DETERMINANTS OF ADOPTION OF IMPROVED WHEAT TECHNOLOGY: IN CASE OF GOZZAMEN DISTRICT, EAST GOJJAM IN AMHARA REGIONAL STATE, ETHIOPIA.

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As thesis research advisors, we hereby certify that we have read and evaluated this thesis prepared, under my guidance, by Belay Wudu, entitled: "Adoption of Improved Wheat Technology in Gozamen woreda, Eastern Gojjam, Ethiopia." I recommend that it be submitted as fulfilling the thesis requirement.

By

Belay Wudu Tewabe

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STATEMENT OF AUTHOR

First, I declare that this thesis is my original work and all sources of material used for this thesis have been duly acknowledged. This thesis has been submitted in partial fulfillment of the requirements for the degree of M.Sc. in Agricultural Economics at Saint Marry University and is deposited at the University Library to be made available to users under rules of the Library. I also declare that this thesis can be submitted to any other institutions, if the University found it important.

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Name: Belay Wudu Signature: …… Place: St. Marry's University

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ACRONYMS

ADC	Agricultural Development Center
ANRS	Amhara National Regional State
CSA	Central Statistical Agency
EC	Ethiopian Calendar
FAO	Food and Agricultural Organization
FDRE	Federal Democratic Republic of Ethiopia
FGD	Focus Group Discussion
GWOA	Gozamen Woreda Office of Agriculture
HHs	Households
MoARD	Ministry of Agricultural and Rural Development
NGO	Non-Governmental Organization
TLU	Total Livestock Unit
WEPLAO	Woreda Environmental Protection and Land Administration Office

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LIST OF TABLES

LIST OF FIGURES

ANNEXES

ABSTRACT

The aims of this study: identify factors influencing adoption of wheat technologies at household level; large numbers of technologies have been generated over the last many years. However, the adoption of these technologies by small holder farmers was limited. The adoption of new technology, under varying contextual setting, is influenced by many socio-economic, institutional and demographic factors of the farm households. So it is vital to be aware and there is a need to understand the contextual factors affecting the adoption of new technologies in order to generate and disseminate appropriate technologies to farmer. For this research multi-stage sampling procedure was employed to select the sample respondents. First, Amhara Regional state was purposively selected. At the second stage, Gozamen district was purposively selected based on wheat production potential. At the third stage three Kebele were randomly selected among wheat growers using random sampling method. Finally, 120 sample respondents were selected from the sampling frame based on probability proportional to size (PPS) random sampling method. A semi-structured questionnaire based interview, participatory rural appraisal (PRA), farm inspection, record analysis, journals and different articles were carried out to collect cross sectional data. Of the total samples were taken 49% were technology adopters and 51% were non-adopters. SPSS statistical computer software program were used to analyze the collected data. The primary data generated on the determinants of improved wheat technology adoption were subjected to an econometric (regression) analysis besides this descriptive statistics were used as analytical tool. The result of the model revealed that the explanatory variables education, farm size, total active household labor in man equivalent, crop income, input availability, contact extension agent, off farm, were statistically significant and positively influence adoption of improved wheat technology, whereas age and market distance were found to have a significant and negative influence on the adoption decision of improved wheat technology. The result from this survey suggests that implementation of well-established extension package, formation of compatible rural credit institutions, improvement of infrastructure and collective action of farmers, researchers, development agent, and entire stakeholders are helpful.

Keywords: Wheat technology, adoption, logit model, Gozamen district, Amahara Regional State, Ethiopia.

CHAPTER 1: INTRODUCTION

1.1 Background

Agricultural production is the bases for domestic food consumption and one of the mitigating mechanisms for the problem of food insecurity in Ethiopia. The government of Ethiopia has developed different ways of agricultural production strategy to enhance the productivity of smallholders, among various approaches Agricultural Development Led Industrialization (ADLI) is the one that had supposed to exploit the existing agricultural potential of the country, its prominence is for enhancement of productivity of the smallholder and industrialization through utilization of the domestic raw materials by using improved labor technologies. After (ADLI) the government of Ethiopia has also developed Five Year Growth and Transformation Plan (GTP) established ambitious targets for the agriculture sector for 2011-2015. The Plan's objectives focus on enhancing productivity and production of smallholder farmers and expanding the amount of land under irrigation, and reducing the number of chronically food insecure households.

Based on the data of CSA (2013), Ethiopia has enormous potential for wheat production with a total area 1.63 million hectare of land with the productivity of 21Qt/hectare however, this huge potential has not executed as planned due to several political, economic and social impediment.

Gozamen district is one of the potential areas of wheat production in Amhara regional state, wheat is one of the most important cereal crops for the district which is the main source of food and cash for small holder farmers. The total area coverage of wheat under cultivation is 10,584 ha with a productivity of 18 quintal per hectare GWOA (2014). To come up with a sustainable way of production and to improve the living standards of the society wheat production has to increase extensively and intensively. This is performed through cultivating the uncultivated area of land and work to increase the productivity of wheat on the specific area of land by increasing the utilization of the necessary inputs that helps to increase production like, improved way of farming, fertilizer, varieties and different cultural practices that enhance the overall production of the sector.

Agricultural production can be increased through extensification (i.e. through expansion of farmlands) or intensification (i.e. by using more inputs and technologies per unit of land). However, increasing horizontal production is not a viable strategy to increase agricultural production for most of the food insecure countries where high population pressure is a critical bottleneck. Where land is scarce, intensification, which entails investments in modern inputs

and technologies, is a better option to increase agricultural production and reduce food insecurity.

Intensification of smallholder wheat production typically involves the adoption of improved wheat seed production and other complementary inputs (e.g., production of improved wheat varieties, purchased fertilizer, pest control measures (pesticides, herbicide and insecticide).

In developing countries like Ethiopia, agriculture is a strong option for spurring growth, overcoming poverty, and enhancing food security, and this has necessitated the need to increase agricultural productivity through the introduction and use of improved agricultural technologies (Moreno & Sunding, 2003; World Bank 2008).

1.2 Statements of the Problem

Wheat is the most widely grown cereal crop in the world, with an ever-increasing demand. It plays a fundamental role in food security, and a major challenge is to meet the additional requirements with new cultivars and improved cropping technologies. Wheat is a primary source of calories and protein for 4.5 billion people in more than 100 countries (Sanjaya Rajaram, 2014).

Wheat is grown on over 240 million hectares worldwide, this shows area coverage of wheat is more than any other crops, and over 80 percent of this land is located in the developing world. Therefore, improving yields of this crop is very important since the diets of human beings on every continent rely on this staple crop.

As per FAOSTAT (2014) now a day wheat production has shown increasing rate due to increase in area coverage but, productivity in a unit area of land is not as expected. Same data shows that for the last five years wheat production trend has shown an increasing rate during the year of 2009 to 2014 world wheat production was 685.6, 651.4, 704.1, 674.9, 713.2 and 220 million metric tons respectively. To this end, the average production of wheat has been increasing by 1.16 percent in the world.

According to Hundie *et al.* (2000) even if the area coverage of wheat in Ethiopia is higher, the mean national yield is (2.1ton/ha) 19 percent and 49 percent below the mean yield for Africa and the World respectively. This relatively low mean national yield may be partially attributed to the low level of adoption of improved wheat production technologies.

Amhara regional state is one of the major wheat growing regions in the country next to Oromia regional state. According to CSA (2013) the region shares about 31 percent (498,192 ha) and 26 percent (8,856,855qt) of the total area and production respectively. Of the total

regional wheat production most of it is coming from East Gojjam province where this thesis was conducted. Even if the province and specifically the district has endowed with potential area for wheat production the lower production hinders the living standard of the household CSA (2013). Therefore, to improve the living standard of smallholders in a sustainable way, introducing improved methods of agricultural practice, advising smallholders to use improved wheat varieties, fertilizers and chemicals are the basic ones. Of these inputs improved wheat variety is the main focusing area of the study because application rate of other inputs are not same with different smallholders. Even though large efforts have been made to disseminate improved wheat variety through the support of governmental and non-governmental organizations in different parts of the country including the study area, the rate of adoption varies widely across different agro-ecology and within the same agro-ecology as a result of various technical and non-technical factors.

Therefore, this study endeavors to investigate the level of adoption and determinants of adoption of improved wheat technology in the study area to fill the information gap.

1.3 Research objective

- General objective:-Assessing various determinant factors of improved wheat technology adoption in the study area.
- Specific objectives:
  - To identify factors influencing adoption of improved wheat technology at household level;
  - To assess the extent of adoption of improved wheat technology of households in the study area.

1.4 Significance of the study

Detail understanding of farmers' adoption behavior of wheat technologies is crucial and mandatory for designing future research and development strategies. This study expected to support policy makers to design future study, extensions', and development programs aimed at benefiting smallholder farmers. Policy makers expected to be benefited from the research output, since they require micro-level information to formulate policies and strategies so that their effort would be appropriate in meeting smallholder farmers need in particular and to bring change in Agricultural sector in general. Also this research result will benefit development planners, other researchers and ultimately the farmers. In addition to this, the

research output has tried to identify determinants of improved wheat technology adoption at household level.

1.5 Research Questions

1. To what extent the smallholder in the study area have adopted improved wheat technology?
2. What are the major factors that influence adoption of improved wheat technology in the study area?

1.6 Scope and Limitation of the Study

The study aims assessment of determinants of adoption of improved wheat technology (wheat variety) in the study area and to identify major factors that influence adoption of wheat improved technology. Due to financial and time limitations, the study focuses only on three kebele, in the selected district. The study will contribute valuable input for agricultural policy design and research with respect to smallholder farmers in the study area.

1.7 Organization of the thesis

This thesis is organized in to five chapters. chapter one includes title and statement of the problem which is focused on adoption of improved wheat technology, Chapter two includes general description and overview of the study area including design of the study, sampling procedure and sample size, and the likes, chapter three focus on the main parts of the thesis which is general methodology of the research, chapter four result and discussion part and the last is reference.

CHAPTER 2: LITERATURE REVIEW

2.1 Theoretical Literature Review

2.1.1 Definition of technology adoption

New agricultural technology is generally a bundle or package of different technological elements such as improved varieties, fertilizers, pesticides (herbicide, fungicides, insecticides), and machines; in addition to this technical practices and skills needed for their effective use (SAMY, 1998; Shahin, 2004). Any definition of technology encompasses a wide range of phenomena. In the broadest sense, technology is defined as the translation of scientific laws into machines, tools, mechanical devices, instruments, innovation, procedures and techniques to accomplish tangible ends, attain specific needs, or manipulate the environment for practical purposes (Shahin, 2004).

Technology adoption concept and idea of technology adoption was started with the exploration of the economics of technological change Goshu et al (2008) cited in Griliches (1957), and the proper adoption and diffusion models applied by Mansfield (1963), Feder et al. (1985) and then by Green and Ng'ong'ola (1993). After a while adoption and diffusion have been conceived as the processes governing the utilization of innovations, and studies of adoption behavior emphasize factors that affect the adoption of agricultural technologies.

In a social system adoption of new technology/innovation has been done through adoption by individuals or groups. Feder et al. (1985) adoption may be defined as the integration of an innovation into farmers' normal farming activities over an extended period of time. It is also noted that adoption however, is not a permanent behavior. This implies that an individual may decide to discontinue the use of an innovation for a variety of personal, institutional, and social reasons one of which might be the availability of another practice that is better in satisfying farmers' needs.

Adoption is 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 (Bahadur and Siegfried, 2004). 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.

2.1.2 Adoption/diffusion theories

People by its nature don't adopt technology through overnight; they normally need some time to adopt. Such a time might continue for several years before even trying to implement the idea for the first time.

(Shahin, 2004), technology adoption is not an easy task for the adopter because, there are factors that contribute to the failure to adopt technology such as lack or scarcity of information; high costs of obtaining information; complexity of the system; technology expense; excessive labor requirements and planning; limited availability and accessibility of supporting resources; inadequate managerial skill; and lastly little or no control over the adoption decision. In contrast, Shahin (2004) gives unwillingness to adopt as another barrier to technology adoption. Shahin (2004) offer the following factors as attributes to the unwillingness to adopt such as information conflicts or inconsistency, poor applicability and relevance of information, conflicts between current production goals and the new technology, ignorance on the part of the farmer or promoter of the technology, inappropriate for the physical setting, increased risk of negative outcomes, and belief in traditional practices are some of them. Besides to these, adoption has several steps or processes which is composed of five stages described here under:

- Awareness stage: The individual hears about the existence of the new idea for the first time but lacks information about it.
- Interest stage: Out of curiosity and interest, the individual tries to gather more information about the idea.
- Evaluation stage: The individual makes a mental judgment taking into consideration both the merits of the new idea and his existing situation and condition. Such an evaluation ends normally in a decision either to try the new idea on a small scale or to reject it.
- Trial Stage: Trial means implementation of the new idea or innovation on a small scale. For example the farmer who normally cultivates five feddans of particular crop might try to cultivate only half Feddan from the new Varity of the crop.
- Adoption stage: After the idea is examined, and its feasibility is tested, the farmer or the individual well try to implement such an idea on a full scale. Implementation on a full scale is conceptualized as adoption.

2.1.3 Types of agricultural technologies

Type of technology has unique limitations that must be kept in mind when setting expectations about what we can learn from impact analysis and the challenges that will arise when implementing evaluations. From the different types of agricultural technologies deJanvry et al. (2011), has identified four categories of agricultural technologies, namely yield-increasing and cost-saving technologies; risk-mitigating technologies; quality-improving technologies and technologies that alter environmental externalities. Describing name is not an enough task but, it is necessary to explain each type of agricultural technologies as shown below.

A. Yield-increasing and cost-saving technologies

As described by DeJanvry et al. (2011) both yield-increasing and cost-saving technologies allow reducing the cost per unit of output. Yield-increasing technologies also allow for higher gross output if some inputs (especially land) are limited. These technologies are often presented or recommended to producers as packages, including a seed variety and the associated best management practice. Cost saving technologies may also include new seed varieties that require fewer complementary inputs and cultivation practices that could produce equal results with less effort.

B. Risk-mitigating technologies

These technologies might not raise yields in times where conditions are favorable, but they reduce the risk of very bad outcomes when negative shocks occur. Drought- and pest-resistant seed varieties are good examples of risk mitigating technologies (DeJanvry et al., 2011).

Evaluating risk-mitigating technologies is difficult. While adoption may impact expected outcomes, these effects may not always be observed. For example, consider a drought-resistant variety that minimizes yield losses in years of low rainfall but is otherwise the same as other varieties. Adoption increases expected yield, but if the farm survey takes place in a year with good rains, no benefit is observed. If the survey takes place during a drought year, the yield gain is observed, and the researcher might mistakenly generalize this as a benefit that is realized annually.

C. Quality-improving technologies

These technologies help to increase the quality of outputs in some respect even if yield does not improve. These types of technologies differ from the others in that the main benefits accrue to consumers. (DeJanvry et al., 2011) states that the impact of quality-improving innovations is difficult to evaluate, in part because the channel of transmission from the availability of the new variety to the manifestation of benefits involves several actors. 'Adoption' by consumers requires that producers have already adopted and produced the variety so that it is available to consumers, and that consumers have chosen to consume it.

D. Technologies that alter environmental externalities

These technologies diverge from technologies that improve or maintain the quality of the outputs. New cultivation may fall into this category, as may fertilizers. These are differentiated from technologies that improve or maintain plot-level soil quality in that they prevent negative externalities on neighboring property or public resources, for example through groundwater contamination. DeJanvry et al. (2011) stated that very little of the effect of the technology can be observed at the level of the adopter. The impacts on public resources can be hard to measure, and such impacts could take a long time to manifest. Yet, without taking into account these external effects, the social value of the technology can be vastly under-estimated.

2.1.4 Wheat technologies uptake and its determinants

The implementation of new agricultural technologies has become a driving force for management change on smallholder farms. Identifying technologies and management practices could enhance the sustainability of agricultural production, as well as constraints to their uptake, is therefore an important element in attaining sustainable smallholder farming systems. Economic viability is a fundamental condition for the wide spread uptake of technologies and management practices that will help to achieve the goal of sustainable agriculture in general, and wheat production in particular. Studies on the factors that influence uptake of agricultural technologies often focus on household resource endowments, characteristics of the household head, location of the household, the nature and extent of information provided before uptake, and characteristics of the technology (Feder et al., 1985). The technology diffusion and adoption literature suggests that many different attributes of individuals may influence them to act in different ways. Studies by Baidu-Forson (1999)

suggest that adoption behavior of farmers is explained by farmer attributes, farm attributes, infrastructure attributes and perceptions about agricultural technologies. According to Rogers (1995), socioeconomic characteristics, personality values and communication behavior of individuals influence their way of adopting innovations such that some individuals adopt innovations earlier than others.

Numerous studies have examined the influence of socio-economic variables on farmers' adoption decisions of agricultural technologies using either the probit/logit model (Kabede et al. 1990, Kaliba et al., 1997) or the ordinary least squares linear regression model (Rezvanfar 2007; Rahman 2007). The linear regression model has a continuous dependent variable, while the probit or logit model involves a binary dependent variable. In these models, the dependent variable is specified as a function of farmer-specific attributes (e.g. gender, age, experience, education, household size, income, extension contact), and farm attributes (e.g. farm size, farm type, location).

High school education is found to be significant and positively related to adoption level. Controlling for other factors, high school education would increase adoption. In other words the more educated the farmer the higher the adoption of wheat production technologies. Education makes people to realize the importance and benefits of adopting new technologies. Therefore educated people can be more willing to adopt and apply the new innovations in their farms.

Access to off-farm employment income has a significant positive effect on adoption of wheat technologies. This entails that increased access to off-farm employment income can lead to increased adoption of wheat technologies. One explanation for this result is that off-farm income provides supplemental income to finance technology expenditures for example: purchase of various inputs.

The distance from the agricultural developmental center (ADC) has a significant negative influence on the adoption of wheat technologies. An increase in distance causes a decrease in adoption level. The ADC is usually strategically located within the farming areas and it is the place where the local extension worker is stationed. As distance from the ADC increases, wheat technology adoption decreases because this causes transport cost incurred in obtaining information on technologies and inputs to increase. Farmers are less likely to adopt the wheat technologies as the distance increases from the ADC (Rezvanfar A., 2007).

2.2 Empirical Literature Review

2.2.1 Wheat production in Ethiopia

Ethiopia is the second largest wheat producer in sub-Saharan Africa, after South Africa. Although most of the wheat grown in Ethiopia is bread wheat, there is some durum wheat which is often grown mixed with bread wheat. Wheat is among the most important crops in Ethiopia, ranking fourth in total cereals production 16% next to maize, sorghum and teff (CSA, 2009). It is grown as a staple food in the highlands at altitudes ranging from 1500 to 3000 m.a.s.l. nearly all wheat in country is produced under rain-fed conditions predominantly by small farmers. A few governments owned large-scale (state) farms and commercial farms also produce wheat. Despite the recent expansion, Ethiopia falls short of being self-sufficient in wheat production, and is currently a net importer of wheat grain.

Wheat ranks fourth in terms of area production and yield among food crops. Production of wheat increased from 2.2 (000T) in 2004/2005 (CSA, 1998) to 2.8 (000 t) in 2010/2011 (CSA, 2000) an increase of 31%. However, the share of wheat in total cereal area decreased 12.4% over the same period, mainly due to a shift in cropping patterns towards sorghum. Wheat yield in Ethiopia is also lagging behind other major producers in Africa: average yield was 1.68 ton/ ha during the same period, about 32% and 39% below Kenyan and South African averages, respectively (FAOSTAT). According to Jeffrey et al. (2001) cited on Tanner et al. (1991) several factors that hiders the productivity of wheat in the nation such as low soil fertility, herbal infection (weed), water logging in vertisol, less adoption of different improved technologies, resistance to disease and pest infestation and water deficits in short rainy seasons are the major ones.

At present, wheat is produced solely under rain fed conditions. Currently, bread wheat accounts roughly 60% of total wheat production and durum wheat accounts for most of the remaining 40%, (Jeffrey et al., 2001).

The study conducted by Itana (1985); Chilot et al. (1996) and Tesfaye et al. (2001), have reported that education had positive and significant relationship with adoption. In the same line Freeman et al. (1996); Habtemariam (2004), reported significant and positive relationships that exist between formal education and literacy level and adoption.

Factors influencing adoption of improved technology includes characteristics of household including education, age, and family size, farm characteristics, technology characteristics, wealth (economic status), contact with extension agents, price, access to credit, position of farmer in farmers' organization (see Legesse 1992, Teressa 1997, and Mulugeta 2000).

As indicated by Doginet (2001) adopters of improved maize technologies were younger, more educated, had larger family size, hired more labor and owned more livestock on adoption of maize varieties. Tesfaye et al. (2001) reported that farm size, participation in on-farm demonstration, attendance at training courses, access to credit, education level and extension contact contributed positively in farmers' adoption of improved wheat varieties. Extension activity, represented by farmer's attendance in the field day was found to significantly and positively influencing adoption of improved maize variety.

In the study of Techane (2002) Tobit model was employed to analyze factors influencing adoption and intensity of fertilizer use among smallholder farmers fourteen variables were found to be significant such as access to extension service, access to input credit, access to hired labor, area under improved seed and regional differentials, gender differential, education, supply of family labor, total number of livestock owned, health status of the household head, off-farm income and slope of cultivated land.

By Haji (2003) Logistic regression model was estimated to identify factors affecting farm households' adoption decision of crossbred dairy cows formal education, total local livestock holding, the distance between farmers' residence and market, family size, total cultivated area, access to credit, access to artificial insemination, access to bull service, farmer's leadership position in local farmers' organization and extension contact were found to be significant variables in the adoption decision of crossbred dairy cows.

Endrias (2003) revealed that Tobit model was used to identify factors affecting adoption and intensity of use of improved sweet potato varieties. Fourteen explanatory variables were included in the model out of which eight were found to be significant. Farm size, extension contact, and distance from research center to farms were the most important factors influencing adoption and intensity of use of improved sweet potato varieties. The other significant variables include farming experience, value of livestock, and farmers' perception of yield, maturity period and establishment performance of improved varieties. The results suggest that strengthening research and extension activities with due attention to improve yield potential, shorten maturity time and better establishment performance of the crop.

According to study by Million and Belay (2004) adoption of organic fertilizer was influenced by the age of household head, access to credit, frequency of development agent visit, livestock holding and off-farm income. The study revealed that age influences adoption negatively and significantly. This is because younger farmers are likely to adopt new technologies such as inorganic fertilizer, as they may be less exposed to deep rooted cultural and social attributes

Asres (2005) revealed that large family size provides sufficient labor for farming operation and those farmers who have access to labor are expected to adopt new technologies. This is in agreement with the studies conducted by Deginet et al. (2001). Minyahel (2008) on the contrary, studies conducted by Million and Belay (2004) indicated that family size negatively affects adoption of physical soil conservation.

In Girmachew (2005) the result of the findings shows that explanatory variables: - farm experience, total household labor, extension agent's visit, and perception of the farmer are significantly related to adoption of new technologies by farmers.

In the study of Mahdi (2005) the logit model results revealed that crop land holding size, number of shoats owned and radio ownership have a significant and positive influence on the adoption decision of improved sorghum varieties, whereas age, type of house owned and distance to input market have a significant and negative influence on the adoption decision. However, family size and education do not have statistically significant influence on adoption decision.

By Yishak (2005) the study output revealed that variables such as farm size, TLU, ownership of oxen, availability of fertilizer on time, availability of cash for down payment, access to formal credit, ownership of radio and attending on demonstration were positively and significantly influenced. On the other hand, input price and distance to market were negatively and significantly related to adoption.

Credit use, distance of the woreda market from dwelling, access to improved seed, frequency of extension contact, hosting demonstration, previous investment in soil and water conservation, perceived risks of land degradation, water logging and gorge/gully influence adoption of fertilizer positively , while plot slope affect negatively Kebede (2006).

The research of Hailekiros (2007) model result confirmed that education, extension contact, forestry training, age, agro forestry practice, (TLU) were variables influenced adoption and intensity of new technology. Similarly input availability, credit use, extension experience, PCE and knowledge of ISM technology were found to be the major determinants of ISM adoption Mekonnen (2007)

Minyahel (2007) indicated that sex, education, annual farm income, credit use, participation in extension events, farmers knowledge about production package were important variable which had positive and significantly influenced adoption and intensity of adoption of improved wheat production and market had shown negative and significant relationship with adoption and intensity of improved Bread Wheat production.

Econometric model results depict that education, knowledge on the improved technology, attitude towards haricot bean, participation of extension, access to credit were important variables which had positively and significantly influenced adoption and intensity of adoption of improved haricot bean production Rahmato (2007).

In the study of Taha (2007) result of econometric model indicated annual farm income, ownership of water pump, participation of cooperative, contact with extension service, information source, were important variables which had positive and significantly influenced adoption and intensity of adoption of improved Onion production. Market and age had shown negative relationship with adoption.

Workneh (2007) also revealed that credit, family size, bee keeping experience, apiary visit, market availability were positively and significantly influencing adoption of improved Box Hive.

The study by Almaz (2008) result of the econometric model indicated that sex, land holding, social participation, extension contact, attitude toward Chickpea technology were found to have positive and significant influence on adoption and intensity of adoption of improved Chickpea production.

Farm experience, family size ,number of TLU, participation on nonfarm activities, mass media exposure, extension contact were found to be significant to effect farmers' innovativeness Amsalu (2008).

As reported by Bekele (2008) distance from market and on information sharing and utilization among farmers on maize technology had negative but significant relationship with access to and utilization of agricultural information. This implies that the more distant farmers are located from the market centers; the lower the likelihood of accessing information and utilize it. Similar study carried out by Yealembirhan (2007) proximity to markets showed positive relationships with the use of modern cultivar wheat seed at the farm level.

In Daniel (2008) indicated that household annual income, access to market, research and extension service, and perception of improved Tef variety were important variable influencing adoption and intensity of use of Tef technology.

Study conducted by Tadesse (2008) result of econometric model indicated that education, access to credit, participation in extension events were important variables which had positive and significantly influenced adoption and intensity of adoption of improved Onion production technology.

Mulugeta (2009) indicated that perception of households, participation in extension events, frequency visit, education, social participation were important variables which had positively and significantly influenced adoption and intensity of adoption of old Coffee stumping Technology.

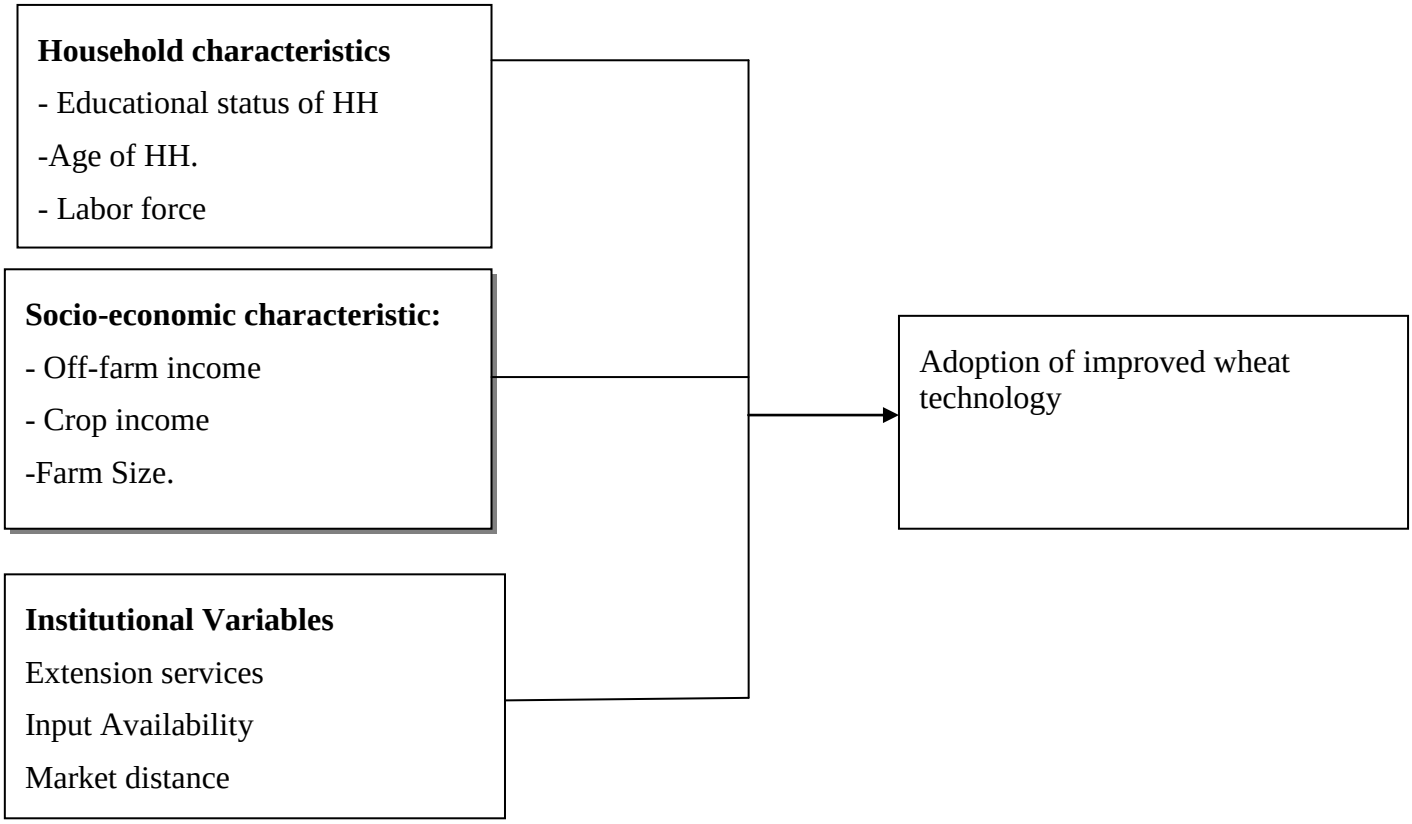
2.2.2 Conceptual framework

Adoption decisions of different technologies across space and time are influenced by different factors and their associations. Factors such as personal, socioeconomic, institutional and psychological factors determine the probability of adoption of improved wheat technology. It is obvious that different studies have been conducted to look into the direction and magnitude of the influence of different factors on farmers' adoption decision of agricultural technologies.

A factor, which is found to enhance adoption of a particular technology in one locality at one time, was found to hinder it or to be irrelevant to adoption of the same technology in another locality. Although some known determinants tend to have general applicability; it is difficult to develop a universal model of the process of technology adoption with defined determinants and hypotheses that hold to everywhere. The dynamic nature of the determinants and the distinctive nature of the areas make it difficult to generalize what factors influence which technology adoption. Hence, the following theoretical structure showed the most important variables expected to influence the adoption of improved wheat technology considering the study area specifically.

The differences in adoption patterns were attributed to variations in agro-climatic, information, infrastructures, as well as environmental, institutional and social factors between areas. Moreover farmers' adoption behavior, especially and in low income countries, is influenced by a complex set of socio- economic, demographic, technical, institutional and biophysical factors Feder et al (1985).

Figure 0-1 Conceptual framework



CHAPTER 3: RESEARCH METHODOLOGY

3.1 Description of the Study Area

The study was conducted in Gozamin Woreda East Gojjam Administrative zone, Amhara regional state. It is located about 300 kms North West of Addis Ababa on the way of Addis Ababa to Bahirdar. According to CSA, (2007), the population of the Woreda is about 132,883 with 66,348 male and 66,535 female. Of these population 1,666 households are living in the selected three kebeles where this study was conducted. Totally, the Woreda Population is indigenous. Population livelihood depends on mainly in crop, livestock and other non-farm activities. The average altitude of the district is 2200 meter above sea level.

Basically, this research is causal or explanatory type of research which identifies on the relationship between dependent and explanatory variables.

Cross-sectional type of study was carried out to analyze determinant factors of wheat technology adoption in the study area. A semi-structured survey questionnaire, focus group discussion, and secondary data sources were used to collect data. Moreover, econometrical models were used to analyses different parameters on wheat technology adoption. Furthermore, my research approach was both qualitative and quantitative type which is called mixed approach.

Figure 0-1: Map of the study area

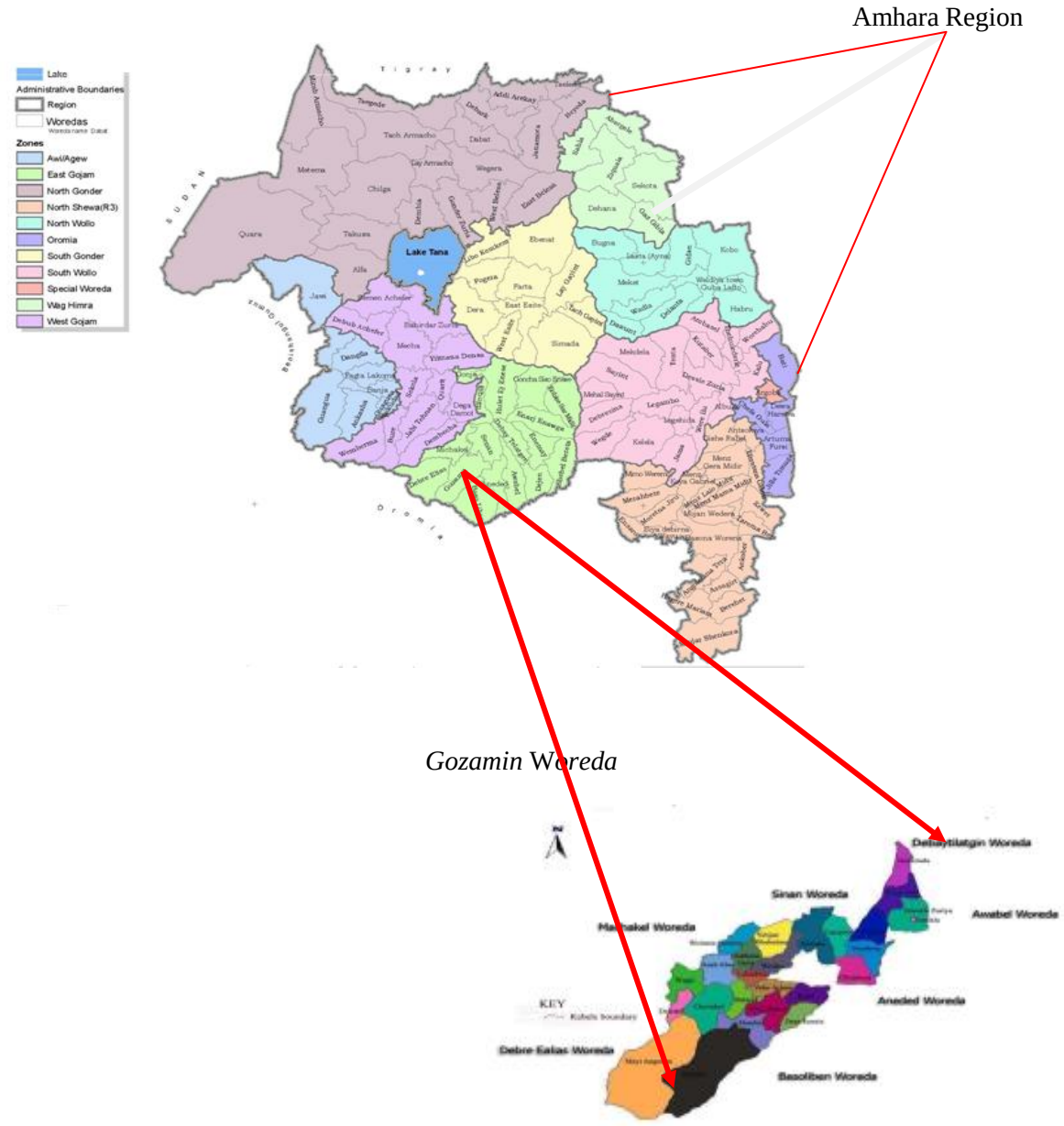


Table 0-1 Type of crops grown in Gozamin district

No	Crop type	Area	Production in quintal
1	Wheat	10,584	190,512
2	Teff	10,263	127,868
3	Maize	7,180	363,145
4	Barley	3,350	68,404
5	Sorghum	427	8,663
5	Engedo (Oat)	1,873	30,000
6	Noug	819	6,121
7	Linseed	244	1,714
8	Sesame	5,227	41,816
9	Bean	2,153	48,270
10	Haricot Bean	318	5,786
11	Soya bean	50	900
12	Chickpea	5	90
13	Guaya	5	90

Source: Gozamin Woreda office of agriculture, 2007 EC.

Production of grains in the Woreda is practiced in a traditional way by plowing with a pair of oxen. Production of wheat is a rain-fed with only one harvest in a year. In the study district crop production is major economic activity followed by animal production. The dominant crops in the area are wheat, teff, maize, sorghum and barely. Cereals took the lion share interims of production and area coverage. Among the cereals bread wheat is the first in production and coverage followed by teff, maize, barley and sorghum respectively. Wheat is the major crop grown and produced in the area using different improved wheat technology package.

3.2 Sampling Procedure and Sample size

Accurate information about a given population could be obtained from a census study. However, due to financial and time constraints in many cases a complete coverage of the population is not possible. Thus sampling is one of the methods which allow the researcher to study a relatively small number of units representing the whole population Sarantakos (1998). A random sampling technique was employed to obtain a representative sample which allows equal chance for all members of the population to be included in the sample.

Determining the size of the sample is an important decision while adopting a sampling technique. Appropriate sample size selection depends on various factors relating to the subject under investigation like time, cost, degree of accuracy desire, etc. (Rangaswamy, 1995; Gupta, 2002). As sample size increases, the sampling distribution of the mean decreases in variability (the standard error decreases) and become more like the normal distribution in shape, even where the population distribution is not normal (Rangaswamy, 1995; Gupta, 2002).

The study was employed multistage sampling procedure to select households who are producing wheat. In the first stage, three potential wheat producing *Kebeles* were selected purposely from others and secondly from the sampled frame of the sampled *Kebeles*, list of sample farmers were selected for the interview. From each kebele based on the proportion to the population, sample households were selected using systematic random sampling technique taking into consideration samples yield accurate & reliable results and constraints of time and budget.

Wheat growers in the selected kebele was used as the sampling frame and the sampling units were the household heads. Adopters were defined as farmers who planted improved wheat variety for two consecutive seasons and non-adopters were defined as farmers who planted local seed or recycled seed

Finally, total sample size of 120 household heads were selected from the wheat growers of the last two years. List of farmers were identified in each kebele using Probability Proportional to Size (PPS) random sampling technique against the total number of wheat growers in the kebeles, which constituted the sampling frame.

During selection of samples this procedure was employed, the sampling frame was arranged in alphabetical order and the total sample size was decided to be 120 and N/n was used to arrive at the interval for drawing samples. N is the total population and n is sample size and it was conducted drawing of samples from the sampling frame until 120 samples is drawn.

Table 4 Sample size

Name of sampled Kebeles	No of Households	No of samples taken		
		Adopters	Non-Adopters	Total
Addisena Guilt	523	18	20	38
Wonqa	642	12	34	46
Lekilekita	498	29	7	36
Total	1,663	59	61	120

Source: *Gozamin Woreda* office of agriculture and own computation.

3.3 Data Collection

3.3.1 Survey Questionnaire

Both quantitative and qualitative data were collected using different data collection methods. Primary data were collected through a face to face interview with contact/sample household heads using a semi-structured questionnaire. Interview was carried out by trained data collectors which are working with small holders which are known as developmental agents (DAs). The survey was conducted after thoroughly explaining the purpose of the interview to the interviewees.

3.3.2 Focus Group Discussion (FGD)

The FGD method was used to get qualitative data using focus group discussion which is organized from different social segments. A sample checklist, serving as a guide and consisting of the main points for focus group discussion interviews were prepared, pre-tested and adjusted based on prior to full implementation.

3.3.3 Secondary Data Collection

The supplementary data was gathered from reports and records of district Agriculture and Rural Development Offices and other relevant institutions in the study areas. Further secondary data was gathered from previous studies, journals and different publications.

3.4 Methods of Data Analysis

3.4.1 Descriptive Statistics

It is difficult to analyze the collected data without the help of different statistical package. So that, the collected primary data were entered and analyzed by using SPSS. The collected primary data regarding on the determinants of wheat technology adoption was subjected to an econometric (regression) analysis using logit model. Descriptive statistics was used to analyze mean, standard deviation, frequency and percentage.

3.4.2 Econometric Model

The models provide empirical estimates of how changes these exogenous variables influence the probability of adoption, and have been widely used to assess the effectiveness of technology to promote technology adoption (Rahm and Huffman 1984; Nkonya *et a1*., 1997). Dichotomous response variable (adoption or no- adoption) subject to the influence of a number of continuous and or/categorical independent variables, including level of

education, gender, equipment owned, and sources of information CIMMYT (1993), Tesfaye et al (2001), Tesfaye and Alamu (2001).

Technology adoption decision of the households relate with characteristics of technology was analyzed through using econometric models. Scientifically, there are different outcomes in the econometrics model but, this research was considered dichotomous or two category choices since, the study was conducted between two groups of farmers (a) adopters and (b) non-adopter of technology. Linear regression econometrics model has its own limitation but, it is overcome by using probit or logit models which are working for a non- linear regression model. The commonly used models to analysis adoption studies are logit, probit and tobit because they accommodate qualitative (categorical or discrete) responses (Cramer, 1991). The probit and logit models are standard and have similar shapes but, latter data concentrated in the tails (Cramer, 1991).

There is no a significant differences between Logit and probit model estimation except logit model can easily explain the result and there is thickness difference around tile however, it is overcome by increasing the sample size (Cramer, 1991).

For this study, logit model was employed to analyze the data. These models relate households and technological characteristics to the probability whether households will adopt a technology or not. Typically, factors included in the model are exogenous which are not controlled by the households. The models provide empirical estimates of how changes in these exogenous variables influence the probability of adoption, and have been widely used to assess the effectiveness of technology to promote technology adoption (Rahm and Huffman 1984; Nkonya *et a1*., 1997)

There are different factors that affect the adoption decision of wheat technology such as distance to the market, household's resource (educational level, off-farm activity, farm size, average productivity (qt/ha), family size, Age etc.) and institutional factors (extension agent, availability of credit).

The following econometric model has shown factors influencing adoption of technologies at household level. Accordingly to various authors' states (Cramer, 1991; Theil, 1979; Gujarati, 1995; Amemiya, 1994).

$$\mathrm{Yi} = \mathrm{f(zi)} \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots . (1)$$

This means there is a functional relationship (f) between the observed survey and the latent index function zi.

Where $$\mathrm{zi} = \mathrm{bo} + \sum \mathrm{biX} \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots (2)$$

Y is the response for the i^{th} observation with binary variables 1 for adopters and 0 for non-adaptors of technology and zi is the latent index function for the i^{th} observation. There is a threshold index for each farmers z*, such that zi*<zi the farmer is considered as an adopter and zi*>zi the farmer is non adopter. The probability of the farmers who adopt the technology is presented as follow.

$$pi = \frac{e^{zi}}{1 + e^{zi}} \ldots \ldots \ldots (3)$$

Where $zi = \beta 0 + \beta 1\, X1 + \beta 2\, X2 + \beta 3\, X3 + \cdots \beta k\, Xk \ldots \ldots \ldots (4)$

Where β0 is the intercept and β1 is the slope of parameter of the model. The slope tells how the log-odds in favor of adopting improved wheat technology change as the independent variable changed by a unit.

The model is specified as follow;

$$Y = ((\ln\{p(Xi))/(\ln(1 - p(xi))\_(\alpha iXi + ui) \ldots \ldots \ldots (5)$$

Y= It is the natural legalisms of the probability adopting wheat technology (P) divided by probability of not adopting it (1-P)

αi= Coefficient of factors influencing adoption of wheat technology

Xi= Factors influencing adoption of wheat technology which are hypothesized to influence adoption.

ui= Error terms

The model is specified as shown in equation

Y = f (location, farmer's resources (human and physical) and institutional factors)… (6)

3.4.3 Hypothesis and Variable Definition

Variable defining is one of the tasks during research working hence; the data was cover the necessary information regarding to social-economic characteristics, wheat production, and factors of wheat technology adoption in the study area. Both continuous and dummy variables were used on economic theories and the findings of different empirical studies. Consequently, to investigate the research questions of this study, the following variables were identified.

A. Dependent Variables

Wheat Variety Adoption: Technology adoption is considered as a packages however, this research was considered only improved wheat variety and the remaining were excluded from this study because of variation in application rate on other technologies (chemicals, fertilizers

and various types of agronomical practices) for different farmers and it is difficult to get reliable data.

Improved Wheat Seed (IWS): Is a dummy variable that represents the probability of the household adopting wheat variety or not. For the household who adopts wheat variety, variable takes value zero and otherwise take value one.

Table 0-2 Distribution of respondents by level of adoption (N=120)

Adoption categories	Sample population	Percentage
Adopter	59	49.2
Non-Adopters	61	50.8

Source: Computed from own survey data, 2009

The study was used 120 households as a total sample size, of which 59 (49.2%) were adopters and the remaining 61 (50.8%) were non-adopters and it is possible to say the percentage of non-adopters are higher than adopters.

B. Independent variables

Independent (explanatory) Variables

There are different independent variables that correlate with wheat technology adoption; some of the variables are as follow:-

1. **GENDER**: This is dummy variable that takes a value of one if the household head is male and zero otherwise. In smallholder farmer's household, both men and women take part in wheat production. Sex difference is one of the factors expected to influence adoption of new technologies. Due to many socio-cultural values and norms, males have freedom of mobility and participation in different meetings and consequently have greater access to information (Techane, 2002).
2. **Family Size** (FS): It is a continuous variable and measured in numbers, family member capable to do an agricultural activities (adult equivalent). Wheat production is labor intensive starting from ploughing to harvesting especially it needs more labor at the time of weeding. Therefore, all activities of wheat production were performed as per the crop calendar, and the production of the farm was found very high.
3. **Distance to market center** (DMT): It is a continuous variable which is measured in kilometers. When the farm area is near to the market the potential of the farmer to sell their product is high and there is no high cost incurred by the households while transportation. Moreover, the household can access the required inputs in the nearby

market because many of input providers are settled around the main market; Almaze (2008) distance from the market has a negative impact on technology adoption; as distance is increased from the market the inputs supply will decrease.

4. **Education level**: It is continuous variable and is measured in years of formal schooling of the households. Education plays an important role in the adoption of innovations/new technologies. Further education is believed to improve the readiness of the households to accept new idea and innovations, and get updated demand and supply price information which in turn enhances producers' willingness to produce more and increase wheat productivity.

5. **Age**: It is a continuous variable and measured in years. Age is a proxy measure of farming experience of household. This hypothesis showed there is a direct relationship between household farm experience and wheat technology adoption. According to Nicholson et al. (1999) age negatively affects technology adoption. When the household age has increased, the probability of technology adoption decreased this is as a result of limited planning horizon when households are getting old.
6. **Off-farm income (OFI**): it is a continuous variable which is measured by the amount of income earned by the households mainly out of on-farm activities. Households participating in off-farm activities are expected to have better income and can easily purchase agricultural inputs. Therefore, off-farm income was found positively influence wheat technology adoption.
7. **Farm Income**: It is a continuous variable and refers to the total annual cash earning to the families from selling of crops, livestock and livestock products after meeting family's requirements. This is believed to be the main source of capital for purchasing agricultural inputs (Kidane, 2001). Thus, those households with a relatively higher level of farm income are likely to purchase improved seeds or other essential agricultural inputs. It is measured by the amount of birr obtained from sale of farm produces.
8. **Land Holding (LH)**: It is a continuous variable and measured in hectares. It is hypothesized that there is a direct relationship between size of land and wheat technology adoption. According to Mulugeta and Hundie. (2012) size of cultivated area of land has a significant influence on technology adoption decision of wheat production.
9. **Access to Credit (AC)**: Access to credit is measured as a dummy variable taking a value of one if the household has access to credit and zero otherwise. This variable is

expected to influence improved wheat technology adoption decision of households because there is high initial cost of improved seeds which may not afford easily. Easily access to credit makes the households free from financial constraint and they can easily cultivate it.

10. **Frequency of contact with extension agent:** This refers to the number of contacts per year that the respondent made with extension agents and it is a continuous variable. The effort to disseminate new agricultural technologies is within the field of communication between the change agent (extension agent) and the farmers at the grass root level (Girmachew, 2005). Here, the frequency of contact between the extension agent and the farmers is hypothesized to be the potential force which accelerates the effective dissemination of adequate agricultural information to the farmers, thereby enhancing farmers' decision to adopt new crop technologies.
11. **Livestock Possession**: Is to be measured in Total Livestock Unit (TLU). Livestock ownership is hypothesized to be positively related to the adoption of technologies because it serves as proxy for wealth status (Chilot et al., 1996; Asfew et al., 1997; Habtemariam, 2004).
12. **Participation in social organization (SOCIALPART)**: Being membership, leadership in the community organization and frequency of participations in the peasant association and different cooperatives are more likely to be aware of new practices as long as they are exposed to information (Chilot et al., 1996; Asfew et al., 1997). Therefore, it is hypothesized that farmers who frequently participated in social organization either as a member or leader are exposed to adopt new technologies. The variable takes a value 1 if a farmer is member of social organization, 2 for committee member and 3 for leader of social organization and frequency of participation scores was given as, 1, 2, 3, 4 and 5 which are very poor, poor, medium, high and very high, respectively. Hence, participating in social organization has a positive influence in adoption decision of smallholder farmers.
13. **Availability of Input**: On time availability of inputs determines the adoption decision of new improved wheat varieties Thus, it was hypothesized that timely availability of inputs has a positively associated with adoption of improved wheat technology.

CHAPTER 4: RESULTS AND DISCUSION

This chapter is the main part of the paper, overall findings of the study is explained in various sections such as descriptive statistics and econometric analysis aligned with the objectives of the study. Results of significant differences between Adopters and non-adopters are presented. Moreover, binary logistic regression and various important results are included in this part of the paper.

4.1 Current Status of Adoption

Practicing adoption of new technology is the best solution as compared to another alternatives and recommendations for smallholder farmers to improve and enhance the production and productivity. Smallholders use same technologies but in variable adoption level, this different level of adoption may be related to several reasons or factors. Therefore, it is important to know and needs scientific research's why farmers adopt a single component of package while refusing the others.

Improved wheat technology has various practical packages which were recommended by the researchers and were being promoted by extension systems, such as use of improved varieties, land preparation, application of fertilizer, application of chemicals, weed management, seeding rate, planting space etc. It is difficult to put in practices all agricultural extension packages as the recommended way especially at farmers level hence, for this study only improved wheat variety was adopted and the remaining inputs are being remained constant since, farmers usually use different application rate due to financial constraints and luck of extension services. This variability created problems to get reliable data consequently, only improved wheat variety was considered and others were excluded.

Having these facts about technology adoption package, level of improved wheat technology adoption is indicated in the table 4.1 below.

Table 0-1 Percentage of respondents by level of adoption (N=120)

Adoption categories	Sample population	Percentage
Adopter	59	49.2
Non-Adopters	61	50.8

Source: computed from own survey data, 2009 EC.

The study was considered 120 randomly selected households as a total sample size and from this 59 (49.2%) were adopters and 61 (50.8%) were non-adopters. The figure shows that the percentage of adopters are less than non-adopters.

Table 0-2 Distribution of sample households by sex (N=120)

Description	Sex of household		Total
	Men	Female	
Adopters	58	1	59
Non-adopter	60	1	61
Total	118	2	120

Source: Computed from own survey data, 2009 EC.

The sample was composed of male and female households, of which 98 percent are male headed and the rest 2 percent are female headed and male sample sizes are higher than female meanwhile the percentage of adopters were found 49 percent and 51 percent were non-adopters this shows that adopters and non-adopters were almost in equal proportion. However, to decrease the number of non-adopters and to increase the number of adopters it requires providing daily extension services. Moreover, from the total male respondents 58 were adopters and 60 were non-adopters, meaning most of the time females are not active or not engaged in wheat technology adoption.

The descriptive analysis was done and discussed in terms of the demographic, socio-economic and institutional characteristics of the adopters and non-adopters.

4.2 Description of adoption decision of improved wheat technology

According to Van den Ban and Hawkins (1998), adoption is a decision to apply new innovation and continue to use. Several factors influence farmer's adoption decision. In this study, the independent variables thought to have relationship with adoption of improved wheat technology are grouped as household's personal and demographic variables. The most commonly household characteristics that were hypothesis frequently influencing farmers' adoption of improved wheat technology included: educational level of household head, family size, and age, farm size, extension service, input availability, and access to credit, market distance, farmers' perception, and off-farm activity. The relationship of these variables with adoption of improved wheat technology is discussed under the following sub topics.

4.2.1 Demographic Characteristics

Table 0-3 Mean and standard deviation of the demographic variables (N=120)

Characteristics	Adopter		Non-Adopter	
	Mean	Std. Deviation	Mean	Std. Deviation
Age	46.7	9.0	48.2	9.6
Education	1.54	0.79	0.54	0.50
Family size	5.3	1.32	6.10	1.54

Source: Computed from own survey data, 2009 EC.

4.2.1.1 Education

Education is one of the explanatory variable for this study and it helps to access, understand, process and utilize various information related to agricultural production. Concerning the level of education it was categorized as illustrate, read and write, grade 1-6, grade 7-10 and collage and above and the language for all levels is Amharic.

After the analysis was conducted the result is, 40.8 percent of the sample respondents were illustrate, 41.7 percent were read and write the remaining respondents were 8.3 percent and 9.2 percent for grade 1-6 and grade 7-10 respectively.

4.2.1.2 Family Size

As shown in the above table 4.3 the average number of family size of the households were approximately 5 for adopters and 6 for non-adopters. This shows that adopters are facing shortage of labor as compared to non-adopters and non-adopters have extra number of families with respect to their activities. Therefore, the extra number of individuals were sent to hire in order to bring an additional income.

As indicated in the table 4.4 below Most of the households have family size ranges from 4-8. Those households have 4 family size accounted for 17.5 percent, 5 accounted for 13.3 percent, 6 accounted for 26.7 percent, 7 accounted for 20 percent and 8 accounted for 13.3 percent. Hence, the average number of individuals for non-adopters was 6 and it had the maximum percentage share from the total.

Table 0-4 Household Family size

Family size	Frequency	Percent
3	3	2.6
4	21	17.5
5	16	13.3
6	32	26.7
7	24	20
8	16	13.3
9	7	5.8
10	1	0.8
Total	120	100

Source: Own computed data, 2009 EC.

4.2.2 Socio-economic characteristics

Table 0-5 Mean and standard deviation of the socio-economic variables (N=120)

Characteristics	Adopter		Non-Adopter	
	Mean	Std. Deviation	Mean	Std. Deviation
Farm size	1.87	0.80	1.37	0.56
Crop income	942.03	558.22	628.74	370.77
Livestock income	2,388	1,893	1,058	735
Off-farm income	460.52	413.90	486.93	449.31

Source: Computed from own survey data, 2009 EC.

4.2.2.1 Farm size

As shown in the table 4.5 above farm size was considered as one of the explanatory variable for wheat technology adoption. The average land holding size of sample households were 1.67 ha with standard deviation of 0.66 which is a bit more than the national average, which is 1.5 hectare implying households relatively have better farm size. The average land holding for non-adopter group was 1.64 hectares which were a bit lower than adopters.

4.2.2.2 Crop income

As shown in the table 4.5 above the main source of income for developing countries is crop production and rearing of animals and these tasks have been challenging since it is exposed to internal and external factors in particular crop production which always depends on natural rainfall. Most of smallholder farmer's income sources were mainly emanated from annual farm production.

Being dependent on natural rainfall is one of the limiting factors in order not to meet the planned amount of production. Hence, income and consumption behavior of smallholder farmers were influenced.

The farm income refers to the total annual earnings of the family from sales of crop produce after meeting their family requirements. This is believed to be the main source of cash to purchase agricultural inputs. Thus, those households with a relatively higher level of farm income are likely to purchase improved seeds or other essential agricultural inputs. In this study, the household income was estimated based on the sales of crops and livestock and livestock products and the average annual income of sales of crop for sample households who adopt technology was 942 birr/year and mean income of non-adopter of technology was 628 birr/year. Thus, the income of adopters exceeded the income of non-adopters, because adopters were utilized improved wheat technology and they produce more.

4.2.2.3 Livestock income

Livestock holding is an indicator of household's wealth position in the study area. Crop production and livestock rearing are the major components of farming. Livestock and its products' sale is another important component of the economic activity in the study area. The results of annual incomes from sale of livestock are presented in the above Table 4.5.

Table 4.5 clearly illustrated that the average contributed by livestock were 1,723 Birr of the total income per household of the sampled farmers. The minimum annual income of the household was 160 birr and maximum household income was 11,500 birr. The average incomes from livestock for adopters' were 2,388 birr whereas 1,058 for non- adopters.

4.2.2.4 Off-farm income

Off-farm income means an income obtain from any activities outside the farm. Participants on off-farm activities are household members and it has been done within the same year with the main farm operation. Smallholders who had inadequate farm income are often looking additional activities for extra source of income to purchase food and farm inputs. Moreover, the extra income is also important to cover the cost of basic necessities for family members.

Therefore, households who were participated in both on-farm and off-farm activities, their income was more likely increased and managed to adopt improved wheat technology. Off-

farm income is one of the socio-economic variables hypothesized to influence the adoption decision of improve technologies. Households who were involved in off-farm jobs were able to earn more money than others, and this extra money is important to purchase improved wheat variety. Off-farm income can also overwhelm the constraint of cash or may help to finance the purchase of oxen (Million and Belay, 2004).

Indicated in the table 4.6 below from the total sampled households only 42.5 percent of the respondents were involved in off-farm activities, and most of the households were encouraged with adoption of new technologies.

From the total 120 respondents 51 households were participated in off-farm activities both adopters and non-adopters and the proportion of adopters were 22 (43%) whereas non-adopter were 29 (57%). Off-farm activities are another way of additional income generation.

Table 0-6 Households participated on off-farm activity are presented in table below.

Activities	Adopters		Non-Adopters		Total	
	Number	%	Number	%	Number	%
No of participants	37	31%	32	27%	69	58%
Chat trading	4	3%	3	3%	7	6%
Livestock trading	8	7%	3	3%	11	9%
Grain trading	4	3%	15	13%	19	16%
Daily labor	6	5%	8	7%	14	12%
Total	59	49%	61	51%	120	100%

Source: Computed from own survey data, 2009 EC.

4.2.3 Institutional Characteristics

Table 0-7 Distributions of respondents by institutional characteristics

Description	Total		Adopters		Non-adopters	
	Number	Percent	Number	Percent	Number	Percent
Participation in social activities						
Yes	50	41.7	23	46%	27	54%
No	70	58.3	36	51%	34	49%
Input availability						
Yes	54	45	28	52%	26	48%
No	66	55	31	47%	35	53%
Access to credit						
Yes	28	23.3	18	64%	10	36%
No	92	76.7	41	45%	51	55%
Description			Mean	Std. Deviation	Mean	Std. Deviation
Market distance			13.11	3.51	9.25	3.66

Source: Computed from own survey data, 2009 EC.

4.2.3.1 Participation in Social Activities

Participation in social organization is expected to have an indirect influence on adoption behavior of farmers. It links an individual to the larger society and exposes him to a variety of ideas. This exposure makes him positively susceptible towards innovative ideas and practices. Farmers having a habit of participating in various social organizations were found adopters of new technology and the reverse is true. As shown in the table 4.7 above from the total respondents 50 were found members of social organization, of which 23 (46%) and 27 (54%) are adopters and non-adopters respectively. This result was repeated by previous authors' findings Dereje (2006), Ebrahim (2006) and Rahmeto (2007).

4.2.3.2 Availability of Input

Input availability was one of the institutional variable and it is important to the farmers to adopt the new technology and to improve their production potential. It also supposed to have a direct influence to the adoption behavior of a new technology. Timely availability of inputs had a potential influence on the adoption decision of smallholder farms because most of the time inputs were not easily available as planned. Hence, farmers were complaining on luck of improved wheat varieties and seed unavailable on time, this situation were forced

the smallholders to use local varieties which has less production potential Chilot, et al, (1996).The two main and reliable sources of improved wheat variety for households were Woreda Agricultural office and farmer cooperatives. As indicated in the above table 4.7 respondents of 66 were found facing shortage of input both adopters 31(47%) and non-adopters 35(53%).

4.2.3.3 Access to Credit

Access to credit is an important economic variable on the technology adoption decision of the farmers especially for farmers facing shortage of finance to purchase agricultural inputs. There is Amhara credit and saving institution which has been working closely with farmers by providing various types of credit to purchase agricultural inputs. Moreover, farmers' cooperative was found another institution which plays an important roles to farmers by providing agricultural inputs in credit basis. To purchase agricultural inputs availability of credit were found important economic variables mostly to farmers who do not have enough amount of money to purchase it. Therefore, availability credit was create a strong relief for farmers to adopt new technology.

As depicted in the table 4.7 from the total respondents 23.3 percent had access to credit and 76.7 percent had not access to credit to purchase agricultural inputs. From the total respondents 64% are technology adopters who had an access to credit and 36% are those who did not adopt technology but they had an access to credit.

4.2.3.4 Distance

Market is the place where buyers, sellers and traders meet to buy and sale and exchange of various information about their product Techane, (2002). Households living to the nearby to market center can travel more frequently than who lives far.

Distance is also another important situational or institutional variable which influences the adoption decision of new technology. Farmers living close to the market had an access to the market services like they can easily purchase improved agricultural inputs and sale their output to market to a short distance with a better price. These were initiated the farmers' to use improved agricultural technology.

Market distance was assumed to influence adoption decision of improved wheat technology; if the market distance is short the smallholders can easily buy inputs and sale their output to the market. The mean score registered by the respondents related to access to market is presented in the above table 4.7.

In the study area, technology adopters were travelled an average distance of 11.2 km and non-adopters were travelled 14.4km to Debre markos market.

4.2.3.5 Frequency of contact with extension agent

The score for frequency of contact with extension agent was calculated on the basis of scores, score of four was given for having no contact with extension agent, score of 0 was given for those who have contact once in a week, 1 was given for those who have bi-weekly contact with extension agent, and score of 2 was given for those who have monthly contact with the extension agents and a score of 3 given for those having yearly contact with the extension agent. Accordingly, the maximum score to be achieved by a farmer was 4.

Table 0-8 Frequency of contact with extension agent

Description	Frequency	Percent
Once in a week	27	22.5
Fortnightly	24	20.0
Monthly	5	4.2
Yearly	48	40.0
No	16	13.3
Total	120	100.0

Source: Own computation 2009 EC.

As illustrated in the above table 4.8 frequency of contact with extension agent. Of the total respondents 27 had a habit a weekly extension contact, 24 of them had bi-weekly extension contact, 5 respondents had a habit of monthly contact with extension agent, 48 had a yearly extension contact and the remaining 16 had no extension contact. This result showed that frequency of extension contact has a positive significant effect on improved wheat technology adoption.

When farmers frequently contact with extension agents, the greater the possibilities of being influenced on adoption of agricultural innovations. Access to information make farmers to be aware to get better understanding on improved agricultural technologies and it facilitate change in behavior of the farmers and ultimately it leads to take the risk of technology adoption decision Teresse, (1997), Mulugeta, (2000).

4.2.3.6 Marketing Problems

Debere markos is the central market to the city dwellers and the surrounding smallholders. Farmers used the central market to purchase and sell their output. The long road is lied on from Addis Ababa to Bahirdar passing through the city which most of the farmers can

access this road to reach the central market. This long distance from their home to the city is a problems to access timely market information and they incur a lot of costs upon transaction of goods and services because of the presence of brokers. The interviewed farmers' reveal, the major marketing problem related to improved wheat production are; low selling price of output, higher input price and exploitation by middle man and lack of improved wheat varieties are the major challenges were recognized during the interview.

Table 0-9 Major marketing problems

Description	Frequency	Percent
Low selling price of products	11	9.2
High input purchase price	17	14.2
Exploitation by middle- men	16	13.3
All	76	63.3
Total	120	100.0

Source: computed from survey data 2009 EC.

As shown in the above table, major marketing problems for smallholder farmers were low selling price, higher input purchasing cost and exploitation by brokers which is accounted by 63.3 percent of the respondents and the rest were influenced by each factors such as 17 (14.2%) by high input purchasing price and 16 (13.3%) by brokers. This situation was considered as one of the reason for presence of higher number of non-adopters.

4.3 Econometric Results of the Binary Logistic Regression Model

Testing the presence of multicollinearity is the first task before conducting logit model for hypothesized variables. There are two ways of testing the presence of multicollinearity, Variance inflation factor (VIF) for association among the continuous independent variables and contingency coefficients for dummy variables. Variance inflation factor shows how the variance of an estimator is inflated by the presence of multicollinearity (Gujarati, 1995).

VIF can be defined as: VIF (Xi) =1/1-R Where Ri is the squared multiple correlation coefficient between Xi and other explanatory variables Maddala (1992). SPSS statistical tools were employed to compute the VIF values. Once VIF values are generated the R^2 values can be computed using the formula. The larger the value of VIF the more "troublesome" or collinear the variable Xi. As a rule of thumb, if the VIF of a variable exceeds 10, there is a problem of multicollinearity.

To avoid serious problems of multicollinearity, it is quite essential to omit the variable with value 10 and more from the logit analysis (Gujarati, 1995). Thus, the variance inflation factor (VIF) was employed to test the degree of multicollinearity among the explanatory variables.

As illustrated in the annexed 1 the value of VIF for explanatory variables were found very small which is less than 10, this shows the data has no problem of multicollinearity. Therefore, 12 explanatory variables are retained and used for the binary logistics regression analysis.

Similarly the contingency coefficient measures the association between various discrete variables using chi-square test to check the degree of association between discrete explanatory variables or existence of multicollinearity problem. The decision rule of contingency coefficient states that when the value approaches 1, there is a problem of association between discrete variables, i.e. Values of contingency coefficient ranges between 0 and 1, zero means no association between variables and value close to 1shows presence of high degree of association.

As indicated in annexed 2 the correlation coefficient was checked and it was found that there is no problem of association between the discrete explanatory variables. Moreover, after screening the best explanatory variables among the independent variables included in the model, multicollinearity problems was checked for both discrete and continuous variables. Therefore, it was found no problem of multicollinearity for both discrete and continuous variables. After checking of multicollinearity problem model estimation was conducted.

4.3.1 Logistic Model Estimates

Two groups of farmers were identified; (a) technology adopters and (b) non-adopter and adopters were represented by 0 and non-adopters were 1. Moreover, these models relate household and technological characteristics to the probability that a household will adopt a technology or not. Typically, factors included in the model are exogenous which are not controlled by the households.

The maximum likelihood methods of estimation is used to bring forth the parameter estimates of the binary logistic regression model and statistically significant variables are identified in order to measure the relative importance on the farmers' adoption of improved wheat technology.

Table 0-10 The maximum likelihood estimates of the logit model

Explanatory variables	Coefficient	S.E	Odd Ratios	Wald statistic	Significant level
Education	1.721	.388	0.132	19.634	.000***
Farm size	.069	.673	0.579	.011	.000***
Family size	.492	.302	1.521	2.659	.857
Crop income	.000	.001	0.999	.323	.000***
Off farm income	.516	.778	1.00	.439	.002**
Social activity	1.258	.747	0.552	2.837	.000**
Input availability	1.485	1.040	0.435	2.037	.000***
Access to credit	.144	.835	1.879	.030	.030**
Market distance	-.219	.130	0.748	2.834	.000***
Extension service	1.060	.958	3.082	1.226	.001***
Constant	-.059	2.844		.000	.000***
Omnibus Chi-square	102.214				
-2 Log likelihood	55.262a				
Cox & Snell R Square	.592				
Nagelkerke R Square	.791				
Correctly predicted	85.7				
Sensitivity	84.5				
Specificity	86.9				
	Note: ** = significant at p < 0.05; *** = significant at p < 0.01				

Source: Own computed 2009 EC.

As per the table **4.10** above the logit model results used to analysis factors influencing adoption decision of improved wheat technology. The result of the model shows that the explanatory variables: education, farm size, family size, crop income, total active household labor in man equivalent, extension agent's visit, input availability, and participating social activities, were found positively statistical significant with adoption of improved wheat technology; whereas, market distance was found negatively and significantly influence adoption decision of improved wheat technology. The detail results of statistically significant explanatory variables of adoption of improved wheat varieties are explained as follows.

4.3.1.1 Education of Household Head:

Reading and writing level of the smallholder's farmers. It was expected that better educated smallholder are a better technology adopter and the result at 1% probability test was shown positively significant. This implies that the more educated the farmers' were the more technology adopters. This is because they can easily understand and analyzed what they heard about. The value of odd ration is 0.132 indicates when smallholders have got more education, their technology adoption decision was increased by a factor of 0.132.

As per various empirical findings were conducted in different parts of Ethiopia by different author's education and technology adoption have a strong positive relation. For instance, Mulat, (1999), Assefa, (1995), Abay and Assefa, (1996), Getu, (1997), Mohammed, (1999), Techane, (2002), Hailekiros, (2007), Minyahel, (2007), Rahmatu, (2007), Tadesse, (2008), Mulugeta (2009).

4.3.1.2 Farm Size

The logit model shows, farm size of the household was an important variable on the adoption decision of improved wheat technology. This shows that when households had access to large farm area, they can produce more than household consumption and the exceeded amount of production is sold to the market and this certain amount of cash helps to purchase agricultural inputs. Moreover, the farmers could access much more information about technology adoption when they met to different individuals during transaction of good and services. The odd ration of 0.579 indicates other things being constant the odd ratio favor for adopting of new technology as the farm size increased by one hectare adoption of wheat technology was increased by the rate of 0.579.

New technology adoption and farm size have positive and significant association at less than 1% significant level and farm size was one of the important explanatory variable. This findings were confirmed by various empirical studies and was found the same result with Getahun (2004), Mesfin (2005), Rahmeto (2007) and Taha (2007).

4.3.1.3 Family Size

This explanatory variable showed that the more family members they had, the higher technology adopters which means this variable has an influence on technology adoption decision.

Farmers who had more family member were found they accomplished their agricultural activities as per the crop calendar and they were more productive than who did not have. Moreover, households who had many family sizes, were accessed new information about technology adoption from different people who had various background. Therefore, the odd ratio of 1.521 reveals when family sizes were increased in a unit, technology adoption was increased by 1.521. So that, family size and technology adoption had positive and significant relationship.

4.3.1.4 Crop Income

New technology adoption require to purchase improved agricultural varieties and this needs availability of better income at household's level to easily purchase input. Therefore, the result shows the households who had higher income were the better technology adopters and it was confirmed using the logit model analysis in which the odd ration is 0.999, as the income of the smallholder was increased by a unit, technology adoption decisions was increased by 0.999. So that, the effect of income was positive and statistically significant at 1% level.

The result of this study is consistent with research findings carried out by Degnet and Belay (2001), Kidane (2001), Getahun (2004) and Taha (2007) were reported farm income is positively influence adoption of improved technologies.

4.3.1.5 Off-farm income

The logit regression model analysis shows that participating in off-farm activities was statistically significant at 5% level. This implies that households participating in off-farm activities had a means to increasing the income of the family. Hence, families were engaged on such additional works had more income and they had better purchasing power of inputs than who did not. Therefore, farmers who participate in off-farm activities were found easily adopt new technology. Other things are remaining constant, the value of odd ratio was 1.0 and when off-farm income were increased by a unit, technology adoption was increased by 1.0. This implies that off-farm income and technology adoption has a positive correlation at 1% significant level.

4.3.1.6 Input Availability

Availability of inputs had positive and statistically significant ($p < 0.01$) effect on new technology adoption decision of the households. The model result shows that those farmers who got input on time were more likely adopter of improved wheat variety than who did not access. In the reverse, input unavailability on time forces farmers to use secondary or recycled seeds this by itself could not provide better yield. The odds ratio of 0.435 shows that, other explanatory variables kept constant, the odds ratio in favor of adopt improved wheat technology was increases by a factor of 0.435.

Agricultural input availability was found positively influence to the probability of improved wheat technology adoption and it was significant at less than 1% level.

This research finding is the same as the results were found by the previous researchers such as Chilot, et al, (1996), Mahdi (2005), and Mekonnen, (2007). Therefore, this implies that input availability and farmers' potential to use improved varieties encourage to adopt the new technology when it was compared to the non-adopters.

4.3.1.7 Access to Market

The result indicates that access to market has significant ($p < 0.01$) and negative influence on adoption decision of improved wheat technology. This implies that improved wheat technology adoption were increased while farmers were easily accessed the market. Moreover, easily market accessibility was important to purchase and sale their input outputs and farmers were easily accessed market information and they can purchase agricultural inputs. Hence, the odds ratio of 0.748 for market distance reveals that, other things being constant the odds ratio for adopting of improved wheat technology increases by a factor of 0.748 as the market distance decrease by one kilometer.

The t-test statistical analysis showed there is a mean difference between technology adoption and market distance. Technology adoption decision of smallholders were decreased when distance of the market is getting far.

This study was supported by various authors and were found market distance have a negative relationships with adoption of technology. For instance, Mergia (2002), Techane, (2002); Asres (2005); Girmachew, (2005), Mahdi (2005), Yishak,(2005), Ebrahim,(2006), Yalembirhan, (2007), Minyahel, (2008), Taha (2007) and Daniel,2008).

4.3.1.8 Extension Service

The regression analysis indicates that participating in extension service is positively and statistically significant at1% level. This implies that frequency of participation of farmers on on-farm demonstration, farmers' training, advisory service; farmers' field day and visits are very important factors in utilization of information on adoption of improved wheat by farmers. Hence, farmers' participation in extension service plays vital role in agricultural information utilization on adoption of wheat technology. The probable reason for this was farmers who had active participation in all extension activities were well informed about the benefits of wheat production technology, which motivated farmers to utilize the technology. When farmers practically observe a new practice they can consider the advantage and disadvantages of the new technology. This can facilitate adoption and helps them to implement the new technology properly. Other things held constant, the odds ratio in favor of decision on adoption of improved wheat technology was increased by a factor of 3.082 for a unit increase of extension services.

This result is consistence with the findings reported by Legesse, (1992), Teresse, (1997), Mulugeta, (2000), Testate and Alamu (2001), Tesfaye et.al. (2001), Asres (2005), Daniel, (2008) and Bekele, (2008) revealed that there was significant and positive relationship between frequency of contact with extension agent and adopting of improved technologies.

4.3.1.9 Social Activity

The regression analysis reveals participating in social and community activities was positive and statistically significant at 1% significant level. If the smallholders have a habit to participate in various social works and meetings, they can easily have an information about the new technology and do by themselves. Social activities are edir, ekub, and group works on various agricultural activities, these accomplishments was made smallholder farmers to enhance their thought related to new technology adoption. Other things held constant, the odds ratio in favor of decision on adoption of improved wheat technology was increased by a factor of 0.552 for a unit increase of social participation per a season.

4.3.1.10 Access to Credit

This explanatory variable was the one and the most important independent variable which was one of the criteria to make a decision on technology adoption at smallholder level. As per the logit model, regression analysis was positive and statistically significant at a level of 5%. Easily accessing credit to purchase agricultural input help most of the smallholder farmers because majority of the farmers are poor in income source and it made them relax during input distribution to each farmers in credit basis. In Amhara regional state in particular, Gozamen district has different credit provider institutions such as Amhara Credit and Saving Institution (ACSI) and farmers based cooperatives, they were established to provide inputs for farmers who did not have cash on time to pay to purchase input of improved wheat technology. Having this other explanatory variables were remain being constant, the odd ratio showed the decision of adoption of improved wheat technology enhanced by a factor of 1.879 for a unit increase of access to credit in a season.

CHAPTER 5: SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Summary

The government of Ethiopia has been implementing growth and transformation plan in order to boost the national economy. Agricultural production has been planned to have enormous contribution to overcome the problem of food security, shortage of export earnings, and provision of employment creating incomes and improving the livelihood of the population. Having these facts, participating and implementing a sustainable and knowledge based utilization of improved technologies are critical to enhance growth and productivity in general and particularly agriculture is one of the focusing area.

Wheat is the second crop next to maize in terms of production and area coverage in Ethiopia and it is playing a critical role on the reduction of food security problem throughout the country and different researchers has provided substantial and better attention on this crop. This situation makes to transfer improved wheat technology to smallholder farmers' level for the enhancement of productivity. However, the availability of potential land could not execute as planned because of several political, economic and social impediment consequently, only small proportion of the farmers adopted these technology. Therefore, it is appropriate to identify the specific factors affecting the adoption decision of smallholders and determine the current rate and pattern of adoption of technologies and this will be expected to suggest possible area of intervention for improving the proficiency of agricultural technology generation and dissemination.

The study was conducted in Gozamin Woreda East Gojjam Administrative zone, Amhara regional state. It was selected on the basis of wheat growing potential. The main objective of this study was to determine factors affecting adoption decision of smallholders and to see adoption level of farmers in the study area.

A sampling procedure was applied to draw the required number of sample units for the study. In the 1st stage, three potential wheat producing *Kebeles* were selected purposely in Gozamen district. In the 2nd stage using the sample frame of the sampled *Kebeles*, list of sample farmers were selected for the interview.

Data were obtained from 120 randomly selected respondents using personal interview, Focus group discussion (FGD), individual discussion and researcher's personal

observations. Moreover, the study was used different secondary sources of data like, different related literatures, MOARD, Journals and articles.

The collected data were analyzed and presented in quantitatively using different statistical methods such as frequency, percentage, and tabulation. Qualitative data were analyzed using explanation, interpretation, summarizing of ideas and concepts. The logit econometric model was used to estimate the effect of hypothesized independent variables on the dependent variables, probability of adoption and SPSS software package were employed for statistical analysis.

The study area adoption level with regards to wheat technology was registered that, the sample size of the study were 120 respondents. Among the total interviewed farmers, 59(49%) were adopters and 61(51%) were non-adopters. From the total interviewed households 99% was male respondents and the remaining 1% was female. As the survey result shows the percentage of non-adopters are higher than adopters. This is because of shortage of continuous extension services providing to smallholder farmers.

Factors that affect the adoption decision of improved wheat technology for both adopters and non-adopters were found significantly different, of which some of the variables were demographic, socio-economic, institutional such as education, family size, farm size, off-farm income, availability of input, availability of credit, farm income, extension visit, and market distance.

Finally, the output of the model showed the independent variables like education, farm size, family size, crop income, input availability, credit availability, off-farm income, contact extension agent, and social organization were important variables which had positive and statistically significant on adoption decision of improved wheat technology, whereas age and market distance were found to have significant and negative influence on the adoption decision of improved wheat technology.

5.2 Conclusion and Recommendations

The government should take in to consideration the above important variables when various policies and programs is designed to implement for the enhancement of agricultural productivity in the country in general and in the study area in particular specially with regards to the types of innovation related to improved wheat technology. The following recommendations are forwarded in this study area based on the above findings:

- ✓ The current ineffectiveness of access to the agricultural extension service in the study area was highlighted as a major impediment to improved wheat production and productivity. Therefore, to effectively implement the extension package program with proper linkage of stakeholders will promote agricultural development. In addition; frequent training must be organized for development agents and supervisors about existing and newly developed improved technologies and new methods of agricultural practices. This is expected to develop the confidence of the agents to transmit appropriate and useful information to farmers. Extension services need to be strengthened especially where lack of knowledge is cited as a hindrance to adoption.
- ✓ The study found that poor input availability. Therefore, source of wheat variety is very limited and farmers have no alternative variety to choose, this results to farmers to prefer the cheaper and more readily available recycled seed. However, to achieve this goal the government should provide the necessary incentives and support the public and private seed companies and improvement of infrastructure development.
- ✓ In the study area there are formal credit provider institutions, However, the interest rate was too much and it was not affordable at farmers level to payback their loan. This situation by itself was an impediment to adopt new technology at smallholder farmer's level. Therefore, the government should alleviate this problem through providing a special way of credit scheme to the farmers to purchase inputs with a reasonable amount of interest rate and after production the government should create linkage and network access to market to easily sale their products with reasonable price.
- ✓ Challenges on the adoption rate of improved wheat technology are increasing and will require the intensive efforts of farmers, researchers, extension agents, seed companies, and other stakeholders. This calls for partnerships in the implementation of such programs.
- ✓ The participation of women in agricultural activities in general and in adoption of improved wheat technology in particular is low in the study area. Given the proportion of women in the society and their role in agriculture they should be encouraged to participate in agricultural extension. Hence, extension organization operating in the area should involve women in education and training programs.

- ✓ The government should work closely with smallholder farmers in order to establish well-constructed and easily accessible roads to easily deliver their product to the market.

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Annexes

Annexed 1 Variance inflation factor for explanatory variables

Variables	Tolerance (R)	Variance Inflation Factors (VIF)
Education level	.719	1.391
Land holding	.550	1.818
Family size	.738	1.355
Crop income	.802	1.247
Off farm income	.517	1.933
Activities in social organization	.909	1.100
Input availability	.569	1.757
Access to credit	.875	1.143
Distance in kilometer	.472	2.118
Extension service	.758	1.319

Source: Own computation 2009 EC.

Annexed 2 Contingency coefficients for dummy variables of multiple linear regression

Description	Adoption	Education	Land holding	Crop income	off farm income	Input availability	Distance in kilometer	Extension service
Adoption	1	.597**	.344**	.317**	.096	.119	-.481**	.354**
Education level		1	.212*	.214*	.255**	-.389**	.232*	-.340**
Land holding			1	.003	.097	-.324**	.567**	-.257**
Crop income				1	.115	-.126	.234*	-.139
Off farm income					1	-.219*	.149	-.075
Input availability						1	-.525**	.416**
Distance in kilometer							1	-.239**
Extension service								1

**. Correlation is significant at the 0.01 level (2-tailed)

*. Correlation is significant at the 0.05 level (2-tailed).

Source: Own computation 2009 EC.

Annexed 3 Questioner

Formal survey questionnaire on determinant of improved wheat technology adoption

Interview schedule

Identification Number (code) ----------

General Information

Date of interview……

Name of the respondent: ----------

PA (Peasant Association):----------

Woreda: ----------

Village: ----------

Name of the Interviewer: ----------Sign. ----------

Instruction

- Introduce yourself to the respondent and ask his/her permission politely
- Tell to the respondent about the purpose of the study
- Check that all questions are asked and responses are filled accordingly

1. Characteristic of the household head.

1) Name of respondent:----------
2) Sex of Household Head: 1. Male 2. Female
3) Age of Household Head:
4) Marital Status of the household head: 1. Married 2. Single 3. Divorced 4. Widow 5. Widower
5) Education level 0= illiterate 1= Read & write 2=primary school (grade1-6) 3= secondary school (grade 7-10) 4= College and above
6) Farming experience of the household head in years (General farming experience) ------Years.
7) Farming experience of the household head in wheat package in years
8) Have you ever served as contact farmer in the wheat package program? Yes 2. No
9) If yes, what are the reasons? 1. Better educational background 2. Progressive farmer 3. Others specify
10) Social status of the household head 1. Village government Chairman 2. Religious Leader 3. Village Government Committee Member 4. Others (specify)
11) Type of house: 1. mobile house 2. Corrugated iron roofed

2. Household resources endowment

1. Total land holding 1qada=0.25 Ha
2. Total Cultivated area————————
3. Livestock ownership (TLU).

N	Category	Number
1	Cows	
2	Oxen	
3	Heifers	
4	Calves	
5	Bulls	
6	Goats	
7	Sheep	
8	Poultry	
9	Donkey	
10	Camel	
11	Others(specify)	
	Total	

4. Socio-economic characteristics of the household

1. Household Family size
2. Household Active labor force they are engaged in wheat production activities.

No	Age category	Number (#)		*Activities engaged in	
		Male	Female	Male	Female
1	1-14 years				
2	15-64 years				
3	>65 years				

* Wheat package activities includes: 1) Land preparation 2) Plantation 3) Weeding 4) Cultivation 5) Harvest 6) Transportation 7) Storage 8) Marketing 9) All 10) Others

3. Did you face labor shortage problem in wheat production? 1) Yes 2) No
4. If yes, how do you solve labor shortage problem? 1) By hiring 2) asking for cooperation 3) All 4) Others (Specify) ----------

5. Household's annual farm income from sale of crops in 2007 E.C

No	Commodity	Annual harvest(qt)	Consumed (qt)	Amount sold(qt)	Unit price	Total price
1	Wheat					
2	Teff					
3	Maiz					
4	Barley					
5	Faba bean					
6	Onion					
7	Cabbage					
8	Tomato					
9	Other specify					
10	Total income					

6. Annual income from sale of livestock in 2007 E.C

No	Animal type	Number sold	Unit price	Total price
1	Oxen			
2	Cows			
3	Heifers			
4	Bull			
5	Calves			
6	Goats			
7	Sheep			
8	Donkey			
9	Camel			
10	Poultry			
11	Others			
	Total income			

5. Households off-farm activities participation

7. Household's participation in off-farm activities per month?

No	Who participate	*Type of activity	Duration (for how long)	Daily earning	Total income
1	Husband				
2	Wife				
3	Elder son				
4	Elder daughter				
	Total HH income				

* Type of activity 1) Chat trading 2) Livestock trading 3) Grain trading 4) Hiring of Donkey cart 5) other (specify) ----------

1. For what purpose do you use the income from off-farm activities?

   Purposes(in order of its share of income) 1) To purchase cloths for the family 2) To pay school fee 3) To purchase farm inputs 4) To settle debts 5) To buy food grains for the family 6) Others(specify)----------

6. Social participation

1. Are you member of any social organization like formal, informal, religion, cooperative 1) Yes 2) No
2. If yes, when you first became member? Year: ----------
3. What services you are getting being member of the cooperative society
   1. Credit in cash 2. Improved wheat seed (Freely, on credit base) 3. Farm inputs (Fertilizer, chemicals, others) on credit base 4.Water pump service
   5. Market information 6.Marketing of wheat harvest 7. Other (specify) ----------

7. Adoption of improved wheat Technology.

1. Have you heard of improved wheat variety? 1) Yes 2) No
2. From whom you heard about improved wheat variety?

   1) MoARD 2) Private investors 3) Individual producers producing improved wheat in the area 4) NGO 5) Cooperative society 6) Neighbor farmers 7) others (specify) ----------
3. Have you ever grown improved wheat variety(s)? 1) Yes 2) No

4. If yes, please provide the following information on wheat varieties

No	Varieties	Year of 1st grown	When stopped using the Varity	Reason for stopping
1	Bolo(HAR-3816)			
2	ETBW-4621(Qulqulluu)			
3	Hitosa (CHEN/ALTAR-84)			
4	Denbi (AJAIA/ BUASHEN)			
5	Tate (CD94523)			
	Other specify			

* Reason for stopping 1) The coming of better variety 2) Unavailability of seeds 3) High purchase price of the seeds 4) others (Specify) ----------

5. If the answer of Q.30 is No, which of the following are the reasons for not growing?

1. Shortage of capital 2) lack of improved seed 3) High cost of production 4) Lack of experience 5) lack of extension advice 6) Other (specify) ----------

6. How did you sow the seeds? 1) broadcasting 2)Line planting 3)- Others specify

7. Which improved wheat variety you prefer and what are your preference criteria?

No	Variety name	Preference rank	*Reason for preference
1	Bolo(HAR-3816)		
2	ETBW-4621(Qulqulluu)		
3	Hitosa (CHEN/ALTAR-84)		
4	Denbi (AJAIA/ BUASHEN)		
5	Tate (CD94523)		
	Other specify		

*Reasons for preference1) Better yield advantage 2) Good straw 3) Good bulb color 4) Early mature 5) higher market demand 6) Better price 7) Better storability 8.) Others (Specify) ----------

8. In general, what criteria you consider to select among improved wheat varieties? (Give rank to the criteria)

No	Criteria	Rank
1	Better yield advantage	
2	Good residue size	
3	Earliness	
4	Higher market demand	
5	Better price	
6	Food Taste	
7	Drought resistance	
8	Disease resistance	
9	Better storage time	
10	Suitability for seed production	

9. Sources of seed for the following improved wheat varieties

Varieties	Source				
	Market	MoA	Research centers	Individual seed producers	NGO
Bolo(HAR-3816)					
ETBW-4621(Qulqulluu)					
Hitosa (CHEN/ALTAR-84)					
Denbi (AJAIA/ BUASHEN)					
Tate (CD94523)					
Other specify					

10. Did you use improved variety last two seasons? 1) Yes 2) No

11. If not what was the reason?

1) I do not know the recommended rate 2) The recommended rate does not fit with my financial capacity 3) The recommended rate is not superior than our own practice 4) It is labor intensive 5) It does not fit with physical environment (soil, RF pattern) 6) It consumes more time and requires skill 7) Others (specify)----------

12. Generally, what are the major problems in improved wheat production? (Rank them in order of importance)

1) High production cost 2) Low selling price of wheat 3) Exploitation by middle men due to lack of market information and poor bargaining power 4) Shortage of improved seed 5) Lack of credit 6) Lack of enough extension support 7) Lack of enough knowledge and experience on wheat package 9) other (specify) ----------

13. In your view, how do you see the price of inputs used for wheat production?

    a. Very expensive, b. Expensive c. Medium d. less expensive e. Not expensive

14. Have you ever accessed credit to purchase improved wheat varieties?

    1. Yes, 2. No

15. Which of the following problems did you face with inputs provided by extension agents?

    a. Low supply, b. Not timely, c. Poor quality, d. Expensive, e. other specify

8. Market related variables

1. Which market centers are accessible to you?

	Name of the market	Distance(in km)

2. How was the selling price of wheat last year (2007 E.C)? ----------birr/kg or qt
3. In your view, how do you see the selling price of wheat?

   a. Very low. b. Medium, c. Good, d Very good

4. What do you think about the major marketing problems with regard to wheat marketing? (Rank them in order of importance)

   Low selling price 2) High input purchase price 3) Exploitation by middle- men 4) other (Specify) ----------

9. Extension services

1. Do you get advisory services from extension agents on wheat production?

   1) Yes 2) No

2. If yes, how frequent you have contact with the extension agents during the production season?

   1) Once in a week 2) Fortnightly 3) Monthly 4) Yearly 5) Never 6) others (Specify) ----------

10. Knowledge on wheat technology Package

1. Names of the improved wheat varieties recommended? 1. ––2.———3.—— 4.———
2. Recommended method of Sowing? 1) 2)
3. How many times weed control has to be done in one season? 1. 1 times, 2. 2 times, 3. 3 times
4. At what stage of crop growth the weeding has to be done