subjected to expansions and/or invasions of subterranean termites. In some areas, including Ethiopia, termite constitutes a significant pest problem in agriculture. In general, plants exotic to the specific area and water-stressed plants are most prone to attack by termites. They are serious pests of a wide range of crops, forest trees and buildings in Western Ethiopia.

4.4 Impacts of Termite Infestation on Crop Production and Productivity

In order to gather data on the impacts of termite infestation on crop production and productivity in the study area, questionnaire, interview and focused group discussion as well researcher's field observations were used. The data obtained through these tools were analyzed and triangulated in the following ways.

Table 4.6. Impacts of termite on crop production (N=84)

No	impacts of termite	Alternative Responses						Total	M	SD
			1	2	3	4	5			
1.	Loss of production and productivity.	F	64	18	0	2	0	84	1.9	0.838
		%	76.19	21.42	0	2.38	0	100	6	
2.	Loss of soil fertility	F	45	33	0	4	2	84	1.5	0.446
		%	53.57	39.28	0	4.76	2.38	100	27	1
3.	Loss of organic fertilizers	F	42	37	2	3	0	84	1.5	0.833
		%	50	44.047	2.38	3.57	0	100	13	8
4.	Annual income losses	F	71	11	1	1	0	84	1.8	.94
		%	84.52	13.09	1.19	1.19	0	100	5	

Key: f= frequency; %= percentage; 1= strongly agree; 2= agree; 3= undecided; 4= disagree; 5= strongly disagree; M=mean; SD= standard deviation

Table 4.6 above summarizes the level of crop production in termite infested areas. In the table item one, the participants showed that farmers' level of annual crop production and productivity was highly affected due to termite infestation in the study area.

In the table item two, the respondents indicated that since soil fertility had been affected with termite infestation level of production and productivity also had been affected.

Moreover, in the table item three, the participants that organic fertilizers on the yards of farmers had been affected due to termite infestation in the study area termite infestation which directly lowered farmers' level of crop production and productivity.

Furthermore, in the table item four, the participants indicated that farmer's annual income generated from crop production and productivity was getting worse and worse due to termite infestation in the study area.

The results obtained from interviews with DA, woreda's agriculture and rural development works and kebele administrators indicated that farmer's level of crop production and productivity were declining from year to year or season to season because of loss of soil fertility due to termite infestation in most areas of Nedjo district. This in turn affected the livelihoods of

farmers and their families that termite infestation made them unable to feed their families and fulfill basic necessities.

Similarly, the results obtained from illiterate study participants' focused group discussion also affirmed that farmers' level of production and productivity were declining from time to time due to termite infestation in the study area. They further indicated that farmers did not reap appropriate harvests from time to time due to termite infestation. In general, the level of crop production and productivity of farmers in the study area was very low and weak because of high termite infestation in the study area.



Fig 4.1. Level of cereal crop production due to termite infestation (own observation)

Table 4.7. Ecological Impacts of termite infestation in the study area (N=84)

No	Items	Alternative Responses						Total	M	SD
			1	2	3	4	5			
1.	Natural forestations are affected due to termite infestation in the area.	F	48	31	0	4	1	84	3.6	.82
		%	57.14	36.90	0	4.76	1.19	100	4	
2.	Soil fertility is highly affected due to termite infestation.	F	67	14	1	3	0	84	3.5	.505
		%	79.76	16.66	1.19	3.57	0	100	32	
3.	Decomposers and natural biomes are distorted due to termite infestation.	F	36	38	2	5	0	84	3.6	.529
		%	42.85	45.23	2.38	5.95	0	100	28	
4.	Wood and woody litter, including dead branches still attached to trees are highly afflicted with termite infestation.	F	66	15	1	2	1	84	3.5	.481
		%	78.57	17.85	1.19	2.38	1.19	100	35	
5.	Land sliding and barren occurred in the study area	F	63	19	2	0	0	84	3.5	0.28
		%	75	22.61	2.38	0	0	100	21	
6.	Loss of environmental beauty	F	55	28	1	0	0	84	3.5	0.025
		%	65.47	33.33	1.19	0	0	100	35	
7.	Animal forage and grazing shrubs and grasses are degraded due to termite infestation.	F	50	29	3	2	0	84	3.5	0.42
		%	59.52	34.52	3.57	2.38	0	100	24	

Key: f= frequency; %= percentage; 1= strongly agree; 2= agree; 3= undecided; 4= disagree; 5= strongly disagree; M=mean; SD= standard deviation

Table 4.7 above summarizes ecological impacts of termite infestation in the study area. In the table item one, majority of participants indicated that termite infestation highly affected the natural forests in the study area. From these responses, one can infer that natural vegetations are highly affected due to termite infestation in the study area which in turn affected the ecology of the study area.

In the table item two, the respondents indicated that termite infestation strongly affected soil fertility in the study area which could be acidic to the ecology of the study area.

Moreover, in the table item three, the participants indicated that soil decomposers and natural biomes were distorted and soil fertility was affected due to loss of these important nutrients added to the soil after decompositions.

Furthermore, in the table item four, the participants indicated that termite infestation highly affected wood and woody litter in the study area.

Additionally, in the table item five, the participants indicated that termite infestation highly degraded soil and land in the study area.

With the same token, in the table item six, the participants indicated that termite infestation made the environment lose its beauty and become unsaturated for survival.

On the other hand, in the table item seven, the participants indicated that termite infestation highly affected forage and feedings of animals in the study area.

The results obtained from interviews with DA, woreda's agriculture and rural development workers and kebele administrators indicated that termite infestation had an impact on farmers, environment, soil, biodiversity, livestock and others in the study area. This in turn highly affected farmers' production and productivity in the study area.

Similarly, the results obtained from illiterate study participants' focused group discussion also showed that termite infestation in their kebeles highly affected their production and productivity and biomes in their areas. They further indicated that termite infestation also affected the natural forestation in the area and due to that the environment had been degraded from time to time. In general, termite infestation highly affected farmers' production and productivity.

Tufa and Ketema (2016) also reported that termite infestation and damage starts while plants are standing in the field. A soil infested with termite mostly resulted in distortion of soil structures and compactions. Hence soil becomes difficult to plough, this in turn results in a reduction of productivity of crops. Termites are devastating insect pests which caused 36 to 62% reduction in yields of hot pepper and maize, respectively.

Additionally, the finding of the current study also revealed that termite infestation adversely affected farmers' production and productivity in the study area. Some researchers also found nearly similar findings with the current study. Researchers like Abhishek et.al, (2021) and Daniel Getahun and Eman(2017) indicated that termites were polyphagous pests and one of the most destructive of agricultural, horticultural, agroforestry and plantation crops. They further explained that certain species of termites were serious pests of growing crops including living trees and they are one of the major agroforestry pests in the tropics



Fig 4.2 Termite infestation on grass land in the study area(own Observation)

4.5 Termite Infestation control practices

In order to get data on termite infestation controlling practices the researcher used questionnaire, semi-structured interview, focused group discussion and observation. The results obtained through these tools were analyzed, interpreted, triangulated, compared and contrasted and discussed in the following ways. The analysis mainly focused on cultural methods, biological methods, physical methods, chemical methods and non-chemical methods.

Table 4.7.Responents response on Cultural method of controlling termite infestation (N=84)

N o	Methods	Alternative Responses						Total	M	SD
			1	2	3	4	5			
1.	Deep winter/spring ploughing	F	28	22	3	4	27	84	2.1	0.992
		%	33. 33	26. 190	3.5 7	4.76	32.1 4	100	31	
2.	Using well decomposed farmyard manure	F	14	4	0	16	50	84	2.6	1.617 21
		%	16. 66	4.7 6	0	19.0 4	59.5 2	100	23	
3.	Intercropping.	F	31	34	4	7	8	84	3.2	0.884
		%	36. 90	40. 47	4.7 6	8.33	9.52	100	24	
4.	Frequently weeding.	F	43	41	0	0	0	84	3.1	0.990 1
		%	51. 19	48. 80	0	0	0	100	27	
5.	Recommended fertilizers use	F	12	2	0	25	45	84	2.1	0.982
		%	14. 28	2.3 8	0	29.7 6	53.5 7	100	33	

Key: f= frequency; %= percentage; 1= strongly agree; 2= agree; 3= undecided; 4= disagree; 5= strongly disagree; M=mean; SD= standard deviation

Table 4.7 above summarizes cultural method of controlling termite infestation in study area. In the table item one, majority of participants indicated that implementations of deep winter/spring ploughing to control termite infestation as cultural/traditional method of controlling termite infestation was moderate. From these responses, farmers' application of deep ploughing to eliminate termite infestation in the yards was moderate which could be considered as ineffective way.

In the table item two, the participants showed that usage of well decomposed farm yards as traditional method of controlling termite infestation was not implemented to the required level. However, there was moderate implementation of it.

Moreover, in the table item three, the participants indicated that farmers in the study area highly used intercropping to their yards as traditional method of controlling termite infestations.

Furthermore, in the table item four, the participants indicated that farmers used frequent weeding from their yards as traditional method of controlling termite infestation.

Additionally, in the table item five, the participants indicated that farmers' use of balanced fertilizers to their yards as traditional control of termite infestation was very low.

The data obtained through interview with developing agents, district's agriculture and rural development office workers and kebele administrators also agreed to the results obtained through questionnaire with selected households above. All the interviewees indicated that farmers moderately used deep winter/spring ploughing, well decomposed farmyard manure to their yards as natural fertilizer, intercropping to their yards to reduce termite infestation, frequent weeding of irrelevant plants/especially spring plants/to avoid termite infestation from their yards and proper and balanced fertilizer to their yards in order to avoid termite infestation. Thus, application of traditional method of termite infestation was moderate in the study area.

The data obtained from focused group discussions with illiterate study participants also revealed that traditional method of controlling termite infestation in the study area was ineffective and inappropriate. Generally, traditional method of controlling termite infestation in the study area was implemented to some extent, but it was not effectively and efficiently implemented in the study area.

Table 4.8. Respondents response on cultural method of controlling termite infestation (N=84)

No	Methods	Alternative Responses						Total	M	SD
			1	2	3	4	5			
1.	Natural enemies(ants and frogs)	F	5	2	1	16	60	84	2.5	0.617
		%	5.9 5	2.3 8	1.1 9	19.0 4	71.4 2	100	43	21
2.	Allowing runoff to the mound	F	24	30	2	8	20	84	2.5	0.660
		%	28. 57	35. 71	2.3 8	9.52	23.8	100	27	61
3.	Breaking the mounds and collecting the queen.	F	47	27	0	4	6	84	3.5	0.633
		%	55. 95	32. 14	0	4.76	7.14	100	13	8
4.	Burning the mounded area	F	29	23	2	11	19	84	2.7	0.561
		%	34. 52	27. 38	2,3 8	13.0 9	22.6 1	100	31 5	87

Key: f= frequency; %= percentage; 1= strongly agree; 2= agree; 3= undecided; 4= disagree; 5= strongly disagree; M=mean; SD= standard deviation

Table 4.8 above summarizes biological and physical method of controlling termite infestation in the study area. In the table item one, majority of participants indicated that they didn't make ants and frogs freely breed and thrive in their yard as a biological and physical method of controlling termite infestation. From these responses, there was wrong implementation of using ants and other insects that eat termites was ineffective.

On the table item two, the respondents indicated that farmers' use of leaving bushes and small scale shrubs as well as ponds of water on their yards as biological methods of controlling termite infestation was improper.

Moreover, in the table item three, the participants indicated that farmers' efforts of breaking termite mounds to avoid queen and kings of them not to infest and breed in their yards was appropriately and effectively implemented.

Furthermore, in the table item four, the participants indicated that farmers also applied botanica method of controlling termite infestation in their yards.

For supporting the results obtained through questionnaire and triangulating them with one another, the researcher conducted a semi-structured interview with developing agents, woreda's agriculture and rural development office workers and kebele administrators on if ecology of the environment could be considered as factors aggravating termite infestation in the study area. For this question, all the participants indicated that the ecology of the area was believed to multiply termite infestation because it was convenient for offering food, basic needs and climate for termite infestation. Therefore, the researcher understood that the results obtained through interview highly agreed with the results obtained through questionnaire. Hence, one can infer that ecology of selected kebeles in Nedjo district could be considered to be factors highly aggravating termite infestations.

For more confirmations, the researcher also conducted a focused group discussions with illiterate study participants on if ecology of the environment could aggravate termite infestations. For this question, the participants indicated that termite infestation was aggravated due to convenience of the ecology in the study area. Generally, from the results above one can infer that ecology of the

environment in the study was considered to be one of the major factors aggravating termite infestation.

**Table 4.9. Chemical method of controlling termite infestation (N=84)
please use say yes or no not frequency**

No	Methods	Alternative Responses						Total	M	SD
			1	2	3	4	5			
1.	using chemicals (<i>cyclodiene, aldrin, dieldrin, chlordane and heptachlor</i>)	F	13	7	5	17	42	84	1.79	.81
		%	15.47	8.33	5.95	20.23	50	100		
2.	I usually use hazardous insecticides like DDT, Roach killer and <i>termicide</i> to my yard to avoid termite infestations.	F	10	2	4	18	50	84	1.81	0.88
		%	11.90	2.38	4.76	21.42	59.52	100		

Key: f= frequency; %= percentage; 1= strongly agree; 2= agree; 3= undecided; 4= disagree; 5= strongly disagree; M=mean; SD= standard deviation

Table 4.9 above summarizes chemical method of controlling termite infestation in the study area. On the table item one, majority of participants indicated that they didn't use *termiticides* such as *cyclodien, aldrin, dieldtrin, chloradene* and *heptachlor* to their yards as chemical method of controlling termite infestation. The participants turn indicated that farmers' use of chemical method like *termiticides* such as *cyclodiene, aldrin, dieldrin, chlordane* and *heptachlor* to their yards to control termite infestation was improper.

In the table item two, the participants responded that farmers' misuse of hazardous chemical make the termites be breed and thrive in the study area.

For supporting the results obtained through questionnaire and triangulating them with one another, the researcher conducted a semi-structured interview with developing agents, worda's agriculture and rural development office workers and kebele administrators on if uses of chemical as controlling mechanism of termite infestation in the study area. For this question, all the participants indicated that farmers rarely used chemicals to kill and control termite infestations on their yards. Therefore, the researcher understood that the results obtained through interview highly agreed with the results obtained through questionnaire. Hence, one can infer that the chemical method of controlling termite infestation in the study area was missed.

For more confirmations, the researcher also conducted a focused group discussions with illiterate study participants on if they used chemical as a method of controlling termite infestations in their area. For this question, the participants indicated that because hazardous chemicals were costly and very expensive, they rarely used them as a method of controlling termite infestations in their localities. Generally, from the results above it is possible to understand that the uses of chemicals as a method of controlling termite infestation were improper and inappropriate.

The findings go in line to the some of the findings disclosed by prior researchers. For instance, Abhishek et al. (2021) disclosed that left over stubbles of previous crop and other decaying matter should be removed from the field as they attract termites. Only well decomposed farmyard manure (FYM) should be applied to the field because partially decomposed FYM acts as an attractant to foraging workers due to the presence of cellulose and optimum moisture. Farmers should follow crop rotation especially including non-preferred crops. Additionally, the effect of intercropping maize with soybean, groundnut and common beans against termites and found a significant reduction in termite attack and increased nesting sites of predatory ants (*Myrmecaria* and *Lepisiota*) in maize fields as cultural/traditional methods of controlling termite infestations.

Mugerwa *et al.* (2014) also disclosed that insects that eat termites should be encouraged to help to reduce the number of termites as a biological method of controlling termite infestations. Akutse *et al.* (2012) indicated that breaking the mounds of the termites and removing the queen and the king should be recommended if they appear close to storage structures as a physical method of controlling termite infestations.

Demissie *et al* (2019) also recommended that different pesticides such as *aldrin*, *dieldrin*, chlordane and heptachlor should be used as a chemical method of controlling termite infestation. Additionally, these scholars indicated that hazardous insecticides should be applied to the infested area as chemical method of controlling termite infestations in the study area.

5. CONCLUSIONS AND RECOMMENDATION

5.1 Conclusions

The finding of the above study indicated that termite infestation is caused due to human factors like poor sanitation, poor waste management practices, overgrazing, deforestation, and excessive use of won dung as fertilizers, exposure of the land to termite, soil texture for striving and breeding termite mounds in the area and ecological causes like conducive climatic conditions and others. This finding in turn reflected similar findings with some of the studies conducted earlier on similar area.

The study also indicated that different types of crops, fruits, vegetables and forest trees were highly sensitive to termite infestations. Crops like maize, barley, sorghum, peas and beans, oil seeds, and soya beans, banana, orange beet root and other types of crops are highly sensitive to termite infestations. Except teff which is considered hard, all other types of cereals, oils seed, seedling plants and fruits and/or vegetables are highly sensitive t termite infestation in the study area.

Additionally, the study result indicated that termite infestation adversely affected farmers' levels of production and productivity, the ecology, loss of resources and soil acidity.

The finding of the study also disclosed that farmers' implementations of different methods for controlling termite infestations in the study area were at the moderate level. This means farmers' implementation of cultural, biological and chemical methods of controlling termite infestations was moderate because farmers did not adequately use these methods proactively or reactively for controlling termite infestation in the study area.

5.2 Recommendations

Termite infestation is the most adversely affecting agents of crop production and productivity in the study area and thus, suggesting its controlling mechanisms is very crucial. Therefore, based on the above results of the study, the following recommendations are suggested.

The Regional, zonal and woreda government should work collaboratively on tackling termite infestation in the study area.

Involvement of various stakeholders through community based observation is essential.

Farmers in the study area are suggested to practice traditional and biological termite controlling mechanism to prevent its infestation into their farmlands.

The DA and environmental workers might work to benefit the local community and to increase their awareness.

Enhance the surrounding community's awareness competency of scouts and their effectiveness significantly through training and patrol equipment.

The government should provide the local communities with expensive chemicals in order to control termite infestation in the area.

Demonstration should be made in the study area on how to control termite infestation by the concerned agricultural specialists from the regional to the kebele levels.

Scholars are suggested to dig out the level of crop sensitivity and controlling mechanisms of termite infestation by conducting further studies in the area.

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7. APPENDICES

7.1 Appendix A: Household Level Questionnaire

This questionnaire is prepared to collect data on the impacts of termite infestation on grass land and cereal crop production and productivity in Nedjo district, West Wallaga zone, Oromia regional State, Ethiopia. The study is conducted to receive degree of masters in environmental sciences/chemistry/ and the responses you give me have a potential contribution to the success of my study. Therefore, I beg your contribution to cordially answer the questions given to you as you asked to respond.

Thank you in advance for your cooperation!

Part I:-General background information

1. Sex of respondents : Male _____ Female _____

2. Kebele/town/ _____

3 Got/PA.....

4. Age.....

6. Marital status: Single ☐ Married ☐ Divorced ☐

7. Position in the HH.....

8. Total number of family members.....

9. Religion: Protestant ☐ Orthodox ☐ Muslim ☐ Wakefata ☐ Other ☐

10. Educational background: Illiterate ☐ Adult Education ☐ Elementary school ☐
Secondary school ☐ College ☐ University ☐

11. Occupation: Farmer ☐ Government employer ☐ Merchant ☐ Other ☐

12. Total land owned..... (in 'Kada')..... (in ha)

13. Total number of livestock you have _____

14. Number of household per hectare in your area _____

Part-II. Impacts of termite infestation on grass land and cereal crop production and productivity

Instruction: The following statements are about impacts of termite infestation on grass land and cereal crop production and productivity. These are level of crop sensitivity to termite infestation, impacts of termite infestations, factors aggravating termite infestations in the study area and methods of controlling termite infestations in the study area. Please show your agreements using Likert scales for the questions using 1 for strongly agree, 2 for agree, 3 for undecided, 4 for disagree and 5 for strongly disagree.

Table 7.1. Questionnaire filled by respondents

N0		Response				
		V	H	M	L	No
		1	2	3	4	5
1.	Level of crop sensitivity to termite infestation					
1.1	There is high damage on my crops due to termite infestation					
1.2	Maize is highly sensitive to termite infestation					
1.3	Wheat and barley are highly sensitive to termite infestation					
1.4	Sorghum and teff are highly sensitive to termite infestation					
1.5	Banana, orange, watermelon, papaya, lemon and other fruits are sensitive to termite infestation.					
1.6	Garlic, onion, pepper, pumpkin, beet root, cabbage, carrot and others are sensitive to termite infestation.					
1.7	Oil seeds and soya beans are sensitive to termite infestations.					
2.	Impacts of Termite Infestation	SA	A	U	D	SD
2.1	My annual crop production and productivity are affected due to termite infestation.					
2.2	My crop production and productivity are declining from year to year due to termite infestation.					
2.3	I earn many crops from yards beside termite infestation.					
2.4	My annual income from my cultivation is getting worse and worse.					

2.5	Natural forestations are affected due to termite infestation in the area.					
2.6	Decomposers and natural biomes are distorted due to termite					
2.7	Wood and woody litter, including dead branches still attached to trees are highly afflicted with termite infestation.					
2.8	The soil and land in our environments are degraded due to termite infestation.					
2.9	The soil and land mass in my yard become difficult and hard to plough after termite infestation into it.					
3.	Factors Aggravating Termite Infestation					
3.1	Lack of knowledge and understanding about termite aggravates termite infestation.					
3.2	Communities' over fertilization specially using cow dung and others on particular field causes termite infestation.					
3.3	Lack of latrine and toilet and putting devication the countryside aggravates termite infestation.					
3.4	Communities' inability to use appropriate waste management techniques causes termite infestation.					
3.5	Overgrazing and deforestation also aggravates termite infestations.					
3.6	Putting wood and woody litters everywhere also extends termite infestation.					
3.7	The nature of the land in the environment for encouraging soil temperature to termite forage aggravates termite infestation.					
3.8	Land convenience to termite mounds are the other factors aggravating termite infestation.					
3.9	Availability of softer spring wood in the environment boosts termite infestation.					
3.10	The topology of the ground for securing necessary atmosphere moister levels also encouraged termite infestation.					
3.11	The structure of the land consisting of adequate food sources for termite boosted its infestation.					
4.	Methods of Controlling Termite Infestation					
4.1	Deep winter/spring ploughing is used to control termite infestation.					

4.2	I use well decomposed farmyard manure to my yard as natural fertilizer.					
4.3	I use intercropping to my yard to reduce termite infestation.					
4.4	I frequently weed irrelevant plants/especially spring plants/to avoid termite infestation from my yard.					
4.5	I use proper and balanced fertilizer to my yard in order to avoid termite infestation.					
4.6	I make ants and frogs freely breed and thrive in my yard.					
4.7	I usually leave bushes and small scale shrubs as well as ponds of water on my yard to avoid termite infestation.					
4.8	I usually break mounds of termite to avoid queen and king of them not to infest in my yard.					
4.9	I apply botanica to avoid and eliminate termites out of my yards.					
4.10	I usually use termiticides such as cyclodiene, aldrin, dieldrin, chlordane and heptachlor to my yards.					
4.11	I usually use hazardous insecticides to my yard to avoid termite infestations.					S

Part: V. Open ended Questionnaires.

Instruction: II. Give your answers to the following questions by generating your ideas to the following questions

1. In your kebeles, what are the major impacts that you come across due to termite infestation?

2. What are some of the factors that you think could aggravate termite infestation in your kebeles ?_____
3. What do you think will be done to reduce termite infestations in your kebeles?

4. If you want to add any more idea on impacts of termite infestations in your kebeles, please add here_____

Thank you in advance

Appendix “B”: Translated Version of Questionnaire

Bargaaffii Abbootii Warraan Guutaman

Bargaaffiin kundhiibbaawwan bakka tokkotti baay’achuu tuuta rimaa akka Aanaa Najjootti qorachuudha. Qorannoon kun ulaagaa digrii jalqabaa barsiisa Saayinsii Naannoo/Keemistriin/fudhachuuf kan qophaa’ee waan ta’eef deebii isiin gaafflee gaafatamaniif kennitan galma ga’iinsa qorannoo koof shoora ol’aanaa qaba. Kanaaf, gaaffilee gaafatamtan akkataa gaafatamtaniin akka deebistaniif isiin gaafadha.

Tumsa keessaniif galatoomaa!!

Kutaa I:-odeeffannoo waliigalaa

1.saala hirmaattotaa: Dhiira _____ Dubara _____

2. Ganda/magaalaa_____

3.Gooxii.....

4. Umurii

6. haala gaa’eelaa: kan hinfuune/hinheerumne ☐ kan fuudhe/heerumte ☐ kan hiike/kte ☐

7. Sadarkaa mana keessatti qabu.....

8. Baay’ina miseensota maatii.....

Kutaa-II.Miidhaa rirmi oomishaafi oomishtummaa midhaanii irratti geessisuu.

Seensa: bargaaffiin kanaan gadii kun waa’ee miidhaa rirmi oomishaafi oomishtummaa irraatti qabu irratti kan xiyyeeffatuudha.Gafafileen dhihaataniis hanga miidhaa inni midhaan irratti geessisu, miidhaa baay’achuun rirmaa qabu, baay’achuu rirmaaf wantoota sababa ta’aniifi karaalee baay’achuun rirmaa itti to’atamuu danda’u irratti hundaa’uuniidha.Kanaaf, hanga walii galtee keessanii safartuu waliigaltee Liikartii fayyadamuun 1-5tti akka agarsiistan kabajaan isiin gaafadha. 1 jehcuun sirriitti irratti waliigalaa, 2 jechuun irratti waliigalaa, 3 jechuun deebiin koo murtaa’aa miti, 4 jechuun irratti walii hingalu 5 jechuun immoo sirriitti irratti walii hingalu jechuudha.

Table 7.2. Translated Version of Questionnaire

T.L		Filannoo Deebiiwwanii				
		HMN	XM	GGM	B	DM
		1	2	3	4	5
1.	Hanga Baay’achuun Rirmaa Midhaan Miidhu					
1.1	Midhaan kiyyaa rirmaan baay’ee miidhamee jira					
1.2	Bogolloon rirmaan daran miidhama					
1.3	Qamadiifi garbuun baay’achuu rirmaan salphaatti miidhamu					
1.4	Bishingaafi xaafiin baay’achuu rirmaan salphaatti miidhamu					
1.5	Muuzii, burtukaana, loomii, paappayyaa, kookiifi kanneen biroon baay’achuu rirmaan salphaatti miidhamu.					
1.6	Qullubbii adii, qullubbii diimaa, raafuu, buqqee, hundee diimaa, kaarootifi kanneen biroon baay’achuu rirmaan baay’ee miidhamu.					
1.7	Nuugifi saliiixni ani oomishu baay’achuu rirmaan salphaatti miidhamu.					
2.	Miidhaa Baay’achuun Rirmaa Geessisuu	SWG	WG	YM	W	SWH
2.1	Oomishniifi oomishtummaan koo kan waggaa baay’achuu rirmaan baay’ee miidhamee jira.					
2.2	Oomishniifi oomishtummaan koo kan waggaa baay’achuu rirmaan baay’ee waggaadha gara waggaatti miidhamee jira.					
2.3	Osomaa rirmi garmalee baay’atee jiruu oomisha midhaanii baay’een argachaa jira.					
2.4	Galii ani waggaatti oomisha irraa argachaa jiru haala yaadnessaa ta’e irra jira.					
2.5	Sababa baay’achuu rirmaan bosonni uumamaa baay’een miidhamee jira.					
2.6	Burkuseessittoonni uumamaafi kanneen uumama biyyee keessatti shoora qaban sababa bnaay’achuu rirmaan baay’ee miidhamanii jiru.					
2.7	Mukeeniifi dameewwan mukaa kannen cacabanii mukatti rarraa’anii jiran sababa baay’achuu rirmaan daran miidhamanii jiru.					
2.8	Biyyeefi lafti naannoo keenyaa sababa baay’achuu rirmaan akka malee miidhamanii jiru.					
2.9	Maasaan koofi biyyeen maasaa koo sababa baay’achuu rirmaan qotamuuf baay’ee rakkisaa ta’anii jiru.					
3.	Baay’achuu Rirmaaf Wantoota Sababa Ta’an					

3.1	Waa'ee baay'achuu rirmaa irratti hubannoo gahaa ta'e dhabuun akka inni baayatu ta'ee jira.					
3.2	Hawaasni xaa'oo humnaan oli fayyadamuu fakkenyaaf dhoqqee loonii bakka tokkotti akka malee fayyadamuun baay'achuu rirmaaf sababa ta'ee jira.					
3.3	Maneen fincaaniitti fayyadamuu dhabuufi bakka arganiitti bobba'uun baay'achuu rirmaaf sababa ta'anii jiru.					
3.4	Malleen dhabamsiisa bal'aa sirrii ta'e fayyadamuu dhabuun baay'achuu rirmaaf sababa ta'ee jira.					
3.5	Bakka tokko irra deddeebiin dheechisuufi manca'insii bosonaa baay'achuu rirmaaf sababa guddaa ta'anii jiru.					
3.6	Hafteewwan mukaa bakka hinmalleetti gatuun rirmi akka baay'atuuf sababa ol'aanaa ta'ee jira.					
3.7	Haalli qilleensaa soorata rirmaaf mijataa ta'e argamuun rirmi akka baay'atuuf sababa ta'ee jira.					
3.8	Koobii rkirmaaf lafti mijataa ta'e argamuun baay'achuu rirmaaf sababa ta'ee jira.					
3.9	Biqiloonni lallafoon yemmuu arfaasaa biqilan baay'achuun walhoruu rirmaaf sababa ta'ee jira.					
3.10	Haalli teessuma lafaa jiidhinsa yeroo dheeraaf qabatee turu jiraahcuun baay'achu rirmaaf sababa ta'ee jira.					
3.11	Haalli teesuma lafaa nyaata rirmaaf mijatoo ta'an baay'achuu rirmaaf sababa biroo ta'anii jiru.					
4.	Karaalee ittiin Baay'achuun Rirmaa To'atamuu Danda'u					
4.1	Yemmuu bonaa yookiin arfaasaa qonna irra deddeebiin qotuun rirma to'achuuf ni gargaara.					
4.2	Maasaa koof xaa'oo kompoostii sirriitti qophaa'een fayyadama.					
4.3	Baay'achuu rirmaa to'achuuf maasii koo irratti midhaan waljijjiruunaan facaasa.					
4.4	Biqiloota barbaachisoo hintaane kanneen yeroo arfaasaa biqlan maasaa koo arameen balleessa.					
4.5	Maasaa koof xaa'oo madaalawaa fayyadamuun baay'achuu rirmaan xiqqeessuu yaala.					
4.6	Goondaafi fatteen maasaa koo keessatti walhoruun baay'achu rirmaa akka to'ataniif nan fayyadama.					
4.7	Comoxxiifi biqiloota xixiqoo maasaa koo irraa balleessuun baay'achuu rirmaa akka to'atamu nan taasiisa.					
4.8	Koba rirmaa maasaa koo keessatti gubuun akka inni					

4.9	Mala baayoloojikaalawwa fayyadamuun baay'achuu rirmaa maasaa koo keessan balleess.					
4.10	Baay'achuu rirmaa maasaa ko keessaa balleessuuf mala keemikaalawwaa nan fayyadama.					
4.11	Farra ilbisotaa ciccimoofi sumaawoo ta'an maasaa koo irratti nan fayyadama.					

Kutaa: V. Gaaffilee Banoo Ta'an

Ajaja: II. Gaaffiilee kanaan gadiif ibsa bal'aa kennuun deebiisa

5. Ganda kana keessattii dhiibbaawwan ijoon sababa baay'achuu rirmaan isiin irra ga'e maal maal fa'i? _____
6. Baay'achuu rirmaan wantoonni akka ganda keessaniitti sababa ta'an maal maal fa'i? _____
7. Baay'achuu rirmaa to'achuuf maal maal ta'uu qaba jettee yaadda? _____
8. Waa'ee miidhaawwan baay'achuu rirmaa oomishaafi oomishtummaa irratti geessisuu ilaalchisuun yaada dabalataa yoo qabaattan asitti itti dabalaa _____

Galatoomaa

Appendix “C”: Semi-Structured Interview for the Officials

Dear interviewees, first of all I would like to express my gratitude from the bottom of my heart for your volunteer presence to my interview. This interview is aimed to collect data on the impacts of termite infestation on grass land and cereal crop production and productivity in Nedjo district, West Wallaga zone, Oromia regional State, Ethiopia. The study is conducted to receive degree of masters in environmental sciences/chemistry/ and the responses you give me have a potential contribution to the success of my study. Therefore, I beg your contribution to cordially respond to the questions given to you as you asked to respond.

Thank you in advance for your cooperation!

1. Is there termite infestation in Nedjo district? _____
2. If yes, to what extent do crops sensitive to termite infestations? _____
3. Which crops are highly sensitive to termite infestation? _____
4. What do you think are the cause for termite infestation in this district? _____
5. Which area of the district is highly afflicted with termite infestation? _____
6. What are the factors that aggravate termite infestation in this district? _____
7. Is there any effort that your office makes to control termite infestation in this district? If there, what are the methods that your office apply to control termite infestation in this district? _____
8. How do farmers try to control termite infestation unto their yards? _____
9. If you want to add more about termite infestation and its controlling mechanism in Nedjo district please add here _____

Thank you for your cooperation!

Appendix “D”: Focused Group Discussions with Illiterate Households

Dear participants, first of all I would like to express my gratitude from the bottom of my heart for your volunteer presence to this focused group discussions. This discussion is aimed to collect data on the impacts of termite infestation on grass land and cereal crop production and productivity in Nedjo district, West Wallaga zone, Oromia regional State, Ethiopia. The study is conducted to receive degree of masters in environmental science /chemistry/and the responses you give me have a potential contribution to the success of my study. Therefore, I beg your contribution to warmly participate on the discussions.

Thank you in advance for your cooperation!

1. Do you know termite infestations?
2. What do you think are the cause for termite infestation in your area?
3. What are the impacts of termite infestation on your production and productivity?
4. Which crops are affected with the termite infestation on your yards?
5. Do you make any efforts for controlling termite infestation on your yards? If yes what are some of the efforts that you make for controlling termite infestation on your yards?
6. What traditional mechanisms do you use for controlling termite infestation on your yards?
7. What biological mechanism do you use for controlling termite infestation on your yards?
8. What chemical mechanism do you use for controlling g termite infestation in your yards?
9. If you want add more on termite infestation and its controlling mechanisms in your area, please add here

Thank you for your cooperation!

Appendix “E”: Observation Checklist

Table 7.3. Observation checklist

No	Things to be observed	Alternative Responses	
		Yes	No
1.	There is termite infestation in the area		
2.	Termite mounds are found everywhere in the area		
3.	The land is barren due to termite infestation		
4.	There is high compile of termites in the area		
5.	Natural forestations area afflicted due to termite infestation		
6.	The growing crops are not attractive enough because of termite infestation		
7.	There were litters and other wastes that aggravated termite infestation in the area.		
8.	The houses in the area are afflicted with termites.		
9.	The walling style of the houses in the area is accessible for termites to get infested.		
10.	Farmers are observed to use traditional, biological and chemical methods of controlling the spreads of termites in the study area.		