ST. MARY'S UNIVERSITY
SCHOOL OF GRADUATE STUDIES

DETERMINANTS OF MALT BARLEY TECHNOLOGY ADOPTOIN: THE CASE OF TWO DISTRICTS, NORTH SHEWA ZONE, AMHARA REGION

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WAGAYE MULUGETA

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A THESIS SUBMITTED TO THE SCHOOL OF GRADUATE STUDIES OF ST.MARY'S UNIVERSITY IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTERS OF SCIENCE IN AGRICULTURAL ECONOMECS

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APPROVAL OF BOARD OF EXAMINERS

This is to certify that the thesis prepared by Wagaye Mulugeta in titled "The Determinants of Malt Barley Technology Adoption: The Case of Two Districts, North Showa Zone, Amahara Region" and submitted in partial fulfillment of the requirements for the degree of Masters of Science in Agricultural Economics complies with the regulation of St.Mary's University and meets the accepted standards with respect to originality and quality.

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DECLARATION

I declare that this MSc. thesis is my original work, has never been presented for a degree in this or any other university and that all sources of materials used for the thesis have been duly acknowledged.

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ENDORSEMENT

This thesis has been submitted to St. Mary's University School of Graduate Studies for Examination with my approval as a university advisor.

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ACRONYMS AND ABBREVIATIONS

CSA	Central Statistic Agency of Ethiopia
FAO	Food and Agricultural Organization of United Nations
FTC	Farmers Training Centers
Ha	Hectare
HYV	High Yield Variety
MOA	Ministry of Agriculture
NGO	Non-Governmental Organization
MEDAC	Ministry of Economic Development and Corporation
RBOA	Regional Bureau of Agriculture
SNNPR	Southern Nations, Nationalities and Peoples Region
VIF	Variance Inflation Factors

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Abstract

Malt barley is a recently introduced industrial crop for the production of malt to beverage industries and produced in various areas of the country. This study was conducted in Hagermariamna Kesem and Angolelana Tera areas North Shewa Zone, Northern Ethiopia; in 2018 production year its aim was to find out the Determine the level of adoption of malt barley technologies and to study factors that affect the adoption among farmers in the study area. In order to achieve these objectives, 179 rural households were selected randomly following probability proportional to sample size technique. The sample households were interviewed using interview schedule. Both primary and secondary data were used. The data were analyzed by using descriptive statistics like mean, standard deviation, percentages and frequency distribution. Inferential statistics such as t-test and chi-square (x2) tests were also used to describe characteristics of adopter and non adopter households. The survey result shows that about 88.83% ***%*** *and 11.17% of sample respondents were found to be adopter and non adopter of malt barley technology respectively. A binary logistic regression model resulted in six significant variables among 14 variables. These were age of the household head, farming experience, oxen ownership, participation in agricultural training and demonstrations, credit use and Profit.*

Keywords: Adoption, Technology, Malt Barley, Binary Logistic Regression model.

CHAPRET ONE

INTRODUCTION

1.1. Background of the Study

Agriculture is the basis for the entire socio economic structure and has a major influence on all other economic sectors of Ethiopia (IBC, 2007). Crop production has an average estimated share of 60% in agricultural value added products (MEDAC, 2010). Despite its importance, low productivity and fragmented smallholder farming system characterizes the Ethiopian agriculture. There is a yield gap between the potential and actual production level of various crops in the country (CSA, 2013

A closer look at over the last three decades on the performance of the Ethiopian agriculture reveals that it had not been able to produce sufficient quantity of produces to feed the rapidly growing population and experienced recurrent droughts that claimed the lives of thousands of people. One of the principal causes of the prevailing structural food deficit is the low level utilization of agricultural inputs (MEDAC, 2010). Consequently, the generation, adaptation and diffusion of agricultural technologies that would enhance productivity and production has been given top priority by the government of Ethiopia.

The world domesticated barleys are categorized as two types based on the growing season namely late and early maturing barleys. Barley is also classified as either six-rows (6R) or two-rows (2R), depending on the physical arrangement of the kernels on the plant. Barley is also described as hulled or hulls-less depending on the presence of beards or awns covering the kernels. Early matured barleys are two row barleys grown mainly in the short rainy season. Long matured barleys are either two or six rows grown in the main rainy season. The advantage of long maturing barley is benefit from higher yields as compared with early matured. In terms of quality two row barleys have lower protein content than six row and suitable for malt production (FAO, 2009). Barley is the fifth cereal crop in terms of area coverage grown in various areas of Ethiopia next to tef, maize, sorghum and wheat. It is produced by more than 4 million households and covers more than one million hectares of farm land (CSA, 2011).

Malt barley is among the multitude crops that has received government attention.

Hence, Ethiopia had not malt barley land races, the introduction of improved malt barley technologies to smallholder farmers received due attention in high altitude areas of Ethiopia. It is grown as a cash crop in a number of developing countries and malt is the second largest use of barley. The popular uses of malt are the production of alcoholic beverages, bakery and baby food industry. The Ethiopian malt barley market is fast-growing at 15-20% per year, driven by the corresponding market growth for beer (Tadesse, 2011).

The domestic market potential of malt barley in Ethiopia is expected to grow from 58,000 MT in 2011 to 133,000 MT in 2016. This can create a significant market potential for high quality domestic product of malt barley which is a pertinent issue for brewery industry. The demand for malt and malt barley is increasing due to improvement of production capacities of the existing brewery factories. Competition of quality standards on domestically produced and imported malt barley grain and malt is low and unable to offer. Brewers are importing 45% to 60% of their malt requirements (Tadesse, 2011and USAID). The production of malt barley stimulates the rural economy through market linkages like purchasing of fertilizer, seed, chemicals, labor, etc. and selling of their produces. This shows malt barley is an important cash crop for resource poor farmers in areas where options are very limited and malt barley is often the only possible crop. The combined annual malt barley consumption of the existing domestic breweries has increased due to expansion of their production capacities. This will be increased more when the newly established factories start production.

Ethiopia has suitable agro-ecology to produce malt barley and sustain the domestic demand. It is the second most important barley producing country in the African continent next to Algeria. The top barley producers countries in Africa for the year 2009 are Algeria and Ethiopia, with a production of 2.2 million and 1.5 million tons, respectively (FAO, 2009). In Amhara region, West and East Gojam, North and South *Gondar*, and *Awi* zones are the major potential producers of malt-barley . Most of malt barley is produced by smallholder, North Shoa zones. The most important malt barley producing areas include Kumdengaye, Sekoru and Nefasamba Kebele of Hagermariamna Kesem districts and Tenegego, Tsegereda and serity Kebele in Angolelana Tera districts of farmers in the highlands.

Although a number of works on technology adoption decisions and the factors which determine them among small holder farmers in Ethiopia have been done, no such works were devoted to the specific case of malt barley technologies in the study area. This study then focused on assessing the factors affecting adoption of malt barley technology production practices. The study also investigated profitability of malt barley as compared to competing crops grown in the study area.

1.2. Statement of the Problem

Much of the barley producing areas are well suited for producing quality malt barley which is immense in Ethiopia. Also, proven malt barley production technologies including improved varieties, recommended agronomic and pest control practices are abound. Available malt barley technologies have also been disseminated malt barley producing districts in the country. Malt barley technology dissemination efforts, however, concentrated in the highlands of Hagermariamna Kesem and Angolelana Tera areas.

Despite past and current malt barley research and development efforts, a huge gap exists between the national malt and malt barley grain demand and supply. For instance, the country imported 53521 tons of malt and malt barley at a cost of 34 million USD in the year 2012. Malt barley production also still suffers from traditional farming practices, low fertilizer use, improper management practices like weeding, crop rotation system, tillage practices, etc. This situation has caused low productivity of the crop to be far below the world average of the potential which is about 1.4 to 1.6 ton/ha (FAO, 2009). The improvement of malt barley demand in the country forced to import additional malt barley and malt from abroad. So far, no enough studies have been conducted to identify the apparent mismatch between the huge gap of malt barley grain demand and supply.

Among others, low adoption of malt barley technologies on smallholder farmers is believed to be one of the factors for the observed gap. Recently, with a view of raising malt barley technology adoption among smallholder farmers, an intensive malt barley technology transfer effort have been made in malt barley producing areas under a collaborative project popularly known as malt barley production improvement project.

The project made available several malt barley varieties along with improved production practices. Farmers were also trained in improved malt barley production practices and encouraged to adopt the technology. This study, therefore, conducted in the target districts of Angolelana Tera areas and Hagermariamna Kesem to identify the factors affecting malt barley technology adoption.

1.3. Objectives of the Study

The general objective of this study is to assess factors that affect adoption of malt barley technologies.

The specific objectives are to:

- Determine the level of adoption of malt barley technologies,
- Identify factors influencing adoption of malt barley technologies.

1.4. Research Questions

This study will attempt to answer the following research questions:

1. What is the extent of adoption of malt barley in the study area?
2. What are the determinants of the adoption of malt barley technologies?
3. Is malt barley profitable as compared to other competing crops?

1.5. Significance of the Study

In the last 35 years various interventions in the area of research, extension and marketing have been made to increase malt barley production and productivity thereby meet malt requirements of the expanding brewery industry of Ethiopia. Despite concerted efforts by public research and development organizations, domestic malt grain production is far below the current demand levels. This calls, for examining the adoption decision behavior of smallholder farmers who are responsible for the production of the required bulk of malt grain. The previous studies conducted on technology adoption didn’t provide the relevant information regarding malt barley technology components as a separate crop. The profitability of malt barley compared to other competent crops was not evaluated in the previous findings. This study suggests alternative approaches for designing technology adoption studies to make them useful for different actors and fill such gaps. The study further helps to evaluate the profitability of malt barley for new producers to perform informed decisions to produce malt barley.

The study can have contributions to increase the level of production and productivity of malt barley grain by generating information on the factors affecting the adoption of malt barley technologies would help research, extension and other development partners to make informed decisions in malt barley research and development. This could facilitate allocation of resources for research, extension and development programs to improve capacity of research and development programs. This study suggests alternative approaches for designing technology adoption studies to make them useful for different actors and fill such gaps. The study will also help to make informed decisions by generating information on the factors affecting adoption of malt barley technologies to research, extension and other development partners in malt barley research and development. This facilitates allocation of resources for research, extension and development programs to improve capacity of research and development programs. The outcome will help to apply appropriate adoption of similar agricultural technologies.

1.6. Scope and Limitation of the Study

The Scope of this Paper is to Assess Factors That Affect Adoption of Malt Barley Technologies in the study area. The study will focus on to identify factors influencing adoption of malt barley technologies and to determine the level of adoption of malt barley technologies. Study of this nature is representative sites in the districts and considers malt barley grower farmers in the area to collect substantial qualitative and quantitative information for the study.

1. 7.Structure of the Paper

This paper contains five chapters. The next chapter presents a review of pertinent literature, while chapter three discusses the methodology of the study. The fourth chapter presents the data analysis and discussion of the results and Chapter five presents the conclusions.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

2.1. Definition of Malt Barley

Barley is thought to have originated in the Fertile Crescent area of the Near East from the wild progenitor Hordeum spontaneum. It is one of the first cereals to have been domesticated, having been cultivated for more than 10 000 years, with archaeological evidence of barley cultivation in Iran as long ago as 8 000 BC. The primary use of barley at that time was in making alcoholic beverages (e.g. barley wine in Babylonia, 2800 BC). Barley was part of the staple diet of those living in ancient Egypt, Greece and China. It was introduced by Europeans to the New World in the sixteenth and seventeenth centuries. Barley is a cool-season crop that is adapted to high altitudes. It is grown in a wide range of agro climatic regions under several production systems. At altitudes of about 3000 masl or above, it may be the only crop grown that provides food, beverages and other necessities to many millions of people. Barley grows best on well-drained soils and can tolerate higher levels of soil salinity than most other crops. Food barley is commonlycultivatedinstressedareaswheresoilerosion,occasional,droughtorfrostlimitsthe abilitytogrow other crops (Berhanu Bekele, Fekadu Alemayehu and Berhane Lakew, 2005).

Malting barley, however, requires a favourable environment to produce a plump and mealy grain. The diversity of barley ecologies is high, with a large number of folk varieties and traditional practices existing in Ethiopia, which enables the crop to be more adaptable in the highlands (Fekadu Alemayehu, Berhane Lakew and Berhanu Bekele, 2002). In 2005, barley was grown in more than 100 countries worldwide, with total barley grain worldwide of 138 million tonne from 57 million hectare, with productivity levels at around 2.4 t/ha. The highest commercial yields tend to come from central and northern Europe. The highest productivity is attained in France (6.3 t/ha), whereas national production is greatest in Russia. Research has shown that yields of 10 t/ha can be obtained under intensive management. World production of barley has remained stable since the 1970s. Consumption has also remained stable. World trade in barley has been around 16 million tonne; this is much less than production, as most of the cereal is consumed locally. Barley holds a unique place in farming in Ethiopia, and various sources agree that it has been in cultivation for at least the past 5000 years in the country.

Barley is one of the major cereal crops grown in Ethiopia. For millennia it has been supplying the basic necessities of life (food, feed, beverages and roof thatching) for many in the Ethiopian highlands. However, the ever-increasing human and livestock populations are placing increasing pressure on the resources in highland environments. Improving productivity and food security in these areas has become imperative. Although Ethiopia is a centre of diversity for barley, most of the country's farmers still obtain very low yields due to a combination of genetic, environmental and socioeconomic constraints. Research has been on-going since 1955 to address these constraints and improve the livelihoods of farmers by increasing the production and productivity of barley. Over this period, barley research in Ethiopia, with the participation of all stakeholders, has generated appropriate production technologies that have improved production, supplied surplus produce to local markets and provided the malt processing industry with good quality malt barley grain. However, malt barley production in Ethiopia has not expanded as expected, despite the potential of the country to grow malting barley in both the quality and quantity required. Malt barley could serve as a source of cash income and would help to significantly improve the livelihoods of highland farm households.

Barley is a cool-season crop that is adapted to high altitudes. It is grown in a wide range of agroclimatic regions under several production systems. At altitudes of about 3000 masl or above, it may be the only crop grown that provides food, beverages and other necessities to many millions of people. Barley grows best on well-drained soils and can tolerate higher levels of soil salinity than most other crops. Food barley is commonly cultivated in stressed areas where soil erosion, occasional drought or frost limits the ability to grow other crops (Berhanu Bekele, Fekadu Alemayehu and Berhane Lakew, 2005). Malting barley, however, requires a favourable environment to produce a plump and mealy grain. The diversity of barley ecologies is high, with a large number of folk varieties and traditional practices existing in Ethiopia, which enables the crop to be more adaptable in the highlands (Fekadu Alemayehu, Berhane Lakew and Berhanu Bekele, 2002). In 2005, barley was grown in more than 100 countries worldwide, with total barley grain worldwide of 138 million tonne from 57 million hectare, with productivity levels at around 2.4 t/ha. The highest commercial yields tend to come from central and northern Europe.

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Malt is germinated cereal grains that have been dried in a process known as "malting". The grains are made to germinate by soaking in water, and are then halted from germinating further by drying with hot air. Malting grains develops the enzymes required for modifying the grain' starches into various types of sugar, including the monosaccharide glucose, the disaccharide maltose, the disaccharide maltotriose, and higher sugars called maltodextrines. It also develops other enzymes, such as proteases, which break down the proteins in the grain into forms that can be used by yeast.

Depending on when the malting process is stopped one gets a preferred starch enzyme ratio and partly converted starch into fermentable sugars. Malt also contains small amounts of other sugars, such as sucrose and fructose, which are not products of starch modification but were already in the grain. Further conversion to fermentable sugars is achieved during the mashing process.

The term "malt" refers to several products of the process: the grains to which this process has been applied, for example malted barley; the sugar, heavy in maltose, derived from such grains, such as the baker's malt used in various cereals; or a product based on malted milk, similar to a malted milkshake (i.e., "malts").

Malting is the process of converting barley or other cereal grains into malt, for use in brewing, distilling, or in foods and takes place in a malting, sometimes called a malt house, or a malting floor. The cereal is spread out on the malting floor in a layer of 8 to 12 cm (3 to 5 inch) depth. The malting process starts with drying the grains to moisture content below 14%, and then storing for around six weeks to overcome seed dormancy. When ready, the grain is immersed or steeped in water two or three times over two or three days to allow the grain to absorb moisture and to start to sprout. When the grain has a moisture content of around 46%, it is transferred to the malting or germination floor, where it is constantly turned over for around five days while it is air-dried.

Barley (Hordeum vulgare), a member of the grass family, is a major cereal grain grown in temperate climates globally. It was one of the first cultivated grains, particularly in Eurasia as early as 10,000 years ago. Barley has been used as animal fodder, as a source of fermentable material for beer and certain distilled beverages, and as a component of various health foods. It is used in soups and stews, and in barley bread of various cultures. Barley grains are commonly made into malt in a traditional and ancient method of preparation. 2014, barley was ranked fourth among grains in quantity produced (144 million tonnes) behind maize, rice and wheat.

2.1.1 Definition of adoption/participation

Adoption process is the change that takes place within individual with regards to an innovation from the moment that they first become aware of the innovation to the final decision to use it or not. However, as emphasized by Ray (2001), adoption does not necessarily follow the suggested stages from awareness to adoption; trial may not be always practiced by farmers to adopt new technology. Farmers may adopt the new technology by passing the trial stage. In some cases, particularly with environmental innovations, farmers may hold awareness and knowledge but because of other factors affecting the decision making process, adoption may not occur.

The adoption is a decision-making process, in which an individual goes through a number of mental stages before making a final decision to adopt an innovation. Decision-making process is the process through which an individual passes from first knowledge of an innovation, to forming an attitude toward an innovation, to a decision to adopt or reject, to implementation of new idea, and to confirmation of the decision (Ray, 2001).

The rate of adoption is defined as the percentage of farmers who have adopted a given technology. The intensity of adoption is defined as the level of adoption of a given technology. The number of hectares planted with improved seed (also tested as the percentage of each farm planted to improved seed) or the amount of input applied per hectare would be referred to as the intensity of adoption of the respective technologies (Nkonya *et al.,* 1997).

Technology is assumed to mean a new, scientifically derived, often complex input supplied to farmers by organizations with deep technical expertise. Neill and Lee point out that the majority of existing literature on agricultural technology adoption is focused on Green Revolution (GR) technologies such as irrigation, fertilizer use, and the adoption patterns of high-yield variety (HYV) seeds. Due to the development process of HYV and the inputs required to make them productive, studies examining HYV adoption look at very advanced forms of technology; HYV seeds are often the product of intensive laboratory research, and when they are targeted to farmers they are bundled with other technology inputs such as chemical fertilizers, pesticides and extensive irrigation because these are necessary for the HYV seeds to perform as designed. Because so many studies of agricultural technology adoption and diffusion focus on HYV and other

GR inputs, their findings are concentrated on a “high-tech” definition of agricultural technology.

However, the association between most agricultural technology adoption literature and “high technology” inputs is incidental; it just so happens that at this point in time, most agricultural technologies being measured are scientifically advanced. This coincidence should not obstruct the point that a technology is simply the application of scientific knowledge for a certain end.

A project or a technique can still be considered a technology even if the science is many steps removed from the eventual implementer. For example, a project where extension workers encourage farmers to rotate legumes into their planting cycles is quite “low-tech,” but the chemistry behind the process of nitrogen fixation is extensive and elaborate. There are many lessons and best practices that can be gleaned from existing studies if *technology* is looked at in broader terms. Gershon and Umali define technology as “… a factor that changes the production function and regarding which there exists some uncertainty, whether perceived or objective (or both). The uncertainty diminishes over time through the acquisition of experience and information, and the production function itself may change as adopters become more efficient in the application of the technology. Adoption is a decision to use and implement a new idea or technology.

2.1.2. Technological Change and Agricultural Development

Agricultural technology refers to innovations of new ideas, methods, practices or techniques of production that provide the means of achieving sustained increase in farm productivity (Abate, 1989). Despite various attempts to transform agriculture by the developing countries, the sector has still remained in its traditional state. The reason behind the low level of agricultural development is introverted policies followed by the governments of these countries over the years. Development strategies of the 1950s and early 1960s also gave priority to promote the industrial sector for which agriculture was neglected. The rapid population growth, on the one hand, and the widening gap between the demand for and the supply of food production, on the other, has brought an impetus for agriculture to receive increased attention in the late 1960s. Therefore, in order to reap the benefits that agriculture can provide to the mass of the rural poor in particular and to the national development at large, it was necessary to transform the traditional agriculture into a productive sector (Shultze, 1964) termed as "getting agriculture moving." Agricultural transformation, therefore, requires appropriate public policy intervention (Yotopoulos, 1967) so as to generate the surplus produce. One of the basic factors in the transformation of agriculture is technological change. Mosher and Barret (2006) emphasized that new technology adoption and diffusion alone is not enough to get agriculture moving and thus changes in the institutional, infrastructural, and cultural factors must occur in the process of transformation. Most of the agricultural development assistance in the 1960s was predicated on the assumption that the wide agricultural productivity gap between the developed and the less developed countries could be attributed to the low level of technology application, by what were then perceived, as irrational tradition bound peasant farmers in the latter (Hayami and Ruttan, 1971). Agricultural development assistance in the 1960s and 1970s was therefore, conceptualized within a dualistic theory of development which perceived the solution to the problem of low agricultural productivity as depending on the direct transfer of modern agricultural technologies from the developed countries to the list developed countries. This approach, as encapsulated in the Green Revolution of the late 1960s and early 1970s, brought tremendous yield increases among many resource-rich farmers in Asia and Latin America (Chambers and Ghildyal, 1985).

2.2. Empirical Studies on Factors Affecting Technology Adoption

The area devoted to barley production in Ethiopia over the past 25 years has fluctuated.

It was around 0.8 million hectare in the late 1970s, and rose to more than 1 million hectare in the late 1980s. It then declined and remained between 0.8 and 0.9 million hectare until the beginning of the third millennium. The production of barley, by-and-large, has been below 1 million tonne per year for most of the past 25 years, except during the years when the area under barley increased above 1 million hectare. Agricultural technology adoption has long been of interest to social scientist because of its importance in increasing production and productivity of crops. In developing countries, adoption studies started about four decades ago following the Green Revolution in Asian countries. Since then, several studies have been undertaken in Asia and Latin America to assess the rate, intensity and determinants of adoption. Economic analysis of technology adoption has also sought to explain technology adoption behavior in relation to household specific characteristics, household resource endowments, asymmetric information, risk and uncertainty, institutional related factors, availability of agricultural input, and poor infrastructure (Uaiene et al., 2009)

Debre Berhan Agricultural Research Centre Following the release of the first barley variety, 'Misrach', by Debre Berhan Agricultural Research Centre, demonstrations of growing food barley have been conducted near Ankober, Asagirt, Debre Berhan Zuria and Tarmaber since the 1999 cropping season. The demonstrations were conducted in both in the Belg (short rainy season) as well as the Meher (long rainy season). The Belg demonstrations were conducted in the vicinity of Ankober, Asagirt and Mezezo, areas known for their higher Belg production in terms of both area cultivated and productivity. Demonstrations of barley cultivation have also been conducted in the Ankober areas during the Meher season, in addition to the previously mentioned Meher season producing areas. Field days were conducted in all these areas and farmers gave their opinions about the technology. They indicated that 'Misrach' has high productivity, high tillering capacity, weed suppressing quality, good capacity to withstand hail damage, and an early maturing potential enabling the grain to avoid early rain showers and frost damage. Moreover it is white in colour, which fetches a good market price. The demonstrations were conducted such that the improved method and the traditional farming methods and the relative performances of the varieties could easily be compared.

The improved methods included different varieties (‘Misrach’ and ‘Shege’), seed application rate (125 kg/ha), fertilizer application rate (41/46 N/P), one hand weeding at 25–30 days after emergence, ploughing two or three times, and different sowing dates (around mid June). The traditional farming method involved the use of local varieties without fertilizers and with no weeding. The results of the demonstrations showed that the improved variety, ‘Misrach’, and its production package produced higher yields. ‘Misrach’, with its package, gave a mean grain yield of 2800 kg/ha, while ‘Shege’, with its package, and the local check gave mean grain yields of 2199 kg/ha and 1625 kg/ha, respectively. A partial budget analysis showed that ‘Misrach’ and its production method gave a marginal rate of return of 68.3%, while ‘Shege’ with its package of production inputs was found to be not economically viable. In their evaluation of the technologies the farmers stated that ‘Misrach’ fits well in the farming system of the Ankober areas, and that it can be used for Belg season production because of its relatively early maturity, which means that it misses the dangers of hail in July and August. In 2000, the results of the demonstrations showed that the improved variety ‘Misrach’ and its production package gave higher yields. ‘Misrach’ with its production package gave a mean grain yield of 3142 kg/ha .

Agricultural technology adoption has long been of interest to social scientist because of its importance in increasing production and productivity of crops. In developing countries, adoption studies started about four decades ago following the Green Revolution in Asian countries. Since then, several studies have been undertaken in Asia and Latin America to assess the rate, intensity and determinants of adoption. Most of these studies focused on the Asian countries where the Green Revolution took place and was successful.

A more recent strand of literature has included social learning and networks in the categories of factors influencing agricultural technology adoption (Uaiene et al., 2009). Some other studies classify these factors into different categories. For instance, Akudugu et al. (2012) grouped the determinant of agricultural technology adoption into three categories namely; economic, social and institutional factors. Empirical literature indicates many categories for grouping determinants of agricultural technology adoption.

However, there is no clear distinguishing feature between variables in each category. Categorization is done to suit the current technology being investigated, the location were the technology is used, and the researcher's preference, or even to suit client needs (Bonabana- Wabbi, 2002). This study was reviewing the resent studies on factors determining adoption of agricultural technology by categorizing them into household specific factors, economic related factors, and institutional factors. Based on this classification a critical review was done on each factor (variables) how it affects agricultural technology adoption among farming households.

2.2.1. Household Specific Factors

The age of the farmer plays an important role in the adoption of new agricultural technologies. However, the effect of age on the adoption of new technology is somewhat ambiguous. On the one hand, some studies suggests that as farmers get older they become more conservative and less open to new ideas. On the other hand, it is also argued that they gain more experience and they are more able to evaluate the benefits of new technologies (Johannes et al., 2010). For example, Simtowe et al. (2016) found that age of household head positively affect adoption of improved varieties. The effect is thought to stem from accumulated knowledge and experience of farming systems obtained from years of observation and experimenting with various technologies.

adoption in developing country is sex of household head. It has been investigated for a long time in agricultural production and technology adoption. Most study show mixed evidence regarding the different roles men and women play in technology adoption. For instance, Solomon et al. (2014) on their study found that sex has positive effect on the adoption of fertilizer and improved se Contrary to this, age has also been found to be negatively correlated with adoption decisions. Berihun et al. (2014) have reported that age was negatively affecting adoption of new technologies. Older farmers, perhaps because of investing several years in a particular practice, may not want to jeopardize it by trying out a completely new method. Similarly, farmers' perception that technology development and the subsequent benefits, require a lot of time to realize, can reduce their interest in the new technology because of farmers' advanced age, and the possibility of not living long enough to enjoy it (Caswell et al., 2001). Moreover,Tolosa (2014) on his study on factors limiting adoption of wheat row planting technology in Ethiopia and Hailu (2008) reported that as age increases, farm households would become reluctant and conservative in adopting new technologies and do prefer their indigenous one. Another factor that affects agricultural technology ed variety in Ethiopia. Another study by Gilbert et al. (2002) had shown a positive significant effect of sex on fertilizer use in Malawi. They explained that in their study district, letting females to be a household head is not yet well developed and recognized. Consequently female headed households mostly are those who are widowed and divorced. In such instances, beside the cultural factors, their probability of adopting new agricultural technology becomes negligible.

The observed patterns of technology adoption are also typically influenced by education level of household heads. Education is thought to create a favorable mental attitude for the acceptance of new practices especially of information-intensive and management-intensive practices and reduce the amount of complexity perceived in a technology adoption and increase technology adoption (Caswell et al., 2001). For instance, Wangare (2007) and Yonas (2014) studded on impact of row planting of teff crop on rural household income in Ethiopia and Alene et al. (2000) on adoption and intensity of use of improved maize varieties in the central highlands of Ethiopia reported the positive effect of education on adoption. They explained that more educated farmers are able to access information on agiven technology and understand and asses the attributes of that technology compared to non educated farmers.

Another important factor which affects agricultural technology adoption is labor. The effect of labor availability on technology adoption differs depending on whether the area targeted with the technology has a net labor shortage or net labor surplus or whether the proposed technology is labor-saving or labor-intensive. Higher labor supply is associated with higher rates of adoption of labor-intensive technologies. On the other hand, the dual nature of off-farm labor possibilities but can also reduce the availability of labor and thereby decrease the likelihood of adopting high-labor technologies (Lee et al., 2001). Labor bottlenecks, resulting from higher labor requirements that new technologies often introduce, and seasonal peaks that may overlap with other agricultural activities, are also another important constraints to technology adoption (Meinzen-Dick et al., 2002).

Tadele (2016), Abrhaley (2016) and Yonas (2014) were reported that, probability of farmers to adopt and the level of adoption of row planting technology are positively affected by family labor. They explained that, row planting technology is labour intensive and hence the household with relatively high labor availability uses the technologies on their farm plots better than others.

2.2.2. Institutional Factors

The major option for increased adoption of technology is to overcome the income/ capital constraint through increased credit provision (Mkandawire, 1993). Access to credit takes cognizance of farmers' access to sources of credit to finance the expenses relating to the adoption of new innovations. It boosts farmers' readiness to adopt technological innovations. For example, Berihun et al. (2014) on their study on adoption decision of chemical fertilizer and HYV found that, access to credit affects technology adoption positively and is one best option whereby smallholders could be instigated in diversifying their economic base. As a liquidity factor, the more farmers have access to credit, the more likely to adopt agricultural technologies that could possibly increase crop yield.

Similarly, Namwata et al. (2010), Leake and Adam (2015), Akinola et al. (2010), Frank et al.(2016) and Beyan (2016) where reported the positive influence of credit availability on technology adoption.

2.2.3. Economic Related Factors

The use of new agricultural technology is directly or indirectly related with the level of income of the farm households. The direct relation is most of the time due to the better purchasing power of the higher income households and induces an improved access to technologies available. Rich farmers are usually observed as the first movers to try new technologies and better risk taking behavior in technology uptake. In contrary, poor farmers are usually characterized by their slow movement towards trying new technologies. This is mainly due to fear to fail to harvest lower yield than basic required amount for their subsistence. Therefore, participation in off-farm activate is one of the mechanism by which farmer alleviate their income constraint because it is important in financing purchased farm inputs and hiring labor (Mwania et al., 1989).

Tadele (2016), Akinola et al. (2010) and Frank et al. (2016) were reported positive influence of off-farm activities on technology adoption decision of farm households. They argued that income from off-farm activity support farmers to easily afford agricultural input costs; and these farmers are mostly exposed to new and updated information since they move from one town to another and contacted with different people with different background.

2.3. Basic Concepts and Theoretical Foundation of Technology Adoption

The vast majority of the world's poor lives in rural areas and is engaged in agriculture, and therefore activities designed to address the vulnerability of these rural poor are often geared toward improving agricultural practices as a means of increasing productivity, efficiency and, ultimately, income. Governments, NGOs, aid agencies and extension workers have long known that the success of any project depends, in part, on whether farmers adopt the offered technologies and, if they do, whether those farmers adopt the technologies in an ideal combination and for the proscribed length of time needed to produce designed results. Researchers have conducted decades' worth of surveys and analyses around the world in an attempt to understand the adoption decisions of individual farmers and the diffusion patterns among communities of farmers and rural poor. By understanding how farmers and communities decide whether to adopt a technology, aid professionals can refine their agricultural technology outreach projects to address the conscious and subconscious concerns of targeted communities, and increase the probability that farmers will be willing and able to participate in project activities.

Agricultural technology plays an important role in economic development of one country by boosting the production and productivity of the sectors. Adoption and diffusion of these technologies are two interrelated concepts. Many researchers belonging to different disciplines have defined the two concepts in relation to their own fields. Adoption commonly refers to the decision to use a new technology or practice by farmers on a regular basis. Furthermore, Bahadur and Siegfried (2004) defined adoption as a mental process through which an individual passes from hearing about an innovation to its adoption that follows awareness, interest, evaluation, trial, and adoption stages. It can be considered a variable representing behavioral changes that farmers undergo in accepting new ideas and innovations in agriculture anticipating some positive impacts of those ideas and innovations. With regard to the relationship of technological attributes with farmers' adoption decision, Rogers (1995) identified five characteristics of agricultural innovations, which are important in adoption studies.

2.4. Paradigms on Agricultural Technology Adoption

The literature on agricultural technology adoption is vast and somewhat difficult to summarize compactly. A recent strand of literature focuses on social networks and learning. For instance, Bandiera and Rasul (2006) looked at social networks and technology adoption in Northern Mozambique and found that the probability of adoption is higher amongst farmers who reported discussing about new technologies with others.

More recently, literature on agricultural technology adoption has also focused on the effect of social learning on adoption decisions. The basic motivation behind this literature is the idea that a farmer in a village observes the behavior of neighboring farmers, including their experimentation with new technology and then farmer updates his priors concerning the technology which may increase his probability of adopting the new technology in the subsequent year. Moreover, there are two important assumptions about the nature of social learning in this story. First, each farmer receives information on the outcomes of experiments from every other farmer in the village. Second, each farmer observes other farmers experiments with no loss of information. Applying this model to high yielding varieties (HYV) adoption in India, Foster and Rosenzweig (1995) found that initially farmers may not adopt a new technology because of imperfect knowledge about management of the new technology; however, adoption eventually occurs due to own experience and neighbors' experience. Overall evidence suggests that network effects are important for individual decisions, and that, in the particular context of agricultural innovations, farmers share information and learn from each other.

To explain the major adoption behaviors and determinants of technology adoption the literature is then synthesized into three paradigms of technology adoption namely innovation-diffusion model, the adoption perception and the economic constraints models.

The innovation-diffusion model, following from the work of Rogers (1995) holds that access to information about an innovation is the key factor determining adoption decisions. The appropriateness of the innovation is taken as given, and the problem of technology adoption is reduced to communicating information on the technology to the potential end users. By emphasizing the use of extension and local opinion leaders or by the use of experiment station visits and on-farm trials the 'skeptic' non-adopters can be shown that it is rational to adopt. The model assumes that a technology is transferred from its source to the end-users through agent medium. In addition, the model assumes that the technology is technically and culturally appropriate but the problem of adoption is one of asymmetric information and very high search cost (Shampine, 1998). The important issue with respect to this model is that technology is appropriate for use provided that it is not hindered by the lack of effective formal and or informal communication methods. Emanating from the pioneering work of Hayami and Ruttan (1971) the economic constraints model or factor endowment model, assumes that the distribution of resource endowments among potential users in a country or region determines the pattern of technological adoption. The model also contends that input fixity in the short run, such as access to credit, land, labor or other critical inputs limits production flexibility and conditions of technology adoption decisions by farmers (Shampine, 1998).

2.5. Conceptual Framework of Agricultural Technology Adoption

Adoption of new and improved agricultural technologies can only be effective when the right conditions for their successful implementation are in place. Farmers face many complex challenges in adoption and scaling out of agricultural and natural resource management technologies and practices (Shiferaw et al., 2009). Context specific empirical understanding of factors affecting household decision is important for promotion and scaling up of adoption of productivity enhancing technologies (Bewket, 2007). Researchers have argued that numerous factors can affect the farmer's decision to adopt agricultural technologies (Yu et al., 2010). Based on theoretical and empirical reviews of the literature on technology adoption various factors that influence technology adoption and intensity of use can be identified and grouped into the following four broad categories.

(1) Factors related to farmers characteristics; (2) factors related to technological attributes; (3) factor related to institution and markets; and (4) economic related factors.

The factors related to the characteristics of farmers include sex, age, labor availability and literacy. Better endowment of human capital and active labor force in the family increases farmers' probability of adoption of new agricultural technologies because of investment capacity and the ability to take risks when experimenting with new technologies. Improved technologies have different labour requirements, hence labor endowment matters. For instance, higher labor supply is associated with adoption of labor-intensive technologies. Literacy is also another important human capital that encourages farmers to experiment in new agricultural technologies, hence increase adoption of the technologies. The factors related to the attributes of the technology include the individual's perception towards the new technology with respect to its relative advantage, compatibility, complexity, trialability and observability. Generally, technologies perceived positively by farmers are more likely to be adopted.

The institutional factors include credit uses, distance to the nearest market, and availability of improved seed, membership in social association, agricultural training and extension contact. The likelihood that a farmer will adopt and continue use an agricultural technology is related to the credit use, frequency of extension contact and participation in agricultural training, especially for technically complex technologies. Credit improves farmer's financial constraints for purchasing different agricultural inputs. In addition, Extension contact and training provides update information, technical skill and enhances farmers' awareness towards the new technologies, hence motivates them to adopt the technologies. New technologies often require repeated and consistent use of new inputs such as improved seed that increase adoption of agricultural technologies. Moreover, Farmers who participated more in social association have better information about new technologies; hence raise their likelihood of adoption of the technologies.

Economic related factors include cultivated farm size, livestock ownership and off-farm income which their better endowment increase farmers' probability of adoption of new agricultural technologies because of investment capacity. Livestock ownership and offfarm activity improve farmer's financial capital for purchasing productivity enhancing inputs and allows farmers to invest in new technologies. On the other hand, farmers with large cultivated farm land are good candidates for investing in scale dependent technologies and also increase farmer's adoption and experimenting with risky or new technologies. However, practical experiences and observations of the reality have shown that one factor may enhance adoption of one technology in one specific area for certain period of time and may create hindrance for other locations. The direction and degree of impact of the factors are not uniform and the impact varies depending on the type of technology and conditions of areas where the technology is to be introduced. Because of this reason, it is difficult to develop a one and unified adoption model in technology adoption process for all specific locations. Hence, the conceptual framework presented in the Figure-1 below shows the most important factors expected to influence adoption and intensity of use of wheat row planting technologies. The arrows indicated in the conceptual framework shows the expected relationship between the variables.

CHAPTER THREE

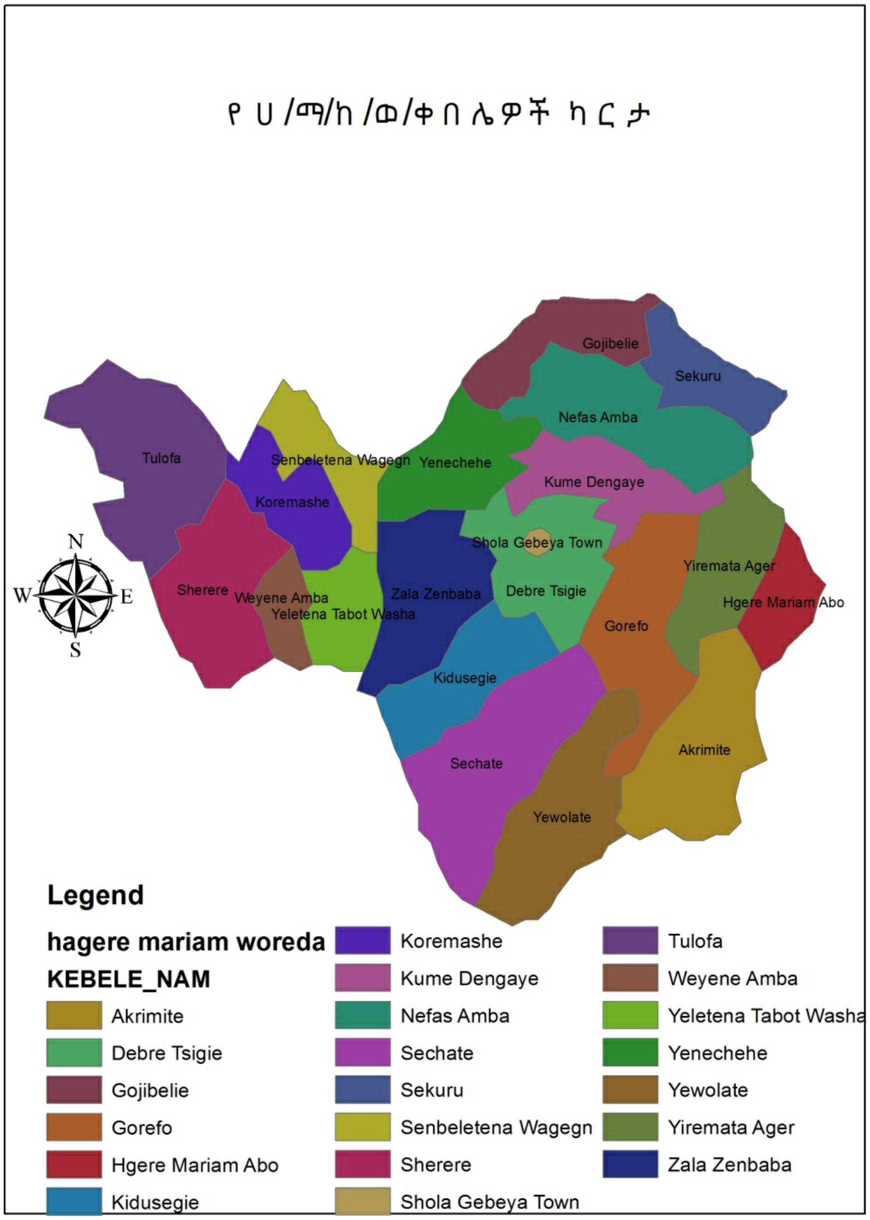
RESEARCH METHODOLOGY

This chapter starts with a brief description of the study area, Angolelana Tera and Hagermariamna Kesem district followed by sources and methods of data collected for the study. Besides, descriptions of data analysis methods that are used to address research objectives are briefly discussed step by step.

3.1. Description of the Study Area

Angolelana Tera district: Angolelana Tera is one of the 19 districts located in North Shewa zone. The district has an estimated total population of 97062 of whom 49813 were men and 47254 were women (CSA, 2017). The agro-ecology of the district comprises highland (86.7%), mid-altitude (9.7%), and lowland (3.567%) areas. Agricultural production in Ethiopia specifically in the study area is good. To improve the traditional agricultural practice, the Ministry of Agriculture (MoA) through Regional Bureau of Agriculture (RBoA) has been made utmost efforts via dissemination of improved agricultural technologies like row planting and matenefef(black soil) technology on barley production in 2012 all over the regions.

Hagere Mariamna kesem district: is one of the 24 districts of North Shewa Zone in Northern Ethiopia. The district is sub divided into 20 kebeles (small administrative units). Agriculture is the main stay of people in the district. Agro ecologically the Woreda (district) categorized into middle altitude (Woinadega) 38.87%, high altitude (Dega) 32.05%, lowland (kola) 14.18%, and frosty weather (wurech) 14.9%, it is suitable for diverse agricultural production. Crop and livestock production are the major sources of income in the district. The total area of the district is 67772.9 hectare and out of which the total 22780 hectare land is used for annual crop production, 2050.5 hectare is coed by permanent crops, 1828.36 hectare is covered by forest, and 4976.5 hectare is used for other purposes such as grazing. Out of 12871 total population, 9788 (76.05%) are male and remaining 3083 (23.95%) are fema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Shola Gebeya Town
Tulofa
Weyene Amba
Yeletena Tabot Washa
Yenechehe
Yewolate
Yiremata Ager
Zala Zenbaba

3.2. Data Collection Methods

Both primary and secondary data were used to attain the stated objectives. A structured questionnaire was used to collect primary data from sample farmers with the help of available literature, guidance from the subject specialists in the area, and officials of agricultural extension and research personnel. The response rate was good and all respondents were cooperating. The data were collected during the fiscal year of April 2018. The collected data were arranged into coding sheet and inserted into computer statistical software SPSS/PC and analyzed using appropriate statistical techniques. Secondary data used for describing the study area were collected from each district kebele offices of agriculture.

3.3. Sampling Techniques and Sample Size

The study employed purposive selection of a district in an attempt to identify a suitable location where malt barley production technologies of extension efforts have been intensively conducted. Angolelana Tera and Hagermariamna Kesem districts were identified as the focus locations for the study. These districts represent the major malt barley growing areas where improved varieties are beginning to be adopted by farmers. Following identification of the districts, a purposively sampling procedure was used, to identify kebeles and representative sample households.

First, rural kebeles in the study areas were grouped into high and low barley producing areas based on area devoted to barley and malt barley production. Then a total of six kebeles from those districts were purposively selected from high barley producing kebeles. Second, using a sampling frame that contains lists of households in each of the selected kebeles; sample household heads were randomly selected based on probability of proportional to sample size. It was done using secondary information of sampling frame constituted all barley growing farmers in the respective identified kebeles from the districts and kebeles offices of agriculture. As a result, the survey was administered and data were collected and analyzed on 179 respondents. Accordingly, the number of respondents in each selected rural kebele was as shown in the Table1.The sample size was determined by following a formula developed by Yemane (1967). The formula is:

$$n = \frac{N}{1 + N(e^2)} = \frac{1021}{1 + 1021(0.07^2)} = 170 \quad (1)$$

Where n is the sample size for the study, N is the population of interest which is 1021, e is the precision level which is 0.07 in this study. The sample size from each kebeles was determined based on their proportion to total share of households residing in each kebeles. adding 5% for a possibility of un-returned questionnaires, the sample size will be 179 (170+170x 0.05 =179). Finally out of the total sample size (179), 159 respondents would be Adopters and the remaining sample respondents, 20, would be Non-adopters.

Table 1 Number of respondents from each selected Kebele

Kebele/pa	HH number		Total Sample distribution
	Male	Female	Number
Kume dengaye	55	4	19
Nefase amba	65	5	23
Sekoru	68	6	25
Tenegego	240	8	35
Tsegereda	265	10	37
Serity	290	12	40
Total	976	45	179

Source: Kebele offices of agriculture

3.4. Method of Data Analysis

The data was analyzed with the help of descriptive statistical tools like, and mean, percentages, standard deviation, maximum and minimum. The inferential statistics like t-test (help to see difference between households in relation to independent variables) and

x^2 tests were administered to see the influence of independent variables on the dependent variable. To find out the significant independent variables, binary logistic regression econometric model was applied since the independent variable has binary outcomes.

3.4.1. Model Specification

One of the purposes of this study is to assess the factors that affect the adoption of malt barley technology. The dependent variable in this case takes a dichotomous variable, which take a value of zero for non adopters' households and one for the adopters' ones.

When one or more of the independent variables in a regression model are binary, we can represent them as dummy variables and proceed to analyze. Binary models assume that households belong to either of two alternatives and that depends on their characteristics. Thus, one purpose of a qualitative choice model is to determine the probability that a household who fall in one of either alternatives (in this study the alternatives were adoption and non adoption).

The Probit and Logit models are commonly used models in adoption studies. However, the Probit probability model is associated with the cumulative normal probability function. Whereas, the Logit model assumes cumulative logistic probability distribution. The advantage of these models over the linear probability model is that the probabilities are bound between 0 and 1. Moreover, they best fit to the non-linear relationship between the probabilities and the independent variables; that is one which approaches zero at slower and slower rates as an independent variable (Xi) gets smaller and approaches one at slower and slower rates as Xi gets large (Train, 1986).

Usually a choice has to be made between Logit and Probit models, but the statistical similarities between the two models make such a choice difficult. Gujarati (1988) illustrated that the logistic and Probit formulation are quite comparable. It does not matter much which function is used except in the cases of where the data are concentrated in the tails following points. For this study the Logit model is selected, though both Logit and Probit models may give the same result. The logistic function is used because it represents a close approximation to the cumulative normal distribution and is simpler to work with. Moreover, as Train, (1986) pointed out a logistic distribution

(Logit) has got advantage over the others in the analysis of dichotomous outcome variable in that it is extremely flexible and easily used function (model).

3.5. Definition of Variables and Hypothesis

dependent variable is adoption of malt-barley technology measured in adoption index. Different empirical studies would expressed adoption in ratio, index, percentage or log form depending on the purpose of the study. In this study, adoption of malt-barley technology would be taken as a dependent variable.

Independent variables and hypothesized relationship: The variables that tend to explain a given dependent variable are said to be explanatory or independent variables. The independent variables were identified from previous similar empirical studies and the nature of the study area. These variables are expected to affect farmer's adoption of malt barley and are defined as follows:

1. Sex of household head: It refers to a biological nature of human being of maleness or femaleness of the head of the household having a binary value.

2. Age of the household head: It is a continuous variable measured in years along with hypothesized as a factor for a given technology to adopt it.

3. Educational status of household head: It is a categorical variable represented as no education, primary, secondary and tertiary level of the household heads. Theoretically education increases the probability that household's adoption of technologies. It was therefore expected to influence adoption of malt-barley technology positively.

4. Total family size: Size of family is a continuous variable measured in numbers of members who are living within the family and hypothesized that if farmers have large family size may adopt the technology better than small family size.

5. Land holding: The size of land holding of respondents measured in hectare represented as a continuous variable. The size of the land holding of the household is an important variable influencing the decision of adoption whether a farmer adopt malt-barley or not. It was, hypothesized that as the size of the land increases, the farmer adopt a given technology was expected to increase.

6. Number of oxen owned: It is a continuous variable that refers to the number of oxen the respondents owned measured in tropical livestock unit. It is the most important factor to cultivate the land of malt barley technology. If framers have more number of oxen, they can cultivate and produce malt-barley and influence adoption positively.

7. Access to credit: This is a dummy variable that takes the value of 1 if the household is accessible to credit and 0 otherwise. Credit is considered as an important source of investment and households who have better access to credit can have better adoption decision. However, small holder farmers are not affordable unless they are supported with loans. Hence, credit was hypothesized as positive influential factors towards adoption of malt-barely technology.

8 Frequency of extension contact: In this study, it is measure by number of contact between extension agent and farmers per year.. Empirical results revealed that extension contact has an influence on farm households' adoption of new technology (Hailu, 2008).

9. Distance of households' residence to the market: Distance is a continuous variable measured in hours and refers to place of the farmer's house from the market. Proximity of the market from their residence determines for their input to purchase and sell their produce. It was therefore, hypothesized that as the farmer is closer to the market, the higher will be the chance to adopt the technology. It also enables farmers to access more information at the market place.

10. Participation in training: Training is one of the means by which farmers acquire new knowledge and skill. It is a dummy variable which participation in training is expected to positively influence in adoption of malt-barley technology.

Table. 2. Summary of hypothesized independent variables and their expected signs

Independent variable	Variable description	Measurement	Expected Sign
Sex	Sex of the household head,0=F1=M	Dummy	0
Age	Age of the household head,measured in years.	Continuous	-
Education	Education level of the HH head, measured in Number.	Continuous	+
Family size	Family member living in a house, measured in Number.	Continuous	+
Experience	Experience in malt barley production, measured in years.	Continuous	+
Attitudes	Attitude on malt barley technologies,1= yes 0= no	Dummy	+
Group participation	The HHH participated in social groups,1= yes 0= no	Dummy	+
Extension contact	No of extension contacts of HHH, measured in Number.	Continuous	+
Market distance	The distance of market in Km, measured in Number	Continuous	+
.Farm size	The total size of farm in ha, measured in Number.	Continuous	+
Oxen	Number of oxen available, measured in Number.	Continuous	+
Soil fertility	If the soil is fertile, 1=yes,	Dummy	+

	0=no		
Credit use	Use of credit, 1= yes 0= no	Dummy	–
Soil type	Soil type ,1=yes, 0=no	Dummy	+
Profit earned	The profit generated from malt barley	Number	+

CHAPTER FOUR

RESULT AND DISCUSSION

4.1. Descriptive Results

4.1.1 Household characteristics on technology adoption

From this study out of the total sample, male headed households' comprise79.3% while female headed households make the balance 20.67%. The data further revealed that 88.83% sampled households cultivated malt barley during the study year, reflecting a high degree of adoption of malt barley technology in the study area (Table 3).

Table 3. Sex characteristics of respondents in technology adoption.

Sex	Adopters		Non-adopters		Total	
	No	%	No	%	No	%
Male	126	70.39	16	8.9	142	79.33
Female	33	18.43	4	2.2	37	20.67
Total	159	88.83	20	11.17	179	100

Sources: own survey 2018, result

The distribution of sample household in level of education is given by Table 4. Literacy rates are generally high and over 80% of the households has accessed to formal education.

There exists significant difference among malt barley technology adopters and non-adopters in some of the hypothesized variables affecting malt barley technology adoption and intensity of use. The levels of significance for those significant variables include age at 10% probability level whereas farming experience at 5% significance level. The number of oxen and Profit earned available is significant at 1% level of significance. Family size in the study area is large with 8.3 persons per household having minimum value of 2 and maximum of 10 (Table 4).

Table 4. Socio economic characteristics of respondents on malt barley adoption

Variables	Adopters (159)		Non-adopters(20)		Total sample(179)		t-value
	Mean	Stdvn	Mean	Stdvn.	Mean	Stddevn.	
Age	41.5	12.8	47.1	12.6	42.1	12.87	1.82*
Family size	8.2	3.5	9.3	3.53	8.3	3.51	1.34NS
Experience	3.3	14.8	4.3	13.6	34.4	15	2.4**
Education	1.18	0.659	1.05	0.848	1.2	0.68	-0.74NS
Oxen	3.3	2.2	2.7	1.6	3.1	2	2.54***
Farm size	2.61	1.78	2.8	1.78	3.3	1.7	-0.54NS
Market distance	8.32	17.7	8.9	17.9	8.3	17	-0.13NS
Extension contact	5.5	4.8	5.1	6.3	5.42	4.93	1.2NS
Profit	19627	20187	7404	9402	18335	19.6	2.59***

***, ** and * significance at 1%, 5% and 10% level source own survey result, 2018

The respondent farmers were recorded as adopters and non-adopters with the relationship of the explanatory dummy variables. There was no significant difference between adopters and non-adopters of malt barley technologies on the explanatory variables of sex, Group participation and Attitude on malt barley technologies. on the other hand participation in training and credit use are at 1% significance levels. (Table 5)

Table 5. Distribution of households by categorical variables

Variables	Category	Adopters		Non-adopters		Total		Pearson
		No	%	No	%	No	%	
Sex	Male	126	70.4	16	8.9	142	79.3	0.002NS
	Female	33	18.4	4	2.2	37	20.7	
Credit Use	Yes	157	87.7	19	10.61	176	98.3	21.362***
	No	2	1.1	1	0.5	3	1.7	
participation in training	No	98	54.8	15	8.4	113	63.2	22.325***
	Yes	148	82.7	8	4.5	156	87.15	
	No	11	6.15	12	6.7	23	12.85	

Source: own survey result, 2018. *** represents significant at 1% significance levels.

4.1.2. Sub plot level factors

Sub plot characteristics which are non-significance on malt barley technology adoption are soil fertility and soil type. From the total observed subplots 70.13% is fertile and the balance is unfertile. Regarding soil fertility about 25.62% from the fertile and 44.71% from the unfertile soil was adopters. Similarly in relation to soil type about 16.6% of subplots were red and the balance was other type. About 6.6% of red soil and 32.1% of other soil types was adopters (Table 6).

Table 6.Sub plot level explanatory variables

Plot characteristics		Adopters	Non adopters	Total	Pearson X^2
		%	%		
Soil fertility	Fertile	25.62	44.51	70.13	0.01NS
	Unfertile	10.90	18.97	29.87	
Soil type	Red	6.50	10.10	16.60	0.57NS
	Others	32.10	51.30	83.40	

***,**and* Level of significant at 1%,5 %and 10%Source: own survey, 2018

4.2. The model result on determinants of adoption malt barley technology

Before entering the variables in to the model, the multicollinearity problems were checked in terms of Variance Inflation Factor (VIF) for continuous and contingency coefficients for dummy and discrete variables respectively have no multicollinearity problems and those with VIF of above 10 are assumed to have a multicollinearity problem. Therefore, since, in this study, the computational results of the VIF for continuous variables confirmed the non-existence of association between the variables and were included in the model.

Out of 14 independent variables which had been expected to be significantly related with the adoption status of malt barley technology, six variables were found statistically significant (Table 7).

Table 7: Logistic estimates of factors affecting the adoption of malt barley technology

Variables	Coefficients (B)	S.E	Wald statistics	Odds ratio	Significance Level
Age HH	.277	.127	4.757	1.330	.076*
Sex HH	-.162	.152	1.135	.879	.287
Household size (AE)	.251	.432	1.221	.354	.135
Farming experience	.349	.153	5.226	1.418	.022**
Education level HHH	.262	1.323	.0392	1.138	.843
Cultivated Farm size	.262	.212	1.524	1.300	.217
Oxen ownership	3.270	1.218	7.203	26.304	.006***
Extension contact	-.034	.052	.421	.967	.516

Participation in Training	-2.353	.842	7.811	.0108	.005***
Soil fertility	-.162	.152	1.135	.879	.287
Credit Use	-2.353	.842	7.811	.0108	.004***
Soil Type	.262	.212	1.524	1.300	.217
Distance to the market	-.019	.045	.182	.981	.670
Profit	2.570	1.654	2.415	23.304	.008***

***,** and *significance at 1%, 5% and 10% level respectively.

Number of observation=179,

Probability > chi^2 = 0.000,

Log likelihood = -54.125 and

Pseudo R^2=0.7374.Source: own survey, 2018 analysis result.

The logit model results used to study factors influencing adoption of malt barley techneology inTable 7. Among the 14 variables used in the model, 6 variables were significant with respect to adoption of malt barley technology with less than 10% of the probability level. These variables include Age, Farming experience, Participation in Training,oxen ownership, Credit Use, Profit,whereas the rest 8 explanatory variables were found to have no significant influence on the adoption. The effect of the significant explanatory variables on adoption of malt barley technology in the study area is discussed below:

Oxen Ownership: Oxen ownership positively influenced the probability of adoption of malt barley technology at less 1% significance level. This result suggests that, those farmers who owned more oxen have better chance to adopt the technology than those who have owned small number of oxen. Farmers need to own at least one pair of oxen to prepare land. Other things being held the same, the odds ratio of 26.304 for the number of oxen owned indicates that, the odds ratio in favor of adopting the malt barley technology increases by a factor of 26.304 as the number of oxen increases by one unit. According to Yishak (2005), farmers need to own at least one pair of oxen to be able to prepare their land well there by boos their production and productivity.

Participation in Agricultural Training: It was found that exposure to information in relation to participating in agricultural training and attending demonstration had positively and significantly influenced the probability of adoption of malt barley technology at less than 1% significant level. The result of logit model in relation to this variable shows that farmers who have opportunity to participate training and attend demonstration of malt barley technology are more likely to be adopter than those farmers who have no similar opportunity. In another words, the result indicates that farmers who are exposed to formal extension information have a higher probability towards adoption than those with less exposure. When farmers practically observe a new practice they can weigh the advantage and disadvantages of the new technology. This can facilitate adoption and helps them to implement the new technology properly. Other thing held constant, the odds ratio in favor of adopting malt barley technology increases by a factor of 0.0108. This result goes along with the study done by Yishak (2005).

Credit use

Credit has been found to boost adoption of new agricultural technologies among smallholder farmer in developing countries like Ethiopia (Adunea Dinku Dissasa, 2017). It was believed that credit is used to promote the adoption of risky technologies through relaxation of the liquidity constraints as well as through the boosting of households' risk bearing ability. This is because with an option of borrowing, a household can do away with risk reducing but inefficient income diversification strategies and concentrate on more risky but efficient investments (Simtowe and Zeller, 2006).As indicated in the Table 5, among sample household heads, 98.3% (176) of them obtained and used the credit and the remaining 1.7% (3) have not received and used the credit. This shows that majority of sample respondents used the credit in the study area. . This may be due to high availability of credit supply institution and high farmer's awareness towards credit uses in the district. With respect to credit uses of farmers in the adoption categories, adopters, 87.7 % and non-adopters, 10.61 % of high adopters have received the credit. The result of chi-square- test (x2=21.362***) there is a high significant difference between adoption categories with respect to credit uses.

Profitability: The actual and expected profitability of malt barley in the study area affects the adoption positively at the probability of 1% level of significance. It is resulted as proposed in the hypothesis. Hence malt barley is an alternative cash crop for those farmers having limited access, the profitability of malt barley is important significant variable for sustainable production. Studies conducted by different individuals and institutions provide similar results (Florina *et al.*, 2011 and CIMMYT, 1998).

CHAPTER FIVE
SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1. Summary

This study assessed the current status of adoption of malt barley technology and identifies factors that determine farmers' decision on adoption of malt barley technology . Two-stage sampling and proportional allocation techniques were used to obtain sample respondents. Thus, the study used a primary data collected through pretested structured interview schedule from randomly selected 179 sample respondents from purposively selected six *Kebeles* in Angolelana Tera and Hagermariamna *Kesem* district of North Showa zone. Furthermore, secondary data from each district kebele offices of agriculture, published andunpublished sources were reviewed for this study purpose. The studies were used descriptive statistics, inferential statistics and econometric model (logit model) for the data analyses. Inferential statistics were used to test the significant relationship between independent and dependent variable.

VIF were also used to assess the existence of multi co-linearity problem among the independent variables. The result of descriptive analysis has shown that 88.83 % of sample respondents are adopters and 11.83 % are non-adopters of malt barley technology during the survey year in study area. But there is a variation among adopters of malt barley. From 14 explanatory variables included in the logit model six variables had shown significant relationship with adoption. Accordingly, Age of Household, Farming experience, credit use, Participation in malt barley Training, Oxen ownership and Profit were found to have positive and significant influence on adoption of malt barley technology .

5.2. Conclusions

The production of malt barley technologies in the study area are influenced by the constraints of limited access to the required production input availability both at the required time and in amount. The major production inputs required by the farmers include herbicides, improved seeds, labor and fertilizer. The most serious production constraint raised by most of malt barley growers was lack of access to sell their crop produces with reasonable price. Based on the logit model analysis the main factors affecting malt barley technology adoption are Age of Household, profitability of malt barley, Farming experience, Participation in malt barley technology, Oxen ownership and credit use. Respondents living far from market center of district or main market sold their malt barley produces to cooperatives for beer production with relative moderate price and local collectors with small selling price and didn't get the expected market price due to transportation access and lack of pack animals to transfer their produce from production area to the market.

5.3. Recommendations

Attention should be given to people having large farm sizes in order to change the attitudes of those farmers this may bring them to produce and improve the adoption status of malt barley. Organizing farmers in a producer cooperative increases their market bargaining power and help to produce and supply malt barley in a sustainable way by eliminating the grower's price fluctuation risk and increase their commitment to produce quality produces.

Hence malt barley is highly sensitive for selling price and production cost. The selling price of malt barley should be adjusted based on the variation of cost of production. Therefore, the future price of malt barley should be adjusted based on costs of production changes. This will help to confirm sustainable supply and demand of the domestic of malt barley and malt on breweries industry. The results of the study suggests, strengthening the market linkage between farmers and malt factory through farmers' cooperative, organizing malt barley producer farmers in to cooperative with due attention to improve profitability of malt barley by shortening interaction of market intermediaries and improvement the performance of malt barley crop will help to improve their bargaining power.

Making available disease resistant malt barley varieties and herbicide would be essential for addressing the two most important malt barley production problems of vital concerns to malt barley producers in the study area. Establishment of contractual production and marketing agreement between farmers and different market actors on malt barley enhances the production and productivity status of malt barley producers by reducing market risks. Hopefully, malt barley contract prices will increase to a level that compensates growers for their risk. Further this will improve the trade balance of the economy by reducing import of malt barley and malt.

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