2021-08

Factors Affecting Farmers Adoption of Improved Wheat Technology in Kuarit Woreda; West Gojjam Zone Amhara Region, Ethiopia.

Mehariw Getaneh

BAHIR DAR UNIVERSITY

COLLEGE OF BUSSINESS AND ECONOMICS

DEPARTMENT OF ECONOMICS

THESIS ON:

FACTORS AFFECTING FARMERS ADOPTION OF IMPROVED WHEAT TECHNOLOGY IN KUARIT WOREDA; WEST GOJJAM ZONE AMHARA REGION, ETHIOPIA.

BY

MEHARIW GETANEH

JUNE, 2021

Bahirdar, Ethiopia

BAHIR DAR UNIVERSITY
COLLEGE OF BUSINESS AND ECONOMICS
DEPARTMENT OF ECONOMICS

FACTORS AFFECTING FARMERS ADOPTION OF IMPROVED WHEAT TECHNOLOGY IN KUARIT WOREDA; WEST GOJJAM ZONE AMHARA REGION, ETHIOPIA.

BY: MEHARIW GETANEH

A THESIS SUBMITTED TO, THE DEPARTMENT OF ECONOMICS, COLLEGE OF BUSINESS AND ECONOMICS, BAHIR DAR UNIVERSITY
IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE IN ECONOMICS (DEVELOPMENT ECONOMICS)

ADVISOR: DAREGOT BERIHUN (Ph.D.).

JUNE, 2021

BAHIR DAR, ETHIOPIA

APPROVAL SHEET

BAHIR DAR UNIVERSITY

COLLAGE OF BUSINESS AND ECONOMICS

DEPARTMENT OF ECONOMICS

The Thesis Titled FACTORS AFFECTING FARMERS ADOPTION OF IMPROVED WHEAT TECHNOLOGY IN KUARIT WOREDA; WEST GOJJAM ZONE AMHARA REGION, ETHIOPIA€. Is Approved For The Degree Of Masters Of Science In Development Economics.

By:

MEHARIW GETANEH

Approved by the Board of Examiners

Chairperson, School of Graduate committee   Signature   Date

Thesis Advisor   Signature   Date

Internal Examiner   Signature   Date

External Examiner   Signature   Date

DECLARATION

I, the undersigned, declare that this thesis entitled €factors affecting farmers• adoption of improved wheat technology in kuarit woreda; west gojjam zone amihara region, Ethiopia., is my original work and has not been presented for a degree or any other purpose in any institution and all the sources used for the thesis have been dully acknowledged.

MEHARIW GETANEH

JUNE, 2021
BAHIR DAR, ETHIOPIA

ACKNOWLEDGMENT

First and for most, I would like to give my glory and praise to the Almighty GOD for his invaluable cares and supports throughout the course of my life and helped me since the inception of my education to its completion and enabled me to achieve my career. Next, I am grateful to appreciate my advisor Dr. Daregot Berihun. He has taken all the trouble with me while I was preparing the paper. Especially, his valuable and prompt advice, tolerance, guidance and useful constructive corrections and insight full comments, and encouragement throughout the paper are highly appreciated. I also would like to express my heartfelt gratitude to my dear sisters Bizuayehu Alemu, who have encouraged and supported me in idea and material which was valuable for my carrier.

Last, but definitely not the least my deepest thanks go to my wife Yezina Wubetu who encouraged and support me for the last two year. Their support, encouragement, dedication and many priceless scarifications contribute to the successful completion of this thesis and study,

LETTER OF CERTIFICATION

This is to certify that Mehariw Getaneh has carried out his thesis on the topic entitled •factors affecting farmer•s adoption of improved wheat technology in kuarit woreda; west gojjam zone Amihara region, Ethiopia€ This work is original in nature and suitable for the award of Masters of Science (MSC) in Development Economics.

DAREGOT BERIHUN. (Ph.D.).

JUNE, 2021

Table of Contents

List of table

List of figures

List of Abbreviations

ADLI	Agricultural Development Lead industrialization
ARD	Agricultural Research Development
BOPED	Bureau of Planning and Economic Development
CIMMYT	International Center of Maize and Wheat Research
CSA	Central Stastiscal Authority
DAP	Di Ammonium Phosphate
EARO	Ethiopian Agricultural Research Organization
EIAR	Ethiopia Institute of Agricultural Research
GDP	Gross Domestic Product
GTP	Growth Transformation Plan
IAR	Institute of Agricultural Research
LDCs	Less Developed countries
NVRC	National Variety of Research Community
PADEP	Peasant Agricultural Development Project
SG	Sasakawa Global
SSA	Sub-Saharan Africa
USA	United States of America

ABSTRACT

Agriculture in the Ethiopian economy prominently is the largest contributor to 50% of Gross Domestic Production (GDP), employs 80% of the population's employment and the main incomegenerating sector for the majority of the rural population. Cereals, pulse and oil seeds are the main crops grown in Ethiopia accounted for about 42.5% of the total agricultural GDP.Wheat (Triticum aestivum) is one of the most cereal crops grown in Ethiopia. Ranking fourth in total crop area and production. However, wheat yield is low and unstable due to several technical and socio-economic constraints. Therefore, adoption and wider use of improved wheat varieties is of paramount importance in alleviating the problems and increasing yield. This study attempted to empirically examine factors affecting adoption and intensity of use of improved wheat technologies in quarit woreda, west gojjam Zone. The study was based on the data collected from randomly selected farm household's level. Six kebele selected from the woreda and a total of 156 selected households were interviewed. The survey was conducted by administering structured questionnaire during January 2021. In addition, secondary data collected from appropriate sources were used to substantiate the primary data of the study area. Double hurdle model were used to identify factors affecting adoption and intensity of use of improved wheat technology. Fifteen explanatory variables were included in the model out of which seven were found to be significant. Fertilizer use, income and credit were the main important factors influencing adoption and intensity of use of improved wheat varieties. Descriptive and econometric analyses were used to analyze data. The results show that about 53.09% and 46.91% were adopters and non-adopters of the wheat technology respectively. The economic investigation using the partial budgeting method and price sensitivity analysis substantially ascertain the profitability of the adopted improved wheat technologies and the validity of the adoption of recommendations.

Key words: Wheat technology, adoption, and intensity.

CHAPTER ONE

1. Introduction

Agriculture is a key to Africa•s future. The continent has a large amount of the world•s arable land, and over half of the population is employed under the agricultural sector and it is the largest contributor to the total gross domestic product (GDP). Know day Africa is producing too little food and less value-added products, and productivity has been broadly stagnant since the 1980s (AGRA, 2018). All of the hungry live in low-income countries, and many of them make the necessary headway towards the structural transformation of their economies. Such successful transformation is driven by agricultural productivity growth which enables the peoples to shift from agriculture towards manufacturing, industry, and increase in per capita income and minimize in poverty and hunger (Adugnaw Anteneh & Dagninet Asrat, 2020)

Agriculture is the mainstay of the Ethiopian economy. It is 80% of the total employment and contributes about 41% of GDP and 86% of exports (Bingxin et al, 2011). Rather than its contribution as the main income-generating sector for the majority of the rural population, it serves as the main source of household food consumption (Stamia, 2009).
The agricultural sector in Ethiopia is dominated by continuation, low input, low output and rain-fed farming system. The purpose of improved seeds is quite limited despite government efforts to encourage the adoption of modern agricultural system and intensive agricultural practices. Therefore, improving the productivity, profitability, and sustainability of smallholder farming is the main pathway out of poverty in using agriculture for development (Word Bank, 2008). One of basic way to increase agricultural productivity is through the introduction of improved agricultural technologies and management systems. Adoption of new agricultural technology such as high yielding varieties stimulates the change from low productivity subsistence.

Agricultural research and development, in wide-ranging contributes to agricultural growth and total factor productivity by increasing crop and livestock yields through development of new technologies and increased technological diffusion and adoption (Nicostrato DP, Mark WR, 2015). Therefore, investment in agricultural research is one of the key priority areas of governments in developing countries that aimed at improving production and productivity of agriculture which play crucial role in the development of the entire economy.

Wheat is one of the strategic crops that is given due stress both in the country's GTP-I and GTP-II as well as in the agricultural transformation agenda of the country. Increasing its production and productivity has been main strategic goal of research and extension institutions in the country. Despite several efforts that have been made to achieve self sufficiency in wheat, the country is still importing large volume of wheat every year (FAOSTAT, 2014).

Wheat is vital cereal crop constituting significant proportion of smallholder crop production in Ethiopia. Significance of wheat to smallholder farm households and to the entire economy manifested through large hectare of land allocated to wheat production, significant proportion of households that are engaged in the production of wheat and total volume produced every year. For the year 2014/15, the whole amount of land allocated for wheat production is 1,663,845 ha and the total volume of wheat produced in the same year is about 4,231,588 tons (CSA, 2014/2015). Ethiopia is the second largest wheat producer in Sub Saharan Africa next to South Africa. Wheat is one of the main staple crops in the country in terms of both production and consumption. In terms of caloric intake, it is the second most important food in the country behind maize (FAO, 2014). Despite the strategic importance of wheat to the national economy, the average productivity level is still very low which could be attributed to several factors among which farmer limited access to high yielding wheat varieties is the most important one (Kelemu, 2017).

Ethiopia's wheat production covers only 75% of the national demand and the remaining 25% of the wheat is obtained through imports (Eyob et al., 2014). This indicates that still the country is under food imports, which requires high investment in agriculture sector to close the demand gaps. According to Misgana (2016), to minimize, wheat yield imports and cut down wheat national demand deficiency, conducting considerable scientific research works that can contribute to positive impact on wheat production and productivity is a critical issue. There are a lot of wheat varieties used by farmers on different regions of the country. Studies to develop improved wheat technologies have been oversee since the 1950s with the assistance of international research centers and foreign donors resulting in several improve wheat varieties and management practices (Tsegaye and Bekele, 2012). Crop variety improvement, demonstration practices and scaling up of the best practices are continuing over years through various government bodies, NGOs, research institutes and universities (Tsegaye and Mulugeta, 2012; Misgana, 2016). Facilitating growers to make decisions in choosing the right varieties, which is compatible to the agro-ecological condition of the environment is an action still requiring a lot of commitment to work on it. Evidence shows that no country achieves food security depending only on food aid rather majority of them reduced the problem of food deficit through making high investment on agricultural activities. That is why considerable amount of attention is given to agricultural sector enhancement and growth in Ethiopia. There is a need to develop farmers on appropriate technologies to achieve agricultural growth. According to Tolossa (2014), increasing yield and meeting the high demand has become the focus of the Ethiopian government's agricultural policy and extension activities.

1.2. Statement of the problem

Wheat is the most broadly grown cereal crop in the world, with an ever-increasing demand. It plays a basic function 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 (Srinivasa, 2014). Wheat is grown on more than 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 essential since the diets of human beings on every continent rely on this staple crop. As per FAOSTAT (2014) at the present 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 correspondingly. To these closing stages, the average production of wheat has been rising by 1.16 percent in the world. According to (Hundie et al, 2000) even if the area exposure of wheat in Ethiopia is higher, the mean national yield is (2.1ton/ha) 19 percent and

49 percent below the recent yield for Africa and the World respectively. This relatively low mean national yield may be to some extent attributed to the low level of adoption of improved wheat production technologies.

Wheat is a staple food crop for mainly households in rural and urban areas in Ethiopia. However, wheat yield is low and unbalanced due to several technical and socio-economic constraints. Weed competition, low or declining soil fertility, diseases, particularly rust, in appropriate use of agronomic practices such as seeding rate, sub-optimal fertilizer application and herbicide use are some of the major technical constraints. some degree of supply of seeds of improved varieties, high price and unavailability of augmenting technologies like fertilizer and herbicides in required quantity and at required time, and inadequate cash or credit for purchase of inputs are the major socio-economic constraints (kenea, 2000)

The distinctive feature of adoption mainly depends on the available agricultural technologies. These available technologies are disseminated through governmental and non-governmental organizations involved in agricultural development programs. Farmers learn about new technologies from various organizations, programs and projects dedicated to research, extension and rural development. Hence, the level of adoption of these improved agricultural technologies in respect to the use of improved practices and improved agricultural inputs by the farm households at the required recommendation are paradoxical.

The study conducted by (Itana, 1985), (Chilot et al, 1996) and (Tsefaye et al, 2001) their rate and intensity of adoption as well as new technologies on yield of wheat and farmers income. But they do not understand the adoption of agronomic wheat technology adoption practice the in the study area is remote area highland. This study partially fills in the existing knowledge and information gaps framers wheat technology adoption.

1.3 Objectives of the study

1.3.1 General objective

The general objective of this study was to examine the wheat technology adoption and identify the main factors that affect farmers to adopt improved wheat technology in quarit woreda.

1.3.2 Specific objective

1. To identify major factors that influences the adoption of improved wheat technology;
2. To study the intensity of improved wheat technology adoption by smallholders farmers;

1.5 Research Questions

1 To what extent intensity of improved wheat technology adoption by smallholder•s farmers?
2. What are the major factors that influence adoption of improved wheat technology in the study area?

1.4 Significance of the study

Detail accepting of farmer•s adoption behavior of wheat technologies is fundamental and obligatory 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 predictable 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 require in particular and to bring change in Agricultural sector in general. Also this research result will benefit development planners, other researchers and finally the farmers.

In addition to this, the research output has tried to identify the factors that affect improved wheat technology adoption at household level.

1.6 Scope and Limitation of the Study

The study aims assessment the factors that affect 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 seven 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, chapter five conclusion and recommendation and the last is reference.

CHAPTER TWO

LITERATURE REVIEW

2.1 Theoretical Literature Review

2.1.1 Wheat Production Technology Developments and Dissemination

The agricultural technologies are generated, established and evaluated by agricultural research centers on farmer's field. After on-farm authentication and proper evaluation, the National Variety Release Committee (NVRC) officially releases varieties. Package of recommendations for farmers usually developed by the respective agricultural researchers and extensions annual

The Ethiopian Agricultural Research Organization (EARO) former Institute of Agricultural Research (IAR) has generated a number of varieties, developed agronomic and crop protection practices. A total of 58 wheat varieties have been released since the start of wheat research in the 1950•s. Fourteen of these are durum wheat while the remaining 44 are bread wheat varieties. Fifteen bread wheat varieties are presently under production.

Agronomic and Crop Protection Recommendations for wheat

Sowing Date

Sowing dates commonly depend on location, soil type, onset and distribution of rainfall and the variety to be used. It must be noted that untimely planting (early or late) is likely to result in reduced yield. Late maturing varieties require early planting relative to early varieties.

Seeding Rate

Seeding rate is 175 kg/ha for semi-dwarf varieties with low tailoring capacity, broadcasting seeds and covering by local plow. The recommended seeding rate is 150 kg/ha for intermediate and semi-dwarf varieties with good tillering capability.

Fertilizer Rate

Fertilizer rates vary from location to location depending on the fertility status of the soil, cropping sequence, varieties used and the input output prices. The whole amount of DAP should be applied at sowing whereas the nitrogen rate is split applied 1/3 at sowing and 2/3 at mid-tilling (35-40 days after emergence). For Hula woreda the extension recommendation is 100 kg/ha of DAP and 100kg/ha of Urea.

Crop Rotation

Crop rotation of wheat with non-cereal crops could provide several benefits to the subsequent wheat crop. Improved soil structure, added organic matter and reduced weed, disease and insect pest problems are some of the advantages of crop rotation. The soil fertility level could also be enhanced if the preceding crop is a nodulating leguminous crop that could make a symbiotic association with Rhizobium bacteria that fix atmospheric nitrogen. Wheat grain yield after faba bean has increased by 1.4 quintal ha^{-1} or by 75% compared to continuous wheat. Experiments showed that a precursor oil crop, mustard, increased wheat grain yield substantially (EARO, 2001).

Weed Management

Seedbed should be free of weeds at seeding. This can be facilitated by uprooting the weeds, plowing or harrowing, or by applying total weed killer herbicides before seeding.

Practicing crop rotation with non-cereals would facilitate the control of grass weeds such as Bromus spp., Phalaris spp., Setaria spp. and Avena spp. Use of clean seed reduces emerging weed population in wheat fields. Twice hand weeding (20-25 and 55-60 days after emergence) is recommended if labour is available. If labour is limiting, herbicides are recommended to use in wheat. Puma Super is recommended against grass weeds in wheat at 1litre ha^{-1} rate, 2,4-D and Starane-M are recommended against broadleaf weeds at rate of 1litre ha^{-1}. Depending on the growth stage of the weed and the prevailing weather conditions mixed Puma Super and Starane-M can be used to control both grass and broadleaf weeds.

Storage

Different storage pests can attack wheat grain while in storage. Proper drying of grains is necessary before putting grains in storage facilities. Grain store should be constructed in a way that it is rodent and bird proof and must be free of pests before storing grain. It is advisable that the storage facility is placed in a well-ventilated area.

Pest Control Practices

The best and economical way of disease control or prevention is use of resistant/tolerant wheat varieties. Alternative methods of pest control could be used as crop rotation, fallowing of land and chemical control option.

To control wheat rusts, spraying 1/2 liter Tilt 250 EC mixed in 150-200 litter water/ha when disease severity is 5% or more is recommended. The second spray may be done 3-4 weeks later if necessary. Spraying of 1 litter Baylaton mixed in 150-200 liters of water/ha, helpful when disease severity is 5% or more.

Technology Dissemination

Agricultural extension services that stimulate the adoption of recommended farming techniques and practices are prerequisite for the successful technology diffusion.

Agricultural extension in Ethiopia began in the early 1950s with the establishment of the Alemaya College of Agriculture. In about a decade in the early 1960s the extension function of the college was transferred to the Ministry of Agriculture that has more or less followed the conventional approach in providing extension service. Peasant agriculture gained more attention during the third five-year development plan (1968-73) and comprehensive agricultural projects like Chilalo Agriculture Development Unit (CADU) and Wolaita Agricultural Development Unit (WADU) were initiated (Tenasi, 1985). These projects encompass the development of infrastructure services such as roads and water, and were thought to serve as models to be expanded to other areas later. The high financial demand of the comprehensive packages led to the initiation of the minimum package projects in the 1970s under the Extension and Project Implementation Department (EPID). The minimum package extension approach comprise inputs (e.g. fertilizer, seed), credit and extension advice. This project continued to operate in two phased Minimum Package Program 1 (MPP1) and Minimum Package Program 2 (MPP2). The Peasant Agricultural Development Project (PADEP) was launched in the 1980s.

The basic aim was to promote agricultural development by concentrating on inputs, credit and marketing services and building infrastructure in geographically delimited areas.

Integrated rural development projects were considered as the most effective tools to bring about maximum impact with a short period of time.

Within the framework of the Agricultural Development-Led Industrialization (ADLI) strategy, a new system of agricultural extension, known as the Participatory Demonstration and Training Extension System (PADETES) was launched in 1994/95.

The system tries to merge the extension management principles of the Training and Visit (T&V) system. The centerpiece of the SG 2000 program is a half-hectare demonstration plot managed by participating farmers who use a complete package of improved seeds, improved management practices, and fertilizer doses and seed rates. The major elements of the extension package are fertilizer, improved seeds, pesticides and improved cultural practice for the main cereal crops (teff, wheat, maize, barley, sorghum and millet).

While fertilizer use in Ethiopia has increased notably since 1990, agricultural intensification in general and fertilizer using in particular are not progressing as rapidly as desired (Mulat et al, 1998).

(Feeder et al, 1985) defined adoption as the degree of use of a new technology in a long run equilibrium when a farmer has all of the information about the new technology and its potential. Therefore, adoption at the farm level describes the realization of a farmer's decision to implement a new technology. On the other hand, aggregate adoption is the process by which a new technology spreads or diffused through a region. Thus, a distinctio exists between adoption at the individual farm level and within a targeted region. If an innovation is modified periodically, however, the equilibrium level of adoption will not be achieved. This situation requires the use of econometric procedures that can capture both th rate and the process of adoption. As the new technology is introduced, some farmers will experiment with it before adopting. The €rate of adoption, is defined as the proportion of farmers who have adopted a new technology at a specific point in time (e.g., the percentag of farmers using fertilizer). Furthermore, the €intensity of adoption, is defined as the level of adoption of a given technology, for example, by the number of hectares planted with improved seed or the amount of fertilizer applied per hectare.

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 thei effective use (Shahin, 2004). Any definition of technology encompasses a wide range of phenomena. In the broadest sense, technology is defined as the translation of scientific law into machines, tools, mechanical devices, instruments, innovation, procedures and technique to accomplish tangible ends, attain specific needs, manipulate the environment for practical purposes (Shahin, 2004).

Among the types of crops, cereals are the most important crop which provides food calories in day-to-day life of the people. To strengthen their life and change their living standards, peoples use various livelihood strategies.

Thus, cereal production and marketing are the means of livelihood strategy for millions of smallholder households which enable them to get high produce for consumption and sale (Taffese et al, 2012). Teff, wheat, maize and sorghum occupy almost three-quarters of the total area cultivated, and they are the major cereal crop for the country. In Ethiopia, wheat can be produced by both small-scale subsistence farmers (Tadese et al, 2018) and large-scale commercial farms. However, small-scale farmers dominate large-scale commercial farms in area coverage and the amount produced. As (Minot et al, 2012) indicated large-scale commercial farms have only 58-80 thousand hectares of land and produced 2.0-2.5 million quintals of wheat.

Wheat is one of the important cereal crops consumed in different forms in Ethiopia and the rest of the world. Ethiopia is the second wheat producer in Sub-Saharan Africa (SSA) next to South Africa (Abu, 2012) (Demeke and marcantonio, 2013) and it ranked 4th after teff, maize and sorghum in terms of area coverage with 1,605,653.9 hectares and 3rd in terms of quantity production with 3,925,174.135 tons in 2013/14 cropping season in Ethiopia (CSA,2016). The last 15 years wheat production, productivity and total land area used for wheat production has shown relatively gentle growth. The average level of wheat productivity for the period of 2000-2014 is about 1.73 ton/ha while the average growth rate in productivity is about 5.93%.

According to USDA data, the domestic consumption of wheat shows the fastest growth trend (from 3.8 million tons in 2010 to 5.4 million tons 2014). Despite the county•s attempt to increase domestic wheat production through improved wheat variety and area expansion, wheat self-sufficiency is still found to be an unattainable plan for the country due to this huge increment of wheat consumption resulted from fast population growth.

2.2.2. 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.

2.3 Empirical Literature Review

2.3.1 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 (Danvry et.al, 2001) cited on Tanner et al. (1991) several factors that hinders 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.

The study conducted by (Itana, 1985), (Chilot et al, 1996) and (Tsefaye 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.

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.

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 (Dognet et al, 2001) (Mkinyahil, 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. (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 demonstration were positively and significantly influenced. On the other hand, input price and distance to market were negatively and significantly related to adoption.

A study carried out by Jha et al. (1988) further indicated that infrastructure represented by location in a better endowed region, access to credit, and household characteristics such as sex, age and education of household head were found to be important factors explaining adoption. Male-headed households are more likely to adopt hybrid maize and fertilizer than female-headed households. However, the findings of Worman et al. (1990) in Botswana demonstrated that the percentage of adopters among male-headed households was not significantly greater than for female and defacto female-headed households.

A study carried out by Legesse (1992) in Arsi Negele, Ethiopia using probit and tobit regression models indicate that the factors significantly influenced the probability of adoption of improved varieties and intensity of adoption of fertilizer and herbicide include experience, credit, expected profitability as represented by expected yield, cash availability for down-payment, participation in farm organizations as a leader and close exposure to technology.

A study done by (Mulugeta, 1994) showed that wheat production technologies are profitable but inputs are used sub-optimally. Mulugeta also pointed out that institutional variables (input availability, credit access and extension contact) significantly affect the incidence of adoption while economic factors (farm size, oxen ownership, labor availability) influence the intensity of use.

An adoption study by (Chilot et al, 1996) indicated that probit and tobit regression models to assess factors affecting adoption of new wheat technologies in Wolmera and Addis Alem areas found that perceived profitability of the new wheat technologies and the timely availability of fertilizer and herbicide had significant effect on farmers' decisions to adopt. Distance of respondents' homes from extension centers also influenced the probability of adopting improved wheat variety, as well as the intensity of fertilizer and herbicide use. Characteristics of the household and household heads had little influence on the adoption decisions of farmers.

Another adoption study by (Bekele et al, 2000) indicated that the tobit analysis revealed that access to credit is an important factor in influencing farmers' decision to adopt improved wheat technologies (variety and fertilizer). Access to credit not only relaxes the cash constraint currently existing in most farm communities, but also facilitates input availability for farmers. Hired labor is another determinant of a farmer•s ability to adopt higher nitrogen fertilizer rates.

Furthermore, an adoption study by (Tefaye et al, 2001) shows that farm size influenced the adoption of improved wheat varieties positively and significantly. Participation of farmers' on-farm demonstration also positively and significantly affected the adoption pattern of respondents. Contacts made with extension agents, service cooperative (SC) representative contributed significantly and positively to adoption.

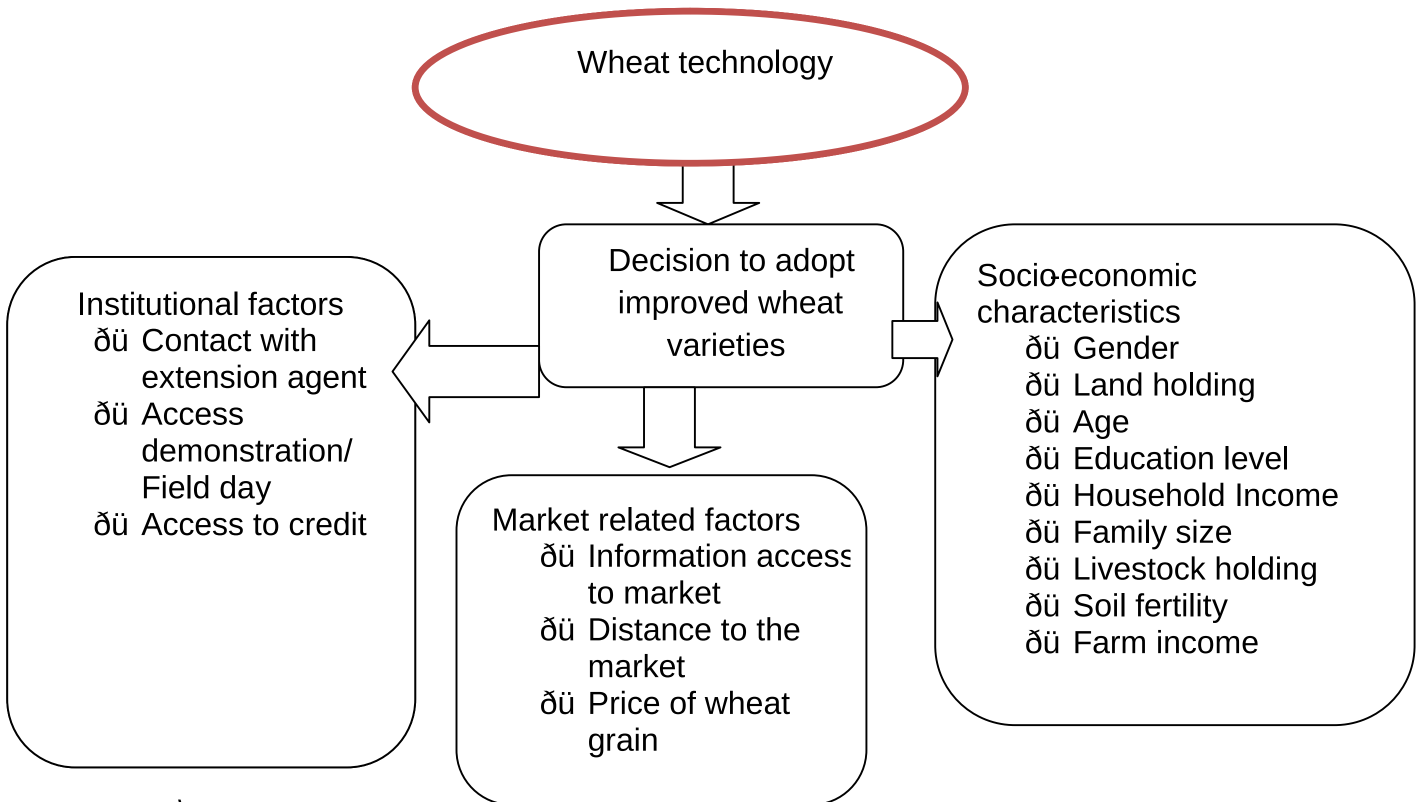
Other variables such as radio ownership contributed very little suggesting that information about improved wheat production technologies is more effectively diffused among farmers through other methods such as extension contact and demonstration of improved wheat variety. Number of livestock units, distance to a development center, and years of farming experience did not contribute to the adoption of improved wheat varieties.

From the review of empirical studies, it could be inferred that agricultural technology adoption and diffusion patterns are often different from area to area or location to location. Such differences were attributed to variations in agro-climatic, information, resource endowment and the type of technologies adopted in the respective study areas of the sampled farmers. Hence, carrying out adoption studies to identify adoption determinants for different areas can help in developing suitable technologies and in effectively promoting them.

2.4. 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 decisions 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 1Figure2.1: conceptual frame work adoption of wheat technology



\

Source: Adopted from Hadush, 2015

CHAPTER THREEE

3. RESEARCH METHODS

In this chapter all attempts are made regarding the description of the study area, the research approach, research design, population, sample and sampling technique of the study, inclusio and exclusion criteria, source of data, study variables, instruments of data collection, procedures of tests• administration, methods of data analysis and ethical issues.

3.1 Geographical location of the study area

This study was conducted at Amihara National regional state, west Gojjam zone Kuarit woreda. Administratively the woreda was dividing into thirty-two kebele•s. The woreda has a total population of 137,610 total population which are 15,823 live in urban, 121,787 live in rural and from the total population 41,671 were youths live in both urban and rural (Amihara plan commission 2011 E.C population prediction).

According to informants, kuarit woreda and its town called Gebez Mariam was founded in 1954 by a land lord of that area named Kegn Azimach Mulatu Desta.

The study area of Quarit woreda was one of the 13 woredas of west gojjam zone in the Amihara Regional State of Ethiopia. It is located 439 km away from Addis Ababa. The study area has both climate conditions. The major portion of the study area is 63 % weinadega 1.28% kola, 35.72% dega. The study area is bordered on the north Illimana Denisa, eas Dega Damot, and west Sekela, south Jabi Tehinane woreda.

Figure 2Figure 3.1: Map of study area

Study area

The crops produced in the study area are cereals (teff, wheat and barley), pulses (chickpea fava bean guaya lentil,) vegetation (onion and potato). Cereals are produced mainly for Subsistence and commercial agriculture.

The farming systems in the study area encompass crop, livestock, and agro forestry productions.

Major crops include maize, teff, wheat, ground potatoes, beans, green peas and vegetable Livestock include cattle, goats, sheep, and chickens. The average farm size is about 0.4 h per household (Woreda Agricultural office)

3.3 Research Design

The design of this research was both descriptive & explanatory research designs. Because descriptive design is nearly to describe the actual situation of things as it exists so that the researcher has used it to answer the question „what• by describing things with its natural setting. The explanatory design is used to explain why events are occurred and to build or test theory. Therefore, both designs are selected as a suitable design to describe and find out that factor affecting the adoption improved wheat technology and its intensity of adoption in kuarit woreda West gojjam zone, Amihara regional state, Ethiopia.

3.4 Research Approach

One of the key issues differentiating among quantitative and quantitative research approaches is the nature of data. In quantitative, it is hard, objective and standardized but in qualitative, it is soft, rich and deep (depth vs. superficiality)

This type of research approach employs strategies of inquiry that is surveys research strategy, collects information using preset standardized instruments that can generate relevant statistical data. Through the study of some specific variables on a great number of objects of investigation, this approach is appropriate for studies to make universal generalizations from sample population to target population.

This research was conducted to assess the adoption of wheat technology and identifying major factors affecting its performance in adoption of wheat technology, thus more quantitative driven approach was used.

3.5 Data Sources, type and collection methods

Both primary and secondary data would used. The primary data were collected on one-to-one interview using a structured survey questionnaire, Secondary data source include books, journals and other published and unpublished documents and district agricultural offices, internet and other related sources to supplement primary data.

3.5.1 Source of data

The Data collected from both primary and secondary sources. Primary data would be collected field work survey from the district woreda in the selected kebeles (house hold head). Secondary sources included published and unpublished (information about Kuarit woreda agricultural office) production in particular and the study area in general. Both data was analyzing using descriptive statistical procedures and the double hurdle econometric model.

3.5.2 Sampling technique and sample size

Sample Size Determination

There are several approaches to determine the sample size, based on the information of Kuarit woreda the sample size is calculated as follow. The formula for sample size determination for finite population is given by Kothari (2004).

,,,,..,,. (1)

Given the perception, confidence level, population proportions p and q where p+q=1. Where:

n: is the sample size for a finite population e: margin of error; N number of populations under the study; z is confidence level.

According to this study, N=356 size of population which is the number of households under the study in kebele. e , margin of error consider is 5% for this study, where p is =0.5 the proportion of adaptors, the adoption of wheat technology in kuarit district q=1-0.5= 0.5 the proportion of non-adaptors, Z …/2: normal reduce variable at 0.05 level of significance z is1.96. According to the above formula the sample size of all sample kebeles is

n= (1.96) ²*0.5*0.5*5019/ (0.05) ²*(5019-1) + (1.96) ²*0.5*0.5= 356

Sampling Technique

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. he explains in the comprehensive way

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 when the population distribution is not normal as stated that

A multistage sampling procedure was used to select farmers for the survey. The survey has focus on farmers from Kuarit woreda where wheat is one of the major crops grown. In the simple random sampling method, the each unit included in the sample has equal chance of inclusion in the sample. This technique provides the unbiased and better estimate of the parameters if the population is homogeneous the same socioeconomic, culture etc.

It was applying to obtain the sample unit based on the number of households in each kebele using the list of farmers.

In the first stage, the researcher would be stratified sampling technique based on wheat potentials. These are high, medium and low. In the study area there are 29 kebeles, from these 16, 8 kebeles and 4 kebeles have high, medium and low wheat productive potential respectively and the remaining 1 kebele is not produce wheat. Seven sample kebeles will be taken by proportionate of its wheat productive potentials from these sample kebeles 1, 2 and 4 kebeles have been taken from low, medium and high productive potential respectively, From these sample kebeles there a total population of 5019 households. By using kothari formula 356 house hold will be taken by using random sampling method. The sample household was taken from these sample kebeles according to its proportionate of the household

Table 3.1: the no of total household head

	Kebele name	Total Household head
1	Woybeygn (high)	1000
2	Fengeta (high)	950
3	Zambit (high)	800
4	Butla(low)	700
5	Dinja tsiyon(medium)	759
6	Hareg(medium)	400
7	Endryas (high)	410
	Total	5019

Total population of house hold head N =5019

3.6 Analytical Model

In this study, both descriptive statistics and double hurdle model were used to analyze the data.

3.6.1. Descriptive statistics

Descriptive statistics such as mean, standard deviations, frequency distribution, percentage will use to have clear picture of the characteristics of the sample units.

3.6.2. 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 effects of extension technology to promote technology adoption

The double hurdle (DH) model was employed to analyze factors that influence adoption and use intensity of improved wheat technology. The model was chosen because it has an advantage over the other models such as Linear Probability Models in that, it reveals both the probability of willingness to adopt and intensity of adoption (Terefe et al., 2013). The DH model controls the reciprocal relationship (dual endogeneity) between the two factors; adoption decision and use intensity (Ketema, 2011). It is also ideal as it can resolve the problem of heteroscedasticity (Asante et al., 2011). Thus, several studies used this model to estimate technology adoption and use intensity (Yu and Nin-Pratt, 2014; Martey et al., 2013; Terefe et al., 2013; Akpan et al., 2012).The model was introduced by Cragg (1971) and assumes that a household head makes two independent and sequential decisions regarding adoption and use intensity of the technology. Assuming these two independent decisions, the first stage of the model deals with the adoption decision equation which can be expressed as:

di*= †1 X i+u1 ‡‡‡‡‡‡‡‡‡‡ ‡‡‡‡‡‡‡‡‡‡‡‡‡.‡.....‡. (2)

Where; d i * is unobservable choice of adoption decision and also known as latent variable, X i is a vector of explanatory variables hypothesized to affect decision to adopt improved wheat technology, and di is normally distributed error term with zero mean and constant variance. Then, the observed improved wheat technology adoption decision is:

D i = 1 " > 0 ; 0 ""d 0 ‡‡‡‡‡‡‡‡‡‡‡‡‡‡‡‡‡‡‡‡..(3

Where; d i * is unobservable choice of the technology by ith household, and D i represents observable ith household decision to participate in technology adoption; 1 if respondent reports adoption of wheat technology use and 0 otherwise.

The second stage deals with the outcome equation which uses a truncated model. The equation helps to determine the extent of optimum use intensity of adoption of improved wheat technology. Most households in quarit woreda use some sources of wheat such as technology without measuring its amount. Due to this, it was difficult to know the exact amount of wheat technology used by farmers. However, households who use adoption of improved wheat technology by taking by variables to know intensity of adoption (low, medium and high). Thus, the application level of intensity low adopter; only used fertilizer, medium adopter (used fertilizer and pesticide), high adopter; used fertilizer, pesticide and improved seeds on their farms. Therefore, in this stage, only respondents who reported positive use of adoption of technology which is greater than or equal to the optimum use intensity of adoption in the study area were included. The evidence from the districts• agricultural development office also showed that not all farmers are used technologies at the same time which means ones used the seed others use fertilizers and pesticide not used full technology.

On the basis of that, using the fertilizer, pesticide and improved seed as a proxy to evaluate intensity of improved wheat technology adoption, the optimum to adoption of wheat technology used was determined as the average level of fertilizer, pesticide improved seed usage per hectare in the study area. A dependent variable that has a zero value for a significant fraction of the observation requires a truncated regression model (referred as a modified Tobit model in this case) because standard OLS results in a biased and inconsistent parameter estimates (Green, 2002). The bias arises from the fact that if one considers only the observable observation and omits the others, there is no guarantee that the expected value of the error term will be zero (Terefe et al., 2013). The truncated model which closely resembles the Tobit model was used to deal with the use intensity of wheat technology adoption (outcome) equation which can be presented as follows:

Let, $Y_i^* = †1 X_i + u_i$ ‡‡‡‡‡‡..‡‡‡.‡‡‡‡‡‡‡‡..‡‡‡‡‡. (4)

And

$Y_i =$ € = 0 €• u ; 0 €, 0 €< u ‡‡‡‡‡‡‡‡‡‡‡‡‡‡‡‡..‡ (5)

Where; Y_i represents observed use intensity of wheat by the household i, Y_i^* is the level of adoption being used by the household i, u representing threshold; minimum adoption of wheat use intensity considered as optimum in the study area, and as explained earlier. Then, the following empirical models were specified to evaluate factors affecting adoption decision and use intensity of wheat technology using double hurdle model:

1st hurdle: Adoption decision model (Probit output);

Adop = Yi = ˆ$_0$ + ˆ$_{iXi}$ + ‡‡‡‡‡‡‡‡‡ + ˆi xk + ‰$_i$ ‡‡‡‡‡‡.. (6)

2nd hurdle: Outcome equation model (Truncate output);

Yi = ˆ$_0$ + ˆ$_{iXi}$ + ‡‡‡‡‡‡‡‡‡‡‡‡.. + ˆixk + ‰$_i$ ‡‡‡. .... (7)

Where, ˆi = no of parameters, xk no of explanatory variables on equation (6) and (7) represented as; Adop is improved wheat technology adoption taking values of 1 for adopters and 0 for non-adopters, Yi is intensity of adoption of being used by the respondents in the study area, SEX(X1) is sex of household head, AGE(X2) is age of the household, FAMILYSIZE(X3) is size of the family, EDUC(X4) is education level of household, LIVESTOCK(5) is livestock ownership of house hold, EXAGENT(X6) is extension contacts, DISTANCE (X7) is and distance from the residence to the nearest market in kilometers, PESTICIDE(X8) is used pesticide of household, FERTILIZER(x9) is fertilizer used, , CREADIT(X10) is access to credit, , FARMSIZE(X11) is farm size of house hold, SOILTIYPE(X12) ,FERTILITY(13) is soil fertility, is soil type of land, OFFFARM(X14) is off farm income of house hold, FARMICOM (X15) is household heads• farm income, $_0$ is constant, ˆ$_1$ to ˆ$_{15}$ is parametrs of respective explanatory variables and is error term.

Detecting Multicollinearity, Outliers and Statistical Specification Problems

There are different types of statistical problems which should be checked during analysis before executing the final model. Multicollinearity is one of the most common problems. Thus, in this study, all the hypothesized explanatory variables were checked for the existence of such a problem. Multicollinearity arises due to the existence of linear relationship between explanatory variables. The problem may cause the estimated regression coefficients to have wrong signs, smaller t-ratios for many variables and high R^2 in the regression. It may also cause variances and standard errors to be high with a wide confidence intervals making the estimation accuracy of the impact of each variable low (Gujarati, 2004; Greene, 2002). Different methods have been suggested by several scholars on the ways of detecting multicollinearity among explanatory variables. Variance-inflating factor (VIF) technique is among these methods. The technique shows how variance of an estimator is inflated by the presence of multicollinearity (Gujarati, 2004). VIF can be computed mathematically as follows:

$$VIF = \frac{1}{1-R^2} \quad (8)$$

Where; R^2 is coefficient of determination among explanatory variables and VIF is variance inflating factor. The larger the value of VIF, the more the degree of colinearity among explanatory variables (Gujarati, 2004). This study has also employed VIF method to check for the existence of multicollinearity. If the VIF of a variable exceeds 10, which could happen if a multiple R^2 exceeds 0.9, that variable is said to be highly collinear (Gujarati, 2004).

3.6.3 Hypothesis and variable definition

Variable definition is one of the best ways of during research working hence; the data is covering the necessary information regarding to socio-economic characteristics, wheat production, and factors affecting of the adoption of wheat technology in the study area. Both continuous and dummy variables are used on economic theories and the findings of different empirical studies. Consequently, to investigate the research questions of this study, the following variables are identified.

A. Dependent variable

Adoption decision: The dependent variable for first hurdle of the model takes a dichotomous value depending on the farmers• decision either to adopt (at least one) or not to adopt any of the improved wheat varieties.

Intensity of adoption: The dependent variables for truncated regression model have a continuous value which is the intensity of use of the adoption of technology.

B. Independent (explanatory) variable

There are different explanatory variables that correlate with dependent variable (with adoption of wheat technology) some of the variables as follow:

1. Gender: This is dummy variable that takes a value 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.

2. Age: It is a continuous variable and measure 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.

3. Educational Level: It is dummy variable ands measure in years of formal schooling of the households. Education plays an important role in the adoption of innovations/new technologies.

4. Family Size: It is a continuous variable and measure in numbers, family member capable to do an agricultural activity (adult equivalent). Wheat production is labor intensive starting from ploughing to harvesting especially it needs more labor at the time of weeding.

5. Distance from the Market Center: 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 incur by the households while transportation.

6. Non-Farm Income: it is a continuous variable which is measure by the amount of income earn by the households mainly out of-farm activities. Households participating in off-farm activities are expect to have better income and can easily purchase agricultural inputs. Therefore, off-farm income is found positively influence wheat technology adoptions.

7. Farm Income: It is a continuous variable and refers to the total annual cash earning to the families from production of crops, livestock and livestock products after meeting family•s requirements.

8. Farm Size (land holding): It is a continuous variable and measure in hectares. It is hypothesizing that there is a direct relationship between size of land and wheat technology adoption.

9, Access to Credit: Access to credit is measure 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. Extension Contact: This refers to the number of contacts per year that the respondent made with extension agents and it is a dummy variable.

11. Fertilizer: it is dummy variables on time availability of fertilizer used or not determines the adoption decision of new improved wheat varieties Thus, it is hypothesizing that timely availability of fertilizer has a positively associate with adoption of improved wheat technology.

12. Soil Type: it is categorical variable, this variable is expected to influence improved wheat technology adoption decision of households.

13. Farm (soil) fertility ; categorical variable that is expected to positively influence improved wheat technology adoption decision of households.

14. Pesticide: it is dummy variables on time availability of pesticide used or not determines the adoption decision of new improved wheat varieties Thus, it is hypothesizing that timely availability of pesticide has a positively associate with adoption of improved wheat technology.

All thus variables are analysis by STATA software.

CHAPTER FOUR

RESULTS AND DISCUSSION

This chapter presents the major findings of the study and discusses it in comparison with the results of other studies. Both descriptive and econometric methods were used to analyze the primary data. Descriptive statistics were employed to describe the general demographic, socio-economic and institutional characteristics of sample wheat producing farmers. Econometric analysis was also used to identify factors affecting adoption and intensity of adoption of improved wheat varieties in the study areas. Cost-benefit analysis was used to assess the profitability of improved wheat varieties adopted in the study areas.

4.1. Descriptive Results

Several factors influence farmers• adoption decision. In this study, the independent variables thought to have relationship with adoption of improved wheat technology are grouped as households• personal and demographic variables. The most commonly household characteristics that were hypothesis frequently influencing farmers adoption of impr wheat technology included: educational level of household head, family size, and age, farm size, extension service, and access to credit, market distance, farm income and off-farm income. The relationship of these variables with adoption of improved wheat technology is discussed under the following sub topics.

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 1 below. The study was considered 356 randomly selected households as a total sample size and from this 53.09%was adopters and 46.91 % were non-adopters. The table 4.1 shows that the percentages of adopters are greater than non-adopters.

Table4.1: percent and frequency of adopters and non adopters

Adoption	Freq	Percent	Cum.
Yes	189	53.09	100.0
No	167	46.91	46.91
Total	356		100

Source: computed from own survey data, 2021 EC.

4.1.1.Demographic characteristics households

The sample size handled during the survey was 356. Among the sample respondents 295(82.87%) were male headed and the remaining 61(17.13%%were female. The chi-square test of sex distribution between the adopters and non-adopters was found to be insignificant. Out of the total respondents, 97.26%, 1.37% and 1.37% were married, single and widowed respectively. The chi-square test of marital status between the adopters and non-adopters was found to be insignificant. (Table 4.2)

Education can influence productivity of producers and adoption of newly introduced technologies and innovations. Hence, literate producers are expected to be in a better position to get and use information which contributes to improve their wheat technology adoption practices. According to the survey results, on average adopters have about literates more adopters than illiterate. The chi-square test result indicates that education level of household was found to be significant between adopters and non-adopters at 1% level of significance. That means adopters have higher level of education compared to non-adopters (Table 4.2).

The sample was composed of male and female households, of which 75.28 percent are male headed and the rest 24.72 percent are female headed and male sample sizes are higher than female. (Table 4.2)

Table4. 2: demographic characteristics households

Variables		Adopter		Non adopter			Test statistic
		No	%	No	%	Total	2-test
Sex of house hold	Male	144	76.19	124	74.25	356	0.672
	Female	45	23.81	43	25.75		
Marital status	single	5	2.65	5	2.99		
	Married	176	94.18	155	92.81		0.856
	Divorce	8	3.17	7	4.19		
Education	Lliterate	31	45.5	153	51.5		0.000
	Literate	158	48.7	14	55.1		

Source: Computed from own survey data, 2021EC.

The average age of the adopters was 40.33862 years and while it is about 39.92814 years f non-adopters. The t-test of age between adopters and non-adopters was found to be insignificant. That means there is no statistical mean difference between adopters and non adopters in terms of age (Table 4.3).

Table 4. 3: age of mean, standard deviation and of adopters and non adopters

Variable	Adopter	Non adopter	Test statistic

	Mean	Std	Mean	std	t-test
Age	40.33862	10.9	39.92814	9.5	-0.37

Source: Computed from own survey data, 2013EC.

4.1.2. Socio economic characteristics

Farm size is one of the variables that characterize farm households. The average farm size o the adopters was 6.016 people and while it is about 6.818 persons for non-adopters. The t-test of family size between adopters and non-adopters was found to be significant (Table 4.4).

Farm animals have an important role in rural economy. They are source of draught power, food, such as, milk and meat, cash, animal dung for organic fertilizer and fuel and means of transport. The districts where known by livestock production as major occupation. Livestock holding size is also one of the indicators of wealth status of the households in the study areas Livestock is kept both for generating income and traction power. As it confirmed in many studies, farmers who have better livestock ownership status are likely to adopt improved agricultural technologies because livestock can provide cash through sales of products which enables farmers to purchase different agricultural inputs like seeds and used as traction power.

Participation on off /non-farm can affect the decision to adopt new technologies. This is particularly true if the adoption of the new technology would require a minimum investment in purchased inputs. Most of the farmers interviewed reported that they don't participate on off/non-farm because of poor infrastructure development in the area. About 1537 mean of adopters and 2436 mean of non-adopters participate on off farm while about 81.25% of adopters and 86.73% of non-adopters did not participate on off farm activities. 25% of adopters and 19.39% of non-adopters participate on non-farm while 75% of adopters and 80.61% of non-adopters did not participate on non-farm activities. The t- test statistics shows that off farm participation between adopters and non-adopters was found to be insignificant. That means there is no mean difference between adopters and non-adopter in off farm a (Table 4.4).

The livestock species found in the study areas are cows, oxen, heifers, calves, sheep, goa donkey, mule and poultry. To help the standardization of the analysis, the livestock number was converted to tropical livestock unit (TLU).The conversion factors used were based on Storck et al., (1991). The average livestock ownership of adopters was 5.17 and 4.13 TLU for the non-adopters. The t-test of livestock holding between adopters and non-adopters was found to be insignificant. That means there is no statistical mean difference between adopters and non-adopters in terms of livestock holding (Table 4. 4).

The average total land holding, total cultivable land and land allocated for improved wheat for adopters is 2.00, 1.84 and 0.25 hectares respectively while it is 2.2, 1.97, and 0 hectares for non-adopters. The t-test of total land holding and total cultivable land between adopters and non-adopters was found to be insignificant. That means there is no statistical mean difference between adopters and non-adopters in terms of total land holding and total cultivable land but the t-test of land allocated for improved wheat between adopters and non-adopters was found to be significant at 1% level of significance indicating that there is statistical mean difference between adopters and non-adopters in terms of land allocated for improved wheat varieties (Table 4. 4).

The time taken to travel from home to the nearest wheat market place where farmers sell their product (wheat), are presented in table 4.4. Adopters and non-adopters travel on average 14.8 and 15.5 hour respectively to reach nearest market. The t-test of distance to nearest market between adopters and non-adopters is significant at 1% level of significance indicating that non-adopters travel more hours to reach nearest market than adopters

Table 4.4: Socio economic characteristics of households

Variables	Adopter		Non adopter		t-test
	Mean	Std	Mean	Std	
family size	6.03	1.7	6.4	1.8	1.96
Livestock	12.4	3.9	12.5	3.3	0.4
Distance	14.8	3.91	15.5	3.96	-1.65**
Farm size	2.1	0.8	2.05	0.67	-0.7
Off farm income	1537	7471	2436	10658	0.95
Farm income	22.6	12.6	23	14	0.342

** Significant at 1%

Source: Computed from own survey data, 2021EC.

Frequency of extension contact refers to the number of contacts per year that the responde made with extension agents. The effort to disseminate new agricultural technologies within the field of communication between the change agent (extension agent) and the farmers a the grass root level. Here, the frequency of contact between the extension agent and th farmers is hypothesized to be the potential force which accelerates effective dissemination of adequate agricultural information to the farmers, thereby enhancing farmers' decision to adopt new technologies. The frequency of extension contact for adopters and non-adopters was 174 and 60 respectively. The Chi-square test of extension contact between adopters and non-adopters is significant at 1% level of significance indicating that there are statistical significance adopters and non-adopters in terms of frequency of extension contact (Table 4.5).

Variables		Adopters		Not adopters		Chi square	f
Contact		Obse	%	Obse	%		
extension	Yes	174	19.9	60	22.6	0.000**	
	No	15	38.2	107	43.3		

**significance at 1% significance level

Source: Computed from own survey data, 2021EC

In this study,farm fertility represents the household•s perception about the fertility of their farm. The results presented in Table 4.6 show that about 8.9 percent of the adopters believe that their farms were less fertile. In comparison, the corresponding figure for non-adopters was about 10.1 percent. Relatively, a higher proportion of households who perceived that their plots are not fertile were found to be adopters of wheat technology. Low farm fertility has been reported to be a major constraint to agricultural production by an increasing number of farmers in Ethiopia (Makokha et al., 2001). This shows that low fertility of the farm could be one of the reasons for adoption of organic fertilizer. Kpadenou et al. (2015) noted that the problem of soil fertility (decrease in farm fertility) is associated with greater likelihood of organic fertilizer use in the Sahel region. The survey results of this study further revealed that about 5.3 and 1.3 percent of the adopter households perceived that their farms wer fertile and average fertile respectively. On the other hand, about 6 percent and 1.5 percent o the non-adopters were believed that their farms were fertile and average fertile respectively.

The test statistics shows that farm fertility was significant to adopters and not adopters. See table (4.6)

Table 4.6: Results on Farm Fertility

Variables	Adopter		Not adopter		Test statistic
Farm fertility	Freq	%	Freq	%	Chi-square
Fertile	114	5.3	59	6	
Average fertile	71	1.3	82	1.5	0.000
Less fertile	4	8.9	26	10.1	

**significance at 1% significance level

Source: Computed from own survey data, 2021EC

4.1.4. Major crops produced

As presented in table 4.5, in the study areas, maize is the dominant crop produced with mea 13.7 quintals for adopters and 12.5 for non-adopters and it is the basis of livelihood in the study areas. The second dominant crop produced is teff with mean of 2.899 and 2.844 quintals for adopters and non-adopters respectively. Barley is the third dominant crop produced with mean of 1.492 and 1.611 quintals for adopters and non-adopters respectively. Wheat is also the major crop produced in the study areas with mean of 13.084 and 12.1796 quintals for adopters and non-adopters respectively. This low productivity of soya bean is due to disease (t) which occurs in the study areas for the last two years. The result of t- test revealed that there is significant mean difference between adopters and non adopters farmers in terms of amount of soya bean produced and amount of sorghum produced at 1% and 5% significance level respectively.

Table 4.5: Major crops produced by sampled households (Qt)

Variable	Adopter		Non adopter		t-test
	Mean	Std	Mean	std	
Amount of Maize produced	13.7	9.4	12.5	7	-1.3**
Amount of teff produced	2.89	1.79	2.84	1.6	-0.3
Amount of barley	1.49	1.2	1.61	1.1	0.93
Amount of Wheat produced	13	8.9	12	5.3	-1.3

Source: Computed from own survey data, 2013EC.

4.2. Econometric Results

4.2.1 Factors influencing the adoption of improved wheat technology

In this subsection, the results of the Double hurdle regression model is presented and discussed. Adoption decision of farm households is influenced by different socioeconomic, technical and institutional factors. Different variables are important across different space and over time in explaining adoption of technologies by farmers. Many factors are hypothesized to influence the adoption of improved wheat varieties based on theoretical models and empirical evidences.

Table 6: results of Cragg•s Double Hurdle Model (Probit Output) factors affecting of Decision of Adoption of improved wheat technology

Variable	coefficients	s e	Marginal effect
SEX	-.068	.635	-.0017
AGE	.035	.034	.0008
EDUC	3.015	1.008	.0758**
FAMILY SIZE	.119	.164	.0030
LIVESTOKE	.106	.0737	-.0026
COEXAGE	3.473	1.384	.0874**
DISTANCE	-.052	.051	-.0013
PESTICIDE	6.092	1.635	.1533**
FERTILIZER	3.649	1.214	.0918**
CREADIT	-1.146	.691	-.0288*
FARM SIZE	-.567	.496	-.0142
SOIL TYPE	.0347	.328	.0008
FERTILITY	2.160	.757	.0543**
FARM INCOME	.0730	.041	.0018*
OFFFARM	-.001	.00005	-4.161
Cons	9.967	3.922	

Number of obs	356
Log likelihood	-10.458777
Pseudo R^2	0.9575

***, **and* are at 1%significance 5% significance and10% significance respectively.

SOURCE: STATA regression output of own survey 2013

Out of 15 explanatory variables included in the model, seven were found to be significant in influencing farmers• decision to adopt improved wheat technology of adopters at 1%, 5% and 10 % significant levels. The variables include co ex agent, pesticide, fertilizer, credit, fertility, education, farm income; seven variables were found to be significant in influencing intensity of adoption at 1%, 5% and 10% significant levels. The variables include sex, age, off farm income, distance, soil type, family size, livestock are insignificant variables.

Education (EDUC): Education level of the household head, which is one of the important indicators of human capital, has a positive and significant effect on adoption of improved wheat seed varieties at 5% level of significance, implying that the likelihood of adoption increases with farmer•s formal education level. Each additional year of education of the household head increases the probability adoption of improved wheat technology varieties by 0.075. This is consistent with the research results of Hassen et al. (2012), Moti et al. (2013), Afework and Lemma (2015) and Sisay (2016), who stated that education, affect to adopt improved wheat technologies positively.

Coexagent: Result of the finding indicated that extension contact was positive and statistically significant at 5% with adoption of improved wheat technology. The result indicate that other things held constant, the odds ratio in favor of decision on adoption of improved wheat technology was increased by a factor of 0.087 for a unit increase of extension services. One of the most important roles of extension service is to raise farmer•s awareness about agricultural productivity through providing them important information related to adoption of agricultural technologies. According to Kassie et al. (2009), in most cases, extension workers establish demonstration plots where farmers get on hands learning and can experiment with new farm technologies which enhance adoption of new technologies. The results of the study therefore confirm that better information dissemination through extension workers could enhance adoption of wheat technology by improving knowledge about the advantage of new technology. Thus, for a given household, the more the frequency of meeting extension workers, the higher the likelihood of wheat technology adoption. The results were statistically significant at 1 percent probability level. The finding was in line with Kassie et al. (2009). They argued that farmers who have regular contact with agricultural experts are more motivated to participate in agricultural technology adoption due to intensive information they may get from the experts

Access to credit: The model result indicates, this variable had negative and significantly influenced the likelihood of adoption of improved wheat technology at 10 percent significance level. From this result it can be stated that those farmers who have access to formal credit from any governmental and non-governmental organization are more likely to adopt improved wheat technology than those who have no access to formal credit. The odds ratio indicated in the model with regard to this variable that, other thing being held constant, the odds ratio in favor of adopting improved wheat technology decreases by a factor of 0.56 as farmers gets 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 probit model, and truncated regression analysis was negative 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 Amihara regional state in particular, quarit woreda has different credit provider institutions such as Amihara 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 0.56 for a unit decrease of access to not use credit in a season.

PESTICIDE: The model result indicates, this variable had positively and significantly influenced the likelihood of intensity of adoption of improved wheat technology at 5 percent significance level. From this result it can be stated that those farmers who have used pesticide of production year are more likely to adopt improved wheat technology than those who have no used pesticide. The odds ratio indicated in the model with regard to this variable that, other thing being held constant, the odds ratio in favor of adopting improved wheat variety increases by a factor 6.09 as farmers used pesticide.

FERTILIZER: use was found to be positively and significantly affected the probability of adoption of improved wheat varieties at 5% level of significance. From this result it can be stated that those farmers who have used fertilizer of production year are more likely to adopt improved wheat technology than those who have no used fertilizer. The odds ratio indicated in the model with regard to this variable that, other thing being held constant, the odds ratio in favor of adopting improved wheat technology increases by a factor of 0.091 as farmers gets fertilizer.

FERTILITY: Result of the finding indicated that fertility of soil was positive and statistically significant at 5% with adoption of improved wheat technology. The result indicate that other things held constant, the odds ratio in favor of decision on adoption of improved wheat technology was increased by a factor of 0.0543 for a unit increase of fertility of soil. One of the most important roles of fertility of soil is to raise farmer•s awareness about agricultural productivity through providing them important information related to adoption of agricultural technologies

FARM INCOME: The probit regression model analysis shows that participating in farm activities was statistically significant at 10% level. This implies that households participating in 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 better purchasing power of inputs than who did not. Therefore, farmers who participate in farm activities were found easily adopt new technology. Other things are remaining constant, the value of odd ratio was 0.001 and when farm incomes were increased by a unit, technology adoptions were increased by 0.001. This implies that off-farm income and technology adoption has a positive correlation at 10% significant level.

4.2.2 Intensity of improved wheat technology adoption

Table 7: results of Cragg•s Double-Hurdle Model (truncated Output) on intensity of Adoption of wheat technology

Variable	Coefficient	S E	Marginal effect
SEX	-.452	.368	-.4523
AGE	.029	.015	.0298*
EDUC	.912	.446	.9126**
FAMILY SIZE	.066	.084	.0667
LIVESTOKE	.146	.043	.1469***
COEXAGE	.172	.468	.1728
DISTANCE	-.008	.041	-.0082
PESTICIDE	1.120	.513	1.1207**
FERTILIZER	.781	.609	-.6874
CREADIT	.755	.339	.7551**
FARM SIZE	-.094	.221	-.0940
SOIL TYPE	.122	.169	.1227
FERTILITY	.341	.252	-.3417
OFFFARM	.3.301	.000	3.30
FARM	.011	.011	.0114

INCOME		
Cons	6.835479	2.083047

limit: lower	-inf
upper	+inf
Number of obs =	189
Wald chi2(15)	38.71
Log likelihood	-875.0969

NOTE: ***, **and* are at 1%significance 5% significance and10% significance respectively.

SOURCE: STATA regression output of own survey 2021

AGE: Age was positively related to intensity of adoption of improved wheat varieties at 10% level of significance the result of the truncated regression model showed that one more unit (year) increase in farmers age increases the probability of adoption of improved wheat varieties increase by 0.029. The result of truncated regression indicate that old age households are more likely to devote significant amount of land to improved wheat varieties than less old households. One more unit (year) increase in farmers age increases the intensity of adoption of improved wheat varieties increase by 2.98%. The implication is that the increase in farmer•s age increases farmers• experience in farming and understanding more the benefits of the technology. Studies by Fitsum (2012), Sisay (2016) also obtained a similar result in their studies.

Education of Household Head: It was expected that better educated smallholder are a better technology adopter and the result at 5% probability test was shown positively significant. This implies that the more educated the farmers were the more tech adopters. This is because they can easily understand and analyzed what they heard about. The value of odd ration is 0.912indicates when smallholders have got more education their technology adoption decision was increased by a factor of 0.912. As per various empirical findings were onducted in different parts of Ethiopia by different authors education a 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).

Livestock (LIVESTOCK): Livestock holding positively and significantly related to intensity of adoption of improved wheat varieties at 1% level of significance, implying that farmers with more livestock holding are more likely to devote significant amount of land to improved wheat varieties than those households with less livestock holding. A household with large livestock holding can obtain more cash income from the sales of animal products. This income in turn helps smallholder farmers to purchase farm inputs. A one unit increase in livestock holding (TLU) increases the intensity of adoption of improved wheat varieties by 0.146. This is consistent with the studies by Solomon et al. (2011), Hassen et al. (2012) and Leake and Adam (2015). According to Leake and Adam, Hassen et al and Solomon et al livestock holding affect intensity of adoption of improved chickpea varieties in Ethiopia , chemical fertilizer technology adoption in North Eastern highlands of Ethiopia and improved wheat variety in northern Ethiopia positively and respectively.

Access to credit: The model result indicates, this variable had positively and significantly influenced the likelihood of intensity of adoption of improved wheat technology at 1 percent significance level. From this result it can be stated that those farmers who have access to formal credit from any governmental and non-governmental organization are more likely to adopt improved wheat technology than those who have no access to formal credit. The odds ratio indicated in the model with regard to this variable that, other thing being held constant, the odds ratio in favor of adopting improved wheat variety increases by a factor of 0.755 as farmers gets access to credit.

PESTICIDE: The model result indicates, this variable had positively and significantly influenced the likelihood of intensity of adoption of improved wheat technology at 5 percent significance level. From this result it can be stated that those farmers who have used pesticide of production year are more likely to adopt improved wheat technology than those who have no used pesticide. The odds ratio indicated in the model with regard to this variable that, other thing being held constant, the odds ratio in favor of adopting improved wheat variety increases by a factor of 0.78 as farmers used pesticide.

CHAPTER FIVE

CONCLUSIONS AND RECOMMENDATIONS

5.1 CONCLUSIONS

This study assessed factors affecting of adopting of improved wheat technology on among farming households in quarit Woreda, amihara region. From the study, it is possible to understand that adoption of improved wheat technology is affected by different factors.

Descriptive statistical analysis results show that adopters of wheat technologies were better on education level, access to farmland, family labor force, livestock ownership, earning annual farm income. In addition to this, adopters of wheat technology had participated more in farm activities, access to credit, and contact with extension agents, used fertilizer and used pesticide than the non-adopters.

The econometrics result shows that Education, contact extension agent, pesticide, fertilizer, farm income and fertility are affect adoption of improved wheat variety positively and significantly while credit affects

adoption of improved wheat varieties negatively and significantly. On other hand, intensity of adoption was affected by age, education, pesticide, credit and size of livestock holding. This finding implies that creating conducive production environment for the farmers plays a vital role for adoption of agricultural technologies.

5.2 RECOMENDETION

Since agriculture is still the largest source of livelihood in rural Ethiopia, policy makers need also to pay a great deal of attention to enhancing agriculture through supporting new wheat technology adoption activities. This is because farming alone may fail to guarantee a sufficient livelihood for most rural households. Thus, non-farm activities can overpass the gap by directly increasing household income and providing cash that can be invested in farm inputs to increase agricultural productivity. The attention therefore should be to adopt policies that aim to enhance the role of agricultural sector improving rural economy and the welfare of poor rural households.

The household farm income on adoption and intensity of adoption was positively significant on the decision to adopt improved wheat varieties. Therefore, the source of income generation to farmers such as crop, livestock and farm activities should be encouraged to hasten the adoption of recommendations of new agricultural technologies.

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 obstacle to adopt new technology at smallholder framers 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.

Education has a significant positive impact on adoption of improved wheat varieties. Hence, strengthening adequate and effective basic educational opportunities to the rural farming households in general and to the study areas in particular is required. In this consider, the regional and local governments need to reinforce the existing provision of formal and informal education through facilitating all necessary materials

The size of livestock owned has a significant positive factor on intensity adoption of improved wheat technology varieties. Strengthening the existing livestock production system through providing improved health services, better livestock feed (forage), targeted credit and adopting agro-ecologically based high-yielding breeds and disseminating artificial insemination in the areas improve intensity of adoption of improved wheat technology.

The extension system has to enlarge span of its operation to reach all farmers with information about improved wheat varieties. 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.

Older household heads are less probable to intensity improve wheat technology adoption and earn less in case they participate. Thus, the governmental and non governmental agencies should sustainability support to old age household head because they cannot supplement their agricultural produce with other sources, overcome the entry barrier and make it available for rural households.

The result shows that fertilizer and pesticide has a significant and positive effect on adoption of improved wheat technology, in the study area where landholding is very small and the population pressure is ever increasing, so the concerned body should be provided excess amount of fertilizer and pesticide.

5. REFERENCE

Abu. (2012). Grain and Feed Annual Report: Ethiopia. USDA Global Agricultural Services: Global Agricultural Information Network (GAIN). GAIN Report Number: ET 120.

Abu, Demeke and Marcantonio. (2012, 2013). Ethiopia is the second wheat producer in sub-Saharan Africa (SSA) next to South Africa.

Adoption of improved Sweet Potato Varieties in Boloso Sore Woreda, Southern Ethiopia M.Sc. Thesis (Unpublished) Presented to Alemaya University, School of Graduate Studies, Alemaya, Ethiopia (200).

Adugnaw Anteneh & Dagninet Asrat. (2020). Wheat production and marketing in Ethiopia: Review study.

AGRA. (2018). Africa agriculture status report: Catalyzing.

AGRA, Bachewe et al. (2018). Africa agriculture status report: Catalyzing government capacity to drive agricultural transf mation (Issue 6). Anne Marie Nyamu, Editorial, Publishing and Training Consultant.

Asres. (2005). Access and Utilization of Development Communication by Rural Women in Dire Dawa Administrative Council, Eastern Ethiopia. M.Sc. Thesis (Unpublished) Presented to School of Graduate Studies, Alemaya University.

Authority), C. S. (2009) Federal Democratic Republic of Ethiopia, Agricultural Sample Survey on major crop production, Addis Ababa, Ethiopia.

Bekele et al. (2000). Adoption of improved wheat technologies in Adaba and Dodola Woredas of the Bale highlands, Ethiopia. Mexico, d.f.: Iinternational Maize and Wheat Iimprovement Center (CIMMYT) and Ethiopian Agricultural Research Organizaton (EARO). .

Bingxin et al. (2011). Cereal Production and Technology Adoption in Ethiopia. Development Strategy and Governance Division. Int. Food Policy Res. Inst. 36p.

Chilot et al. (1996). "Factors influencing adoption of new wheat technologies in Wolmera and Addis Alem areas of Ethiopia." Ethiopian Journal of Agricultural Economics, 1: 63-84.

Chilot et al. (1996). Factors affecting adoption of new wheat technologies in Wolmera and Addis Alem areas of Ethiopia. Ethiopian J. Agric. Econ.1 (1):63-84

CSA. (2012). Agricultural sample survey report on area and production of major crops (Private peasant holdings, Meher season 2011/2012 (2005 E.C.)). The FDRE statistical bulletin, Volume VII.

CSA. (2012,2013,,2016,2017,2018). Agricultural sample survey report on area and Meher season 2011/2012 (2005 E.C.)). The FDRE statistical bulletin, Volume VII.

Determinants of Farmers Access to Information about Improved Wheat Varieties: Case of farmers in major wheat growing regions of Ethiopia. (2017). Kaleb Kelemu.

Doginet. (2001). Detrminants of adoption of High Yielding Sorghum Varieties in Nuno Zone: The Case of Manna and Kersa Woredas. An M.Sc Thesis Submitted to School of Graduate Studies, Alemaya University.

Dognet et al. (2001). Adoption high yielding varieties of maize in Jimma Zone. Evidence from Farm Level Data. Journal of Agricultural Economics, 5 (1&2).

EARO. (2001). "Technological package on bread wheat production.." Bread wheat regional project." National Wheat Research Program, Kulumsa Research Center.

Endrias. (2003). Adoption of improved Sweet Potato Varieties in Boloso Sore Woreda, Southern Ethiopia M.Sc. Thesis (Unpublished) Presented to Alemaya University, School of Graduate Studies, Alemaya, Ethiopia.

FAO. (2014). Analysis of price incentives for wheat in Ethiopia, Technical notes series, MAFAP, by Wakeyo.

FAOSTAT. (2014). FAO Statistical Data base for Maize production in Ethiopia: Food and Agriculture Organization of the United Nations, Rome.

Feder, G., Slade, R. (1984). The acquisition of information and the adoption of new technology. Amer. J. of Agric. Econ. 66(2): 312-320.

Feeder et al. (1985). "Adoption of agricultural innovations in developing countries: A survey." Economic development and cultural change, 33:255-298.

Freeman et al. (1996). 1996 The Role of Credit in the Uptake of Improved Dairy Technologies Ethiopian Journal of Agricultural economics 1: 1-17.

Girmachew. (2005). Determinants of Adoption of soil and water concervation practices in the envaroments of semin mountains: National Parks Eth. An M.Sc.

Habtemariam. (2004). The comparative Influence of Intervening variable in the adoption of Maize and Dairy Farmers in Shashemene and Debrezieit, Ethiopia. PhD Thesis, University of Pretoria.

Hundie et al. (2000). Selected Poster prepared for presentation at the International Association of Agricultural Economists (IAAE) Triennial Conference, Foz do Iguaçu, Brazil, 18-24 August, 2012. Page 1-5.

Itana. (1985). An Analysis of Factors Affecting the Adoption and Diffusion of Agricultural Technologies in Subsistence Agriculture A Case Study in Two Extension Districts of Ethiopia, M.Sc. Thesis, AAU.

Janvry et.al. (2001). Recent Advances in Impact Analysis Methods for Ex-post Impact Assessments of Agricultural Technology: Options for the CGIAR. Report prepared for the workshop: Increasing the rigor of ex-post impact assessment of agricultural research: A discussion on esti.

Kelemu, K. (2017). Determinants of Farmers Access to Information about Improved Wheat Varieties: Case of farmers in major wheat growing regions of Ethiopia.

Kelemu, K. (2017). Determinants of Farmers Access to Information about Improved Wheat Varieties: Case of farmers in major wheat growing regions of Ethiopia.

kenea. (2000). "On-farm analysis of durum wheat production technologies in central Ethiopia." In: CIMMMYT. The eleventh regional wheat workshop for Eastern, Central and South Africa, Addis Ababa, Ethiopia.

kenea. (2000)of improved varieties, high price and unavailability of augmenting technologies .

Million and Belay. (2004)Factorsinfluencing adoption of soil conservation measures in Southern Ethiopia. The case Gununo Area. Journal of Agricultural and Rural Development in the Tropics and Sub-tropics, 105(1): 49-62.

Minot et al. (2012).Agricultural production in Ethiopia: Results of the 2012 ATA baseline survey,International Food Policy Research Institute.

Mkinyahil. (2008).Analysis of Factors Influencing Intensity of Adoption of Improved Bread Wheat Production Package in Jamma District, South Wello Zone, Ethiopia. M.Sc.

Mulat et al. (1998). "Agricultural Market Performance and Determinants of fertilizer use in Ethiopia."Ministry of Economic Development and Cooperation: Grain Market Research Project, Working Paper 10, Addis Ababa.

Mulugeta. (1994)An economic analysis of smallholder wheat production and technology adoption in the South Eastern Michigan State University.highlands of Ethiopia. PH.D thesis,.

Nicostrato DP, Mark WR. (2015).The Impact of Investment in Agricultural Research and Development and Agricultural Productivity. IFPRI Discussion Paper 01447, Environment and Production Technology Division of the International Food Policy Research Institute (IFPRI), Washington, DC.

okelo, s. a. (2011). wheat is the commodity that will most easily find an export market to.supply

Samia. (2002)Innovative and Successful Technical Experience in the Production of Agricultural Statistics and Food Security of Ethiopia. Contributing Paper Presented at a Seminar on a New Partnership to Strengthen Agricultural and Rural Statistics in Africa for Poverty.

Sanjava, R. (2014).The world food prize, global and regional food consumption patterns and trends.

Shahin. (2004).Adoption of Innovations in Smallholder Buffalo Dairy Farms in the Menoufia Province in Egypt. PhD thesis, Menoufia University, Egypt.

Shiferaw et al. (2011).Future of Wheat Production in Sub-Saharan Africa: Analyses of the Expanding Gap between Supply and Demand and Economic Profitability of Domestic

Production. Paper presented at the Agricultural Productivity-Africa Conference 1-3 November 2011, UNECA, Addis.

Tadese et al. (2018). Wheat production and breeding in Sub-Saharan Africa challenges and opportunities in the face of climate Change Strategies and Management, 11(5), 696-715.

Taffese et al. (2012). Crop production in Ethiopia: Regional patterns and trends. International Food Policy Research Institute (IFPRI).

Techane. (2002). Determinants of fertilizer adoption in Ethiopia: The case of major cereal producing area. M.Sc. Thesis (Unpublished) Presented to School of Graduate Studies of Haramaya University, Ethiopia.

Tefaye et al. (2001). Adoption of Improved Bread Wheat Varieties and Inorganic Fertilizer by Small-Scale Farmers in Yelmana Densa and Farta Districts of Northwestern Ethiopia. Mexico, D.F.: Ethiopian Agricultural Research Organization (EARO) and International Maize and Wheat I.

Tesfaye et al. (2001). Adoption of Improved Maize Technologies and Inorganic Fertilizer in Northern Ethiopia: Research report no. 40. EARO, Addis Ababa, Ethiopia.

Tsefaye et al. (2001). Adoption of Improved Maize Technologies and Inorganic Fertilizer in Northern Ethiopia: Research report no. 40. EARO, Addis Ababa, Ethiopia.

Tsegaye Mulugeta Bekele Hundie. (2012). Impacts of Adoption of Improved Wheat Technologies on Households• Food Consumption in Southeastern Ethiopia.

UNDP. (2002). UNDP assistance in the fifth country program to the agricultural sector.

Word Bank. (2008). Agriculture for Development, World Development Report, Washington, DC. www.worldbank.org.

WUDU, B. (2017). DETERMINANTS OF ADOPTION OF IMPROVED WHEAT TECHNOLOGY:.

Yishak. (2005). Determinants of Adoption of Improved Maize Technology in Damot Gale Woreda, Wolaita, Ethiopia. M.Sc. Thesis (Unpublished) Presented to School of Graduate Studies, Alemaya University, Ethiopia.

Appendex1: Questionnaire

Date of interview (Date, Month, Year)‡‡‡‡..

Name of interviewer‡‡‡‡‡‡‡‡‡region ‡‡‡‡.woreda‡‡‡..

kebele‡‡‡‡‡.

Part I: Socio-Economic Characteristics

Name of respondent‡‡‡‡‡..sex 1 male ☐ 2 femal☐

age‡‡‡‡.year

1. Marital status 1Single☐ 2Marri☐ 3Divor☐ 4Wid☐ed
2. What is your educational level? illiter☐ liter☐
3. Number of household members (including you):‡---------------------(number

no	Livestock holding	NUMBER	Equivalence in cash (in birr	no	Livestock holding	no	Equivalence in cash (in birr
1	Oxen				Chicken		
2	Cow				Beehive		
3	Calves				Heifers		
4	Sheep				other specify it		

Part II: Information and Agricultural Extension service (access to extension services)

1, Do you have contact with extension agent? ☐ ☐o

2, If yes How often times you meet local extension agents in the last production year? Once a month 1☐ 2 twice a mor☐ 3 Three a mo☐ 4 More than thre☐

3,What were the positive advantage you get from the local extension agents in the last production year? Modern farming ☐ New harvesting ways ☐ Produced the more crops ☐

Other‡‡‡‡‡.

4. Have you ever attended any training or seminar on improved wheat variety last year ☐ Yes no ☐

5. If yes which topics were discussed? 1Wheat variety selection ☐ 2 Production of wheat ☐ 3. Wheat management practice ☐ 4Marketing of Wheat ☐ 5. Other specify________________

6. How far the nearest market from your farming area ?.............

Part III: Crop Production (improved seeds)

1Have you cropping improved seeds in 2019/20(2011/2012E.C production year? YES ☐ NO ☐

2 If yes, what type of improved seed you produced Last year?...... danfi (denda) ☐

Menza(har3008) ☐ dhasa(ETBW5795 ☐ avola(HAR1522 ☐ other specify‡‡..

3, If you have produced the wheat improved seed what was the size of land under Improved seeds (ha)? ‡‡ha

4, How much did you get production from of your improved wheat seeds?........quntal

5, Are the following factors hinders you from adopting the improved wheat varieties seeds? Risk aversion ☐ Price of seed ☐ Germination capacity ☐ Other•s specify------

V Pesticide and herbicides

1, Did you have used pesticides in the last production year? 1Yes ☐ 2 No ☐

2, If yes what type of pesticide did you have used? 1Herbicides ☐ 2 insectcide ☐

3,If yes when did you have used the pesticides? 1During croping ☐ 2 During weedin ☐

3During ploughing ☐ Others please sepsify‡‡.

4, What factor that hinders you in the use pesticides? 1The price pesticide ☐ 2 Supply of pesticides ☐ 3The techiqes of us ☐ Other spe ☐

5,What factor that hinders you in the use pesticides? 1The price pesticides 2 Supply of pesticide ☐ 3The teqhes of using ☐ Other spesify-----

Part Vi accesses to fertilizer

1.Did you have used fertilizer In the last production year? 1 ☐ ☐o

2.What types of felitrazer did you ave used?

1.Dap ☐ 2 organic cpomund ☐ 3others specify----------------------

3.When did you have used the felitrazer? 1During croppin ☐ One month after cropp ☐ Two weak after cro ☐g Others specify‡‡‡.

4,How often have used felitrazer in one production crop peroied? Once ☐ Twic ☐ Thrice ☐ More than three

5.What factor that hinder you from using the fertirazer ?1cost of fer ☐ nature of the soil types ☐ 3. lakes of awaren ☐ others specify--------------------

Part vii: access to credit

1. Did you have used credit In the last production years? Yes1 ☐ 2 NO ☐

2. What was the source of credit did you have used? 1Ethiopacommercial ban ☐ 2 saving and credit institution ☐ 3. from individua ☐ 4. others private banks specify------------------

3. What was the purpose of credit? 1To buy crops ☐ 2To buy fertilizer ☐ 3buy pesticide ☐ others specify-------------------

4. Often have used credit in one production round?

1 Once ☐ 2Twice ☐ 3 Thrice ☐ More than three

5. What were the problems that hinder you from using the credit?

1lakes of awareness ☐ 2. lake of access credit institution ☐ 3. lake of good gov.e management ☐ 4. Others specify----------------

Part viii Income from off-farm activities

Labor employment-------------------Handcraft------------------------------

Brewery--------------------------------Remittance----------------------------

Others---------------------------------

The farmerƒs total farming income

Wheat ,,,..quntal maize ,,.qtl teff ,, qtl barley,,.qtl

Land size and ownership

3.1 Size of total farm holding (timad)------

3.2 How many parcels of land do you have?----

3.3 What is the size of each parcel? (timad)-----

3.4 Area under cultivation (timad)----

3.5 Area under fallow (timad)-------

Soil typology

Soil color 1.Black heavy soil .Medium light or loam soil3.Light soil 4.Sandy poor soil

Land slop 1. steep or hilly(> 13% 2. Gently slopping or rolling (2-13% 3.flat (0-2%)

Fertility 1. Fertile 2. average Fertile 3. Less fertile 4. Unfertile

Erosion control 1. contour (terracing)2. trees 3. grazing patch 4. Others (specify‡

Appendix 2: variance inflation factor

Vif

Variable	VIF	1/VIF
FERTILIZER	4.02	0.248668
PESTICIDE	2.88	0.346757
EDUC	2.22	0.451076
COEXAGENT	2.20	0.454764
FARMSIZE	1.20	0.831903
DISTANCE	1.20	0.833003
AGE	1.19	0.840345
FERTILITY	1.16	0.862934
CREADIT	1.15	0.867362
LIVESTOKE	1.13	0.888774
SEX	1.13	0.888880
SOILTYPE	1.12	0.895419
FARMINCOME	1.10	0.912421
FAMILYSIZE	1.09	0.921500
OFFFARM	1.06	0.943520
Mean VIF	1.59	

Appendix: 3 probit output

ADOPTION	Coef	Std. Err.	z	P>|z	[95% Conf. Interval]	
Sex	-.0685408 -	.6358656	-0.11	0.914	1.314814	1.17773
AGE	.0354108	.0341723	1.04	0.300	-.0315657	.1023873
EDUC	3.015258	1.008751	2.99	0.003	1.038142	4.99237
FAMILYSIZE	.1193465	.1646901	0.72	0.469	-.2034402	.4421331
LIVESTOKE	.1067487	.0737731	-1.45	0.148	-.2513414	.037844
COEXAGENT	3.473885	1.384713	2.51	0.012	.7598979	6.187872
DISTANCE	-.0529344	.0513894	-1.03	0.303	-.1536558	.0477869

PESTICIDE	6.09289	1.635758	-3.72	0.000	-9.298916	-2.886864
FERTILIZER	3.649152	1.214562	| -3.0	0.003	-6.02965	-1.268654
CREADIT	1.14605	-.690580	-1.66	0.097	-2.499562	.2074624
FARMSIZE	-.567945	.4968873	-1.14	0.253	-1.541826	.405936
SOILTYPE	.0347469	.3280921	0.11	0.916	-.6083018	.6777956
FERTILITY	2.16051	.7579234	-2.85	0.004	-3.646013	-.6750078
OFFFARM	-.0000165	.0000506	-0.33	0.744	-.0001158	.0000827
FARMINCOM	.0730845	.0417741	1.75	0.080	-.0087913	.1549603
_cons	9.967671	3.92268	0.011	2.54	2.279359	17.65598

Appendix 4: marginal effect after probit

Average marginal effects Number of obs = 356

Expression : Pr(ADOPTION), predict()

dy/dx w.r.t. : SEX AGE EDUC FAMILYSIZE LIVESTOKE COEXAGENT DISTANCE PESTICIDE FERTILIZER CREADIT FARMSIZE SOILTYPE FERTILITY OFFFARM FARMINCOME

dy/dx		Std.Err	. z	P>z	[95%Conf. Interval]	
SEX	-.0017248	.0159765	-0.11	0.914	-.0330381	.0295886
AGE	.0008911	.0008334	1.07	0.285	-.0007424	.0025245
EDUC	.0758762	.0208644	3.64	0.000	.0349827	.1167697
FAMILYSIZE	.0030032	.0041301	0.73	0.467	-.0050916	.0110981
LIVESTOKE	-.0026862	.0018041	-1.49	0.136	-.0062222	.0008498
COEXAGENT	.0874171	.0298406	2.93	0.003	.0289306	.1459036
DISTANCE	-.001332	.0012457	-1.07	0.285	-.0037737	.0011096
PESTICIDE	-.153322	.0306441	-5.00	0.000	-.2133832	-.0932607

FERTILIZER	-.0918276	.0245122	-3.75	0.000	-.1398706	-.0437845
CREADIT	-.0288393	.0171947	-1.68	0.093	-.0625402	.0048616
FARMSIZE	-.0142918	.0121837	-1.17	0.241	-.0381715	.0095879
SOILTYPE	.0008744	.0082533	0.11	0.916	-.0153018	.0170506
FERTILITY	-.0543673	.0164527	-3.30	0.001	-.0866141	-.0221205
OFFFARM	-4.16e07	1.27e06	-0.33	0.743	-2.91e06	2.07e06
FARMINCOME	.0018391	.0009891	1.86	0.063	-.0000996	.0037778

Appendix 5: truncated regression output

runcated regression

Limit: lower = -inf		Number of obs = =	356
upper = +inf		Wald chi2(15) =	38.71
Log likelihood =-875.0969		Prob > chi2 =	0.0007

INTENSITY	Coef.	Std. Err.	Z	P>z	[95% Conf.	Interval]
SEX	-.452393	.3683944	-1.23	0.219	-1.174433	.2696468
AGE	.0298816	.0158913	1.88	0.060	-.0012647	.0610279
EDUC	.9126648	.4464215	-2.04	0.041	-1.787635	-.0376947
FAMILYSIZE	.0667862	.0848585	0.79	0.431	-.0995334	.2331057
LIVESTOKE	-.1469341	.0437814	-3.36	0.001	-.2327442	-.0611241
COEXAGENT	.1728682	.4681254	0.37	0.712	-.7446408	1.090377
DISTANCE	-.0082548	.041638	-0.20	0.843	-.0898638	.0733542
PESTICIDE	1.120769	.5131764	-2.18	0.029	-2.126576	-.1149619
FERTILIZER	.7803263	.609636	-1.28	0.201	-1.975191	.4145383
CREADIT	-.7551522	.3396381	-2.22	0.026	-1.420831	-.0894737
FARMSIZE	-.0940855	.2202027	-0.43	0.669	-.5256748	.3375039
SOILTYPE	.1227334	.1694482	0.72	0.469	-.2093789	.4548457
FERTILITY	.3417567	.2522378	-1.35	0.175	-.8361337	.1526202
OFFFARM	3.30e06	.000017	0.19	0.846	-.0000299	.0000366
FARMINCOME	.0114942	.0116379	0.99	0.323	-.0113157	.0343041
_cons	6.835479	2.083047	3.28	0.001	2.752781	10.91818
/sigma	2.826951	.1059445	26.68	0.000	2.619304	3.03459

Appendix 6: marginal effects after truncation

Marginal	effects after truncreg					
Y	= Linearprediction (predict)					
= .64589888						
Variable	dy/dx Std. Err. Z	P>z	[95%	C.I.]	X	
SEX	-.452393 .36839 -1.23	0.219	-1.17443	.269647	1.247	
AGE	.0298816 .01589 1.88	0.060	-.001265	.061028	40.14	
EDUC	-.9126648 .44642 -2.04	0.041	-1.78763	-.037695	1.483	
FAMILY~	.0667862 .08486 0.79	0.431	-.099533	.233106	6.216	
LIVEST~	-.1469341 .04378 -3.36	0.001	-.232744	-.061124	12.49	
COEXAG	.1728682 .46813 0.37	0.712	-.744641	1.09038	1.342	
DISTANC	-.0082548 .04164 -0.20	0.843	-.089864	.073354	15.19	
PESTIC~E	-1.120769 .51318-2.18	0.029	-2.12658	-.114962	1.435	
FERTIL~	-.7803263 .60964-1.28	0.201	-1.97519	.414538	1.415	
CREADIT	-.7551522 .33964 -2.22	0.026	-1.42083	-.089474	1.660	
FARMSIZ	-.0940855 .2202 -0.43	0.669	-.525675	.337504	2.080	
SOILTYP	.1227334 .16945 0.72	0.469	-.209379	.454846	2.300	
FERTIL~	-.3417567 .25224 -1.35	0.175	-.836134	.15262	1.598	
OFFFAR	3.30e06 .00002 0.19	0.846	-.00003	.000037	1948	

FARMIN~	.0114942	.01164	0.99	0.323	-.011316	.034304	22.91