ST. MARY'S UNIVERSITY

SCHOOL OF GRADUATE STUDIES

BY

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JUNE, 2014

"ASSESSING THE ROLES OF FARMER'S RESEARCH GROUP (FRG) IN POTATO TECHNOLOGY ADOPTION: A CASE STUDY OF WELMERA WEREDA, OROMIYA SPECIAL ZONE, ETHIOPIA"

A Thesis Submitted to St. Mary's University in Partial Fulfillment of the Requirements for the Degree of master in rural development

June, 2014

Addis Ababa

ENDORCEMENT

As thesis research advisor, I hereby endorse that I have read and evaluated this thesis prepared by Ayalew Adela, entitled"Assessing the Roles of Farmer's Research Group (FRG) in Potato Technology Adoption: A case study of Welmera Wereda, oromiya special zone, Ethiopia". I recommend that it can be submitted as fulfillment of the thesis requirement.

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BOARD OF EXAMINERSE

As member of the Board of Examiners of the MA thesis open defense examination, we certify that we have read, evaluated the thesis prepared by Ayalew Adela Worku and examined the candidate. We recommended that the thesis is accepted as fulfilling the thesis requirement for the Degree of Master in Rural Development.

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Declaration

I declare that this thesis is my original work and all sources or materials used for this thesis have been properly acknowledged. This thesis is submitted in partial fulfillment of the requirements for M.A. degree in Rural Development at St. Mary Universityand it has never been submitted to other universities in Ethiopia or abroad for the acquisition of any other degree. The thesis can be made available to the University's Library under the rules of the Library.

Name: Ayalew Adela Worku

Signature: ……

Place: St. Mary University

Date of Submission: June, 2014

DEDICATION

This piece of work is dedicated to the memories of my late parents
Wro, Asgdech Adenew and Ato Adela Worku
Who laid a strong and firm foundation for my education and my present status

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LIST OF ABBREVIATION

CSA----------Central Statics Authority

GDP----------Gross Domestic Product

ADLI----------Agricultural Development Lead Industrialization

NARS----------National Agricultural Research System

T&V----------Training and Visiting

TOT----------Transfer of Technology

PADETES----------Participatory Demonstration and Training Extension System

FSR----------Farming System Research

EIAR----------Ethiopian Institute of Agricultural Research

FRG----------Farmers Research Group

COR----------Clint Oriented Research

REAC----------Research Extension Advisory Council

M&E----------Monitoring and Evaluation

CBPR----------Community Based Participatory Research

FPR---------- Farmers Participatory Research

PLA----------Participatory Learning Action

PTD----------Participatory Technology Development

PRA----------Participatory Rural Appraisal

FFS----------Farmers Field School

NGOs----------Non-Governmental Organization

WCARRD----------World Conference on Agrarian Reform and Rural development

US----------United State

SIDA----------Swedish International Development

CADU----------Chelalo Agricultural Development Unit

WADU----------Wolayeta Agricultural Development Unit

ARDU---------- Arsi Rural Development Unit

FAO---------- Food and Agriculture Organization

MPP I ----------Minimum Package Program First

MPP II----------Minimum Package Program Second

PADEP----------Participatory Agricultural Development Extension Program

IFAD----------International Fund For Agricultural Development

DA----------Development Agent

EEA----------Ethiopian Economic Association

SG2000----------Sasakawa Global 2000S

SNNP----------South Nation and nationalities peoples

EMTP----------Extension Management Training Plots

NARSE----------National Agricultural Research System of Ethiopia

IAR----------Institute of Agricultural Research

EARO----------Ethiopian Agricultural Research Organization

OFR----------On Farm Research

IDRC----------International Development Research for Canada

ARC----------Agricultural Research Center

JICA----------Japan International Corporation Agency

CIAT----------International Center of Tropical Agriculture

MOA----------Ministry Of Agriculture

AKIS----------Agricultural Knowledge Information System

RELC----------Research Extension Linkage Council

REFLAC----------Research Extension Farmers Linkage Advisory Council

RELAC----------Research Extension Linkage Advisory Council

ADPLAC----------Agricultural Development Partners Linkage Advisory Council

CIP----------Centro International de la Papa

LB----------Late Blight

OARI----------Oromiya Agricultural Research Institute

OA----------Office of Agriculture

R&D----------Research and Development

IAASTD----------International Assessment of Agricultural Knowledge, Science & Technology

TLU----------Tropical Livestock Unit

ACKNOWLEDGEMENTS

First and foremost I praise and honor the almighty God in the name of the Lord Jesus Christ for his mercy and help in all aspects my life and who offered me this opportunity to pursue and complete my M.A studies.

I am greatly indebted to my beloved wife Tsehay Tadesse and my sister Felekech Adela with Gods` help who supported me much to accomplish this study.

My great gratitude goes to my advisor Dr. Mulugeta Taye for his guidance in my research work starting from proposal development, to the completion of the thesis write up and his commitment to support me to complete the research work on time.

I am greatly indebted to my brothers Mr. Gebermedhin Woldegiorgis and Getachew Alemu for their unreserved help, advice, insight the guidance and financial support to my study and field work without their professional help it would be difficult to be successful in my academic, research work and thesis write up.

I would also like to carry my gratitude to Dr. Aster Yohanse (Director of HARC), Ato Daniel Muleta, Ato Getahun Meteku, Ato Germew Taye, Ato Temesgen Desalgne, Dr Anegaw Tsige Dr. Berehanu Kuma, Ato Ali Mohamed, Ato Dereje Fekadu and Ato Mesfen Tesera for their valuable support and advice to complete this study

I would like to give my special thanks to Dr. Zenebe Ademasu who served me as co-advisor to my thesis work.

My special gratitude goes to Ato Abebe Chefo, Ato Fekadu Amesalu, Ato Assefa yelema and Ato Abesha Shifa for their continuous support to complete this study

I would like also thanks to all the enumerators the members of the sample farm households and key-informants for their valuable cooperation during data collection at the peak time of agricultural activity in the area

My gratitude also goes to My sisters Etenesh Adela, Hana Adela, Ato Bezuneh Kebed W/o Bezawite Bezuneh, Ato Asrat Yeznegawe, Fistium Bezuneh, my children Natnael Ayalew, Ruhama Ayalew, Nahom Wondoson, Crisetan Aserate who prayed for me to be successful

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ABSTRACT

The main focus of this study was to assess the roles of FRG for the adoption, extent and determinant factors of improved potato production package in Welmera wereda. The sample size of the study was 130 households, of which 54 were FRG members and 76 were non-FRG members. The samples were taken from two administrative kebeles. The sampled respondents were interviewed by using structured interview schedule. Group discussion was also undertaken with selected farmers, development agents and researchers to gather the qualitative data and SWOT analysis in the selected kebele administration. For data analysis, statistical tests like chi-square, t-test, and one way ANOVA were used to test the variation among the FRG and non-FRG. The econometric model Tobit was used to identify the effect of the hypothesized variables on the dependent variable. The result of the econometric model indicated that educational level of respondent, total land holding, accesses to research and access to extension were found significant to influence adoption of improved potato production packages. In general, this study found that FRG approach has contributed to significant extend for adoption of improved potato production technology. The most important thing mentioned by the respondents were non-FRG participant farmers have very great interest to be a member of FRG. The overall finding of the study underlined different stakeholders involvement is crucial to strengthen existing FRGs and in the formation of new FRGs.

CHAPTER ONE

1. INTRODUCTION

1.1. Background

Ethiopia is one of the least developed countries in the world with a total population of 87 Million (CSA, 2013) of which about 82.72% lives in the rural areas (World Bank 2012). Agriculture is the main sources of livelihoods for the majority of the people and contributes 46% of the Growth National Product (GDP), 84% export revenues, 85% of employment and contributes around 70% of the raw materials requirements for agro-based domestic industries. The sector is largely subsistence dominated by smallholders and yet it is the major source of food and livelihood for the majority of the population. However, the sector has not developed enough to change the livelihood of the rural community (Abera, 2001). Despite its lion share in the economy, the development of the sector has been slow for many decades. Many factors have been holding back agricultural sector development in the country of which the major ones include adverse environmental condition, rapid population growth, traditional production inputs used by the farmers, ineffectiveness of extension system, and weak linkage between research and dissemination partners and farmers.

Agriculture being the dominant sector of the economy it can play a great role in the overall development of the economy, particularly in deteriorating standard of living of people by reversing problems of food insecurity through increased productivity (Legesse, 2002).

In order to increase agricultural productivity and enhance economic growth of the country, the Ethiopian government has been developing and introducing different

agricultural development policies and strategies over the last five decades. Agricultural research was one of the major agricultural technologies deliveries by government for rural transformation.

The establishment of Agricultural Research by the government was taken as one strategy to develop and advance agricultural technologies for possible rural transformation. Agricultural extension system which is accountable for the dissemination of these technologies accordingly, many improved technologies generated by various research centers and universities available in different agro ecologies of the country can be disseminated.

Despite the long term effort, of agricultural technologies developments most farmers resisted the technology adoption and continued practicing using their traditional agriculture. Many studies indicated that adoption of the technologies generated through the conventional research process was minimal. The commonly mentioned reason for low uptake of the technologies by farmers was incompatibility of the technologies generated with the farmers' real situations.

According to Ejigu and Pound (2002) and Abera and Fasil (2005), technologies generated on station with limited involvement of farmers were not usually relevant because there were few opportunities to consider the socio-economic and agro-ecological circumstances of the end user. According to Tilahun*et al.* (2002), the well-intended top-down research effort often achieved little because it did not consider the biophysical and socioeconomic conditions of the farmers.

Therefore, recently the importance of involving stakeholders in research has been recognized to be crucial to maximize research impact. According to Elias (2005) research planning often failed to appreciate the participation of the stakeholders. However, over yearsofstakeholders' participation and client orientation in research planning, implementation, monitoring and evaluation have become an important concern and focus of attention.

The conventional top-down research and extension systems, that assume scientists as knowledge generators, extensionists as knowledge conduits and farmers as passive knowledge recipients challenged over the past several years was one of the grounds for looking and testing other alternatives. Various assessments and studies conducted in Ethiopia have indicated that technologies developed at research centers without participation of end users have little contribution to increased production and productivity and valued as low by farmers (Chimdo, 2008) this is due to the fact that the technologies that were generated from the view point of researchers had a little chance in meeting the actual farmers needs and solving their critical problems.

Agricultural technology generation, intervention and dissemination mechanisms may not looked the existing socio-economic and other conditions of the target group. In order to change the situation, many stakeholders from government and non-governmental organizations have designed and implemented different types of participatory research approaches for technology generation and dissemination.

The government of Ethiopia provided great emphasis to improving the agriculture sector as core means to support industrialization for economic growth of the nation and poverty

alleviation. Agricultural Development Led Industrialization (ADLI) strategy has been launched by the government to promote market led economy and to overcome widespread poverty. This change in strategies and global forces demanded due attention to transform National Agricultural Research System (NARS) to more efficient and effective organization through increased involvement of clients (Solomon, 2007).

The adoption by farmers of improved technologies developed in research center was found to be very low and the return is said to be insignificant when one compares the investment in research and its outcomes. AS it is repeatedly stated by practitioners and researchers alike, farmers are still mostly considered as passive recipients of technologies developed by researchers despite their rich experience, knowledge and capacity to both investigate and generate useful idea that would set and guide the research agenda. This has become an important concern and focus of attention by individuals, policy makers and social researchers that ultimately led to the turning point to participatory research (Chambers, 1997)

After many years of efforts and huge investment in the conventional research approach the Ministry of Agriculture(MOA) adopted various approaches in agriculture including transfer of technology (TOT),Training and Visit (T&V), Participatory Demonstration Training Extension System (PADETES), Farmers Field School, Package Testing, Multidisciplinary Survey Approach and Farming System Research (FSR), were the major participatory research approaches promoted through NARS until 1997.

Participatory research approaches improve involvement of stakeholders in general and farmers in particular. In these participatory approaches the extent of farmer participation

remained consultative and thus the impact of research on the livelihood improvement of farmers and on economic growth remained minimal (Elias, 2005). Although those approaches have contributed to the growth in agricultural production they have never produced the desired outcome (Habtemariam, 2007). Despite the fact that due attention was given to the agricultural extension for the introduction of modern agricultural technologies, it has overlooked the knowledge and experience of rural community (Belay,2003).The extension approaches followed top-down, supply-driven system instead of encouraging the knowledge of the local people. The trend of past experience of technology generation indicated that technologies have been generated for the fulfillment of academic interest without focusing on the real problems and the need of farmers (Belay, 2003).

The extension system was not designed in a way to enhance gender equality, participation of the target groups in the research and extension and consider the concerns and interests of the targeted community in the extension system.

During the design knowledge and experience of the local people as well as their innovation and innovativeness have not been considered in the implementation process and relevant actors that have high stake in the extension system have not been identified and/or have been overlooked that affected the learning process among stakeholders.

In order to change the top-down approach and solve the observed problems the extension approaches adopted to participatory methods. Especially in the late 1990s, participatory methodologies that enhance active participation of small group of farmers in research emerged and become popular in many countries. This new methods of engaging or

involving farmers in the research process was found to be an entry point for minimizing the existing wide gaps between research, extension and farmers which is a turning point to active participation of farmers and a means for matching needs and potential technologies developed in research centers

To strengthen the link between farmer, research and extension service, alternative extension approaches that can considered the interest and issues of all parties have been considered by different institutions. The EIAR has introduced client oriented extension approach namely, Farmers Research Group (FRG) a more participatory research approach since its launching in June 2004.

Development partners, researchers and extension workers have started to consider farmers knowledge and to promote demand driven, client oriented research to improve impact of research.

1.2. Statement of the problem

As it is stated above the extension approach implemented for years follows the top - down and supply- driven approach where researchers try to solve farmers problems, In this system extension people directly pass the information obtained by researchers while farmers are recipients of technologies and are there considered passive. This approach could not directly address the real and felt needs of the farmers. Technologies generated on station through the conventional research approach with limited involvement of farmers, were not usually relevant to farmers` need and they are less adopted by farmers (Abera and Fasil, 2005). This indicates that, low uptake of improved technologies by farmers is associated with technology generation process which does not adequately

involve farmers and other stakeholders; this does not enable to solve diverse interest and complex site specific problems of farmers. Besides, weak linkages between research institutes and key stakeholders wear additional constraints of effective generation, dissemination and utilization of technologies.

Knowing of the inadequacy of conventional approach to research and extension, EIAR has been implementing various types of Farmer Participatory Research approaches at different agro ecology of the country to make research process participatory and thereby enhance adoption since 1975. However, approaches adopted by the NARS before 1998 did not contribute as expected because of low participation of farmers and poor linkage between farmers and other stakeholders in research and development. It was only consultative and informal therefore, acceptance was remaining low. According to Agajie*et al.* (2002), even though, farming system research (FSR) has made positive contribution in improving impact of research the adoption level of the agricultural technologies was below expectations.

Later, in 1998, more participatory approach i.e. Client Oriented Research (COR) approach was launched by EIAR through FRG strategy to raise the involvement of clients in research and extension process and thereby improve research impact. Research and Extension Advisory Council (REAC) was the institutional arrangements organized at national, regional and zonal levels to strengthen linkage among the major clients to make research effective and responsive to the demand of the clients.

The target area, Welemerawereda, is a potential vegetable growing wereda and potato is the dominant tuber crop cultivated for commercial and consumption purpose. Due to this,

a number of potato producing FRGs were established. Since year 1998, various improved potato cultivars with their package practices have been introduced, demonstrated and verified through established FRGs by the Holeta Agricultural Research Center (HARC).

FRG strategy assumed to transform research process from consultative to collaborative and also increase participation of different stakeholder's to enhance agricultural technology adoption. However, so far there is little systematic study conducted to assess the materialization and its contribution in enhancing agricultural research through strengthening participation of the client. Therefore, this study was initiated to assess the contribution of the newly introduced research and extension strategy (FRG) in enhancing client-oriented and demand-driven technology generation and adoption.

1.3 Objective of the study

The general objective of this study is to address the contribution of FRG approach in making the research process problem/action oriented and enhance potato technology adoption

The specific objectives of the study are to assess:

1. The roles played by FRGs in enhancing client oriented improved potato production technology adoption by farmers.

2. Opportunities and constraints encountered with the FRG approach to improved potato production technology adoption by farmers.

3. Extent of adoption of potato production technology packages in FRG members

Farmer

1.4 Research Questions

1. What are the roles played by FRG in enhancing client oriented improved potato production technology adoption and dissemination?

2. What are the opportunities and constraints of working with FRG?

3. What is the extent of use of improved potato production technology package in FRGs member's farmers?

1.5 Scope of the study

This study was conducted only in two kebeles from one wereda FRGs and only one hundred and thirty potato producers' farmers (respondents) were involved. Assessing client orientation has a wide range that encompasses, among others human resource, financial management, linkage and coordination, planning, implementation, Monitoring and Evaluation (M&E), dissemination and access to information. Due to limitation of time and other resources, this study did not adequately carried out the detailed investigation of institutional aspects.

1.6 Significance of the Study

There is growing interest in participatory approach to speed up farmers` participation in research and broaden the impact of research. Remarkable group based participatory research approaches are spreading widely in the world in general and in the country, in particular. In recent years, public agricultural research service delivery is put under increasing pressure due to reluctance of both donor and central government to fully finance it. Therefore, Client Oriented Research (COR) applications that emphasize

equity, capacity building, maximize involvement of clients in research process to finance/co-finance research are highly appreciated.

However, the issue of assessing their performance and impact on technology generation and adoption is a central concern. Studying the relations and cooperation of inter institutional and interdisciplinary actors that surround FRG from innovation perspective and its impact on research output was crucial. Understanding this helps in identifying the gaps and deficiencies for improvement effort. Therefore, result of study will be instrumental to fine-tune the approach for enhanced impact of research on improved technologies generation and adoption to the sustainable agricultural development.

The entry point of this study is used for further study by agricultural researchers about FRG approach to technology generation, dissemination and adoption and also can be evaluate farmer's participation in terms of knowledge, attitude and income etc. The findings of this study therefore will be shared within the NARS, extension system and other various institutions working on participatory research which can help for further refinement and improvements of the approach and give direction for policy makers in order to maintain or design appropriate policy formulation.

CHAPTER TWO

. LITERATURE REVIEW

2.1. Review of Key Concepts

In this chapter key concepts relevant to the theme of the study have been reviewed. The word Farmers Participation,Farmer Participatory Research (FPR), Agricultural Extension Approaches followed so far in Ethiopia, participatory research in the national agricultural research system of Ethiopia.Recently new participatory research and extension methodology FSR, Farmers Field School (FFS), Client Oriented Research (COR) etc. developed and used in wider scale (Chimdo*et al*., 2005). According to Agajie*et al*. (2002), it is understood that the concept of the family of participatory approaches like FSR, FPR, FFS, COR etc. are unclear and seems to similarity each other and no clear demarcation line was drawn among them. Therefore, a clear definition of the concept of participatory research approach is important before additional discussion on related subjects.

2.1.1 Farmers Participation

Farmer participation in research is not a new concept in Ethiopia, similar to other parts of the world. Farmer participation portrays an acceptance of the fact that farmers are knowledgeable in identifying problems and finding solution to their own problem to meet their needs. It means that stakeholders such as researchers and extension workers give support to farmers in their own efforts to change their farming system. They Support to enhancing farmers` capacity to change their farming system in a sustainable way and to increase their control over resource and decision making to make their farms more

profitable affecting their farms. Several years ago, in Ethiopia, different strategies have been employed to make the agricultural technology generation adoption processes more participatory. It is hard to give single definition of participation as a practice. We can have normative, descriptive or literal meaning. Literally to participate means for some people to take part in or be involved in. In this case participation is everything people do. In normative and descriptive terms participation includes process, through which stakeholder's influence and share control over development initiatives and decisions and resources (Leeuwis, 2004). Farmers Participation in agricultural projects means putting responsibility in the hands of farmers to determine agricultural programs which can make services more responsive to the local conditions, accountable, effective, sustainable and clear definition of roles and responsibilities. According to (salam,2004) farmers Participation in technology generation and adoption projects was due to participants knowledge, skills, claims and assurance of long-term rights so that they are assured of receiving the benefits of the protected and improved agricultural system and natural resources. According to Barret (2008), the most important factor in stimulating farmer's participation would be providing opportunities to increase income utilize income and benefit from agriculture.

Participation is classified into five types based on forms and level of participation Leeuwis 2004).These is receptive, passive, consultative, collaborative and self-mobilization. Receptive is when participants are only informed/told about the intervention while the passive one is when participants can respond to questions and issues that interventionist dream for making decision Consultative participation is when participants are asked about their views and opinions openly and without restriction. In

the collaborative type, participants are partner and jointly decide on the issue and self-mobilization is when participants initiate, work on and decide on independently

2.1.2 Overview of agricultural extension in Ethiopia

Agricultural extension is « a service or system which assists farm people, through educational procedures, in improving farming methods and techniques, increasing production efficiency and income, bettering their levels of living and lifting the social and educational standards of rural life ». A definition, revised in the light of the World Conference on Agrarian Reform and Rural Development (WCARRD) and other developments since 1973, might refer specifically to men, women, youth, and the most disadvantaged groups in general, encouraging and involving rural people's own organizations, enhancing individual and collective self-reliance, and environmental and population issues.

When we look at the history of economic growth and development in general, only very few countries have succeeded sustainable economic growth without priority or simultaneously developing their agriculture (Birkhaeuser *et al*., 1991). Therefore, in least developed countries like Ethiopia, improving the performance of the agricultural sector is the best alternative to show the way out of poverty and hunger. Though, there is potentially cultivable land in the low lands of the country, high population growth rate makes the expansion of farmland difficult in the highlands. As a result land size is diminishing from time to time and even there are landless families in the rural Ethiopian highlands nowadays. Degradation that results from intensive cultivation, overgrazing, short or zero fallow periods, cultivation of steep slopes etc. was observed in the country

long time ago. These and many other problems necessitate bringing in the idea of agricultural extension in the county to minimize the gap between the demand and supply of food, to reduce the pressure on the natural resources, and to prevent land degradation. Without any doubt, the outward shift in production possibility frontier needs transformation of the agricultural sector by the use of improved agricultural technologies, and interventions like extension to the rural mass (Wale and Yalew, 2007). At least more than 50 years have been spent since the idea of extension was brought in to the country. However, more has been said than done practically, about the Ethiopian agricultural system in bringing the expected change in the rural communities of the country (EEA, 2006).

The beginning of agricultural extension service and the effort of the government to modernize the agricultural sector dates back to the establishment of the Ministry of Agriculture, the former 'Yersha Mesriabet', in 1908 (EEA, 2006).

The mandate of Ministry of Agriculture was provision of advice on crop and livestock production, protection of wildlife and forest resources, provision of veterinary services, and at the same time collection of relevant statistical information. However, since then the Ministry has undergone frequent restructuring and reforming, both in the staff under it and the institutions and programs to be followed. For the past three decades alone, the Ministry of Agriculture has passed through at least ten big restructuring and reforming Processes (Ibid, 2006) under this frequently reformed institution with new program coming in every time, the approaches followed by the extensionists to reach farmers were also different. As a result different extension programs were following different

approaches to reach the farmer. Generally there are many different extension approaches existing today

2.1.3 Concepts of Adoption

Adoption is defined as the degree of use of a new technology in long-run equilibrium when a farmer has all the information about the new technology and it's potential. Adoption refers to the decision to use a new technology, method, practice, etc. by a firm, farmer or consumer. Adoption of the farm level (individual adoption) reflects the farmer's decisions to incorporate a new technology into the production process. On the other hand, aggregate adoption is the process of spread or diffusion of a new technology within a region or population. Therefore, a distinction exists between adoption at the individual farm level and aggregate adoption, within a targeted region or within a given geographical area (Feder*et. al.*, 1985).

If an innovation is modified periodically, the adoption level may not reach equilibrium. This situation requires the use of economic procedures that can capture both the rate and the process of adoption. The rate of adoption is defined as the proportion of farmers who have adopted new technology overtime. The incidence of adoption is the percentage of farmers using a technology at a specific point in time (e.g. the percentage of farmers using fertilizer) The intensity of adoption is defined as the aggregate level of adoption of a given technology e.g., the number of hectares planted with improved seed. Aggregate adoption is measured by the aggregate level of use of a given technology with, in a geographical area (Feder*et. al.*, 1985).

Adoption is a decision to make full use of an innovation as the best course of action available or extended use of the innovation in terms of time and extent (Ray, 2001). Adoption is a process composed of learning, deciding and acting over a period of time. Adoption is applying an innovation on a large scale in preference to old methods (van den Ban and Hawkins, 1996). Final adoption at the farmers' level is defined as the degree of use of a new technology in the long-run equilibrium when the farmer has full information about the technology and its potential uses (Degnet, 1999).

Adoption is not a sudden event, but a process. Farmers do not accept innovations immediately; they need time to think things over before a decision (Adams, 1982; Dasgupta, 1989). The adoption process is a decision making process involving a period of time during which an individual goes through a number of mental stages before making a final decision to adopt an innovation (Dasgupta, 1989). Decision making process is the process through which an individual passes from first knowledge of an innovation, to forming an attitude toward an innovation, to a decision to adopt or reject, to implementation of the new idea, and to confirmation of the decision (Ray, 2001; Leeuwis, 2004).

2.1.4 Empirical findings of adoption

A lot of adoption studies were carried out by different authors in different areas. The adoption studies reviewed from literatures for various crops is presented below: The study done by Gerhart (1975) states that the presence of drought-resistant crops in the farmers' crop mix, used as a proxy variable for risk perception, was significantly and negatively related to adoption. Income from cash crops, formal education, knowledge of

credit, extension visits, attendance at farmers training center courses and attendance at demonstrations were found positively related to adoption. Schultz (1975) suggested many testable hypotheses: that the probability of adoption of a new technology will depend on the difference in profitability between the new and old technologies; and the ability of the farmer to perceive the advantage and efficiently utilize the new technology (often measured by education, farming experience and exposure to extension service).

A study in Nigeria conducted by Voh (1982) shows the factors affecting the adoption of recommended farm practices. These were education, access to market, extension contact, socio-economic status, leadership role in farm matters and practicing subsidiary activities, which were positively related to adoption of new technologies. But the studies are mainly concerned with major cereals and due to this reason studies conducted in the area of horticultural crops particularly potato is very limited. For ease of clarity the variables so far identified as having relationship with adoption are categorized as household personal variables, socio-economic factors, psychological variables and institutional factors.

2.1.5 Potato technology Generation in Ethiopia

Potato (s.tuberosum L.) originated in the high lands of the Andes in south America and was brought to Europe in the 16th century. The crop was introduced to Ethiopia in 1859 by A German Botanist called schimper (Horton, 1987; pankirust 1964) for many years since its introduction potato production was limited to homestead as a garden crop.

A gradual rise in production occurred at the end of the 19th century when there was a long famine in Ethiopia Research document, 1975)since then potato become a very

important garden crop in many parts of Ethiopia. In the mid-1970s, the total potato acreage was estimated to be 30,000ha with average yield of about 5t/ha.

In 1975, a national potato research was started to develop and disseminate new production technologies.in a decade, the crop was grown more widely; a swift rise in acreage to 50,00ha was reported in the mid-1980s. Development of appropriate production technologies through research facilitated the expansion of potato production in the country. Since the inception of national potato research, a large number of germplasm were introduced and considerable efforts were made to improve traditional production practices. Potato become a very important cereal stable in Ethiopia compared to cereals potato is a short duration crop that can potentially yield up to 30 -35t/ha of starch based produced in 3-4 months. Ethiopia is divided in to 18 major agro- ecologies. Most of these agro-ecologies have suitable climatic and edaphic condition for the production of high yield of quality potatoes about 70% of the cultivated agricultural land is suitable for potato production (Solomon, 1989).

There are four potato production system which are Belg (short rain),Meher (long rain) ,residual crop and irrigated production in the last three decades , the land under potato had increased from 30,000ha in the mid-1970s to 50 thousand in the mid-1980s and since then there has been a steep rise to about 160,000ha by2000 since 1975 considerable research achievements have been obtained that have helped small house hold farmers to improve potato production and utilization .Using the improved production package farmers were able to get high yield ranging from 25to 40 tons compared with the national average yield of 8 tons per ha.

2.1.6 Personal and demographic variables

In this section variables that are mostly related with farmers' adoption behavior such as age and education level of household head were reviewed.

The study conducted by Nkonya*et al.* (1997) on factors affecting adoption of improved maize seed and fertilizer in northern Tanzania, indicated that farmer's age did not significantly influence improved technology adoption. In contrary, the result of Million and Belay (2004) shows that age has significant but negative influence on the adoption of fertilizers. Shivani et al. (2000) reported that more the experience of growing chickpea, the higher the adoption of new varieties. Such a pattern is expected because more experienced farmers may have better skills and access to information about improved technologies. For example, Techane (2002), in his study on determinants of fertilizer adoption in Ethiopia found that male headed households are more likely to adopt fertilizer than female headed households. similarly, Mulugeta et al (2001).reported that gender differentials among the farm households positively influenced adoption and intensity of adoption of fertilizer use at 5% significance level. Many researchers mentioned that being a male headed household increases probability of adoption by 5.9%. The findings of Habtemariam (2004), Million and Belay (2004), Itana, (1985), Kansana et al. (1996), and Nkonya et al. (1997), indicated that farmer's education had positive and significant influence on adoption. Each additional year of education increases the probability of adoption of improved seed.

2.1.7 Institutional variables

Institutional factors like frequent extension contact is positively related to the adoption decision of farmers.Chilot et al., 1996, Huque et al., 1996, Degnet, 1999, Tesfaye et al., 2001, Habtemariam, 2004, and Kansana et al.,(1996) in their study reported that the availability of reliable information sources will enhance communication process and had significant associations with adoption of improved technologies.

A study conducted by Degnet (1999) in Mana and Kersa wereda showed that the number of oxen owned by a farmer determines maize technology adoption. The study revealed that availability of off- farm income opportunity and wealth status of the head of household affects adoption of maize technology significantly. Asfaw et al. (1997) in Bako area reported that participation of farmers in extension activities (which is represented by farmer's attendance at the field days) is the only variable which is found to Significantly influence the adoption of improved maize variety

Economic related variables such as farm size, off- farm activities, livestock ownership influence farmers' adoption behavior. Nkonya*et al.* (1997), Bekele et al. (1998) and Yishak (2005) reported that farm size has a positive influence on adoption of improved technologies .Different technology adoption studies conducted by Kidane(2001) ;Birhanu, (2002) Mulugeta et al., (2001) and Mesfin, (2005) indicated positive relationship between off-farm income and adoption. Contrary to this, Techane (2002) in his study on determinants of fertilizer adoption in Ethiopia reported the negative influence of participation in off-farm income on farmers' adoption of chemical fertilizer. Million and Belay (2004) in their study on factors influencing adoption of soil

conservation measures in southern Ethiopia found positive effect of household's labor availability on adoption of soil conservation measures.

2.2. Conceptual framework

The conceptual framework of this study was developed to show the key components and interaction among the different stakeholders in client oriented improved potato technology adoption. In addition it tries to show effect of explanatory variables on the intensity of use of improved potato technology package. It is developed based on reviews of theories and structural arrangements of responsible institutions to promote participatory improved potato technology development and adoption. The independent variables include: personal and demographic, economic, and institutional variables. The left side of the framework (Figure1) shows the linkage of different actors in technology development process. While the right side shows different factors supposed to affect farmers' decision making to adopt improved potato technology. All existing relationship between explanatory variables was not shown in the figure. This does not mean that there is no relationship between explanatory variables, but the target was simply to demonstrate relationship of explanatory variables with the dependent variable rather than relationship among themselves

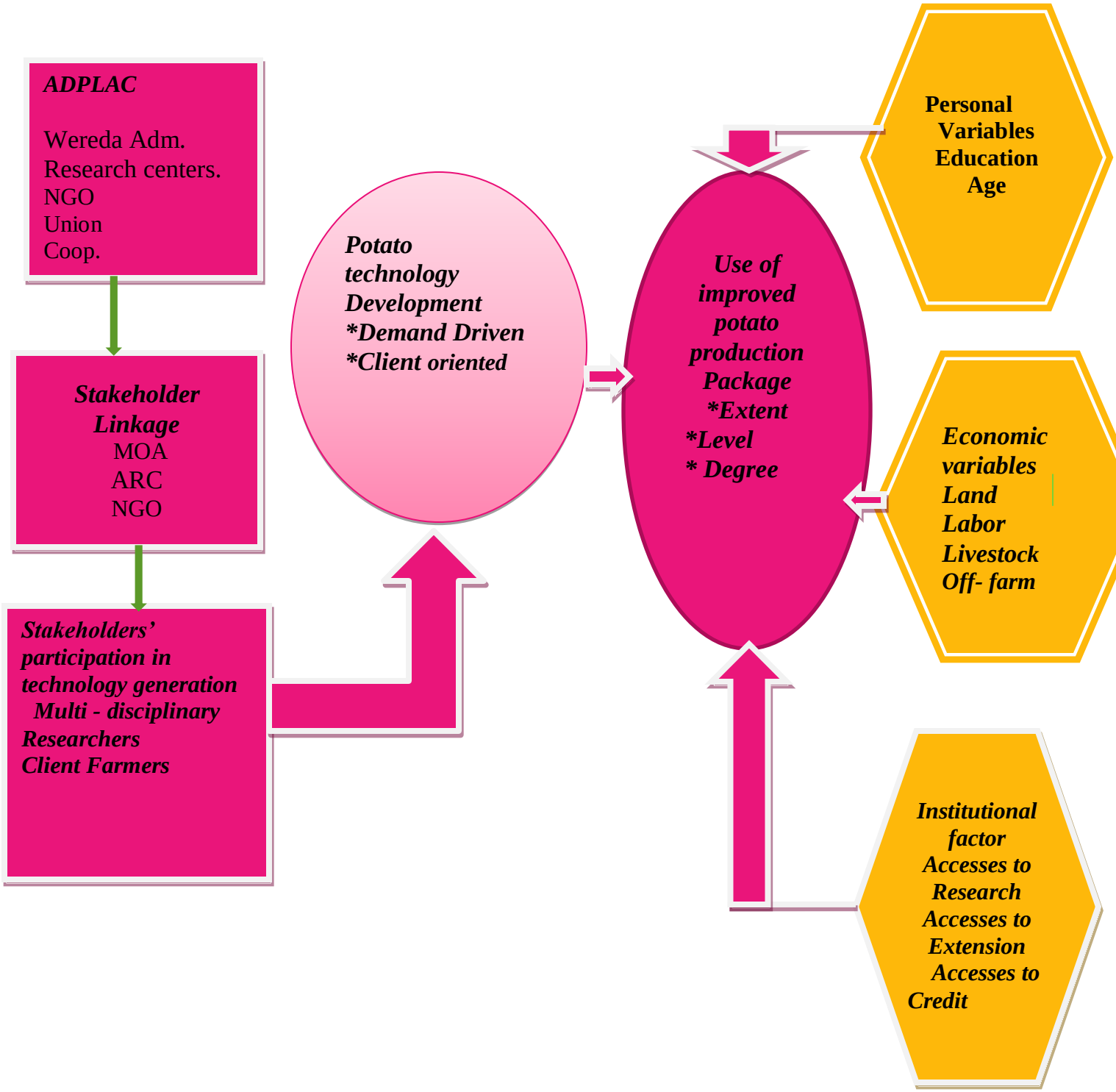


Figure 1 Conceptual frame work of the study

Source: Welmera Wereda Agriculture office. Year 2012

CHAPTER THREE

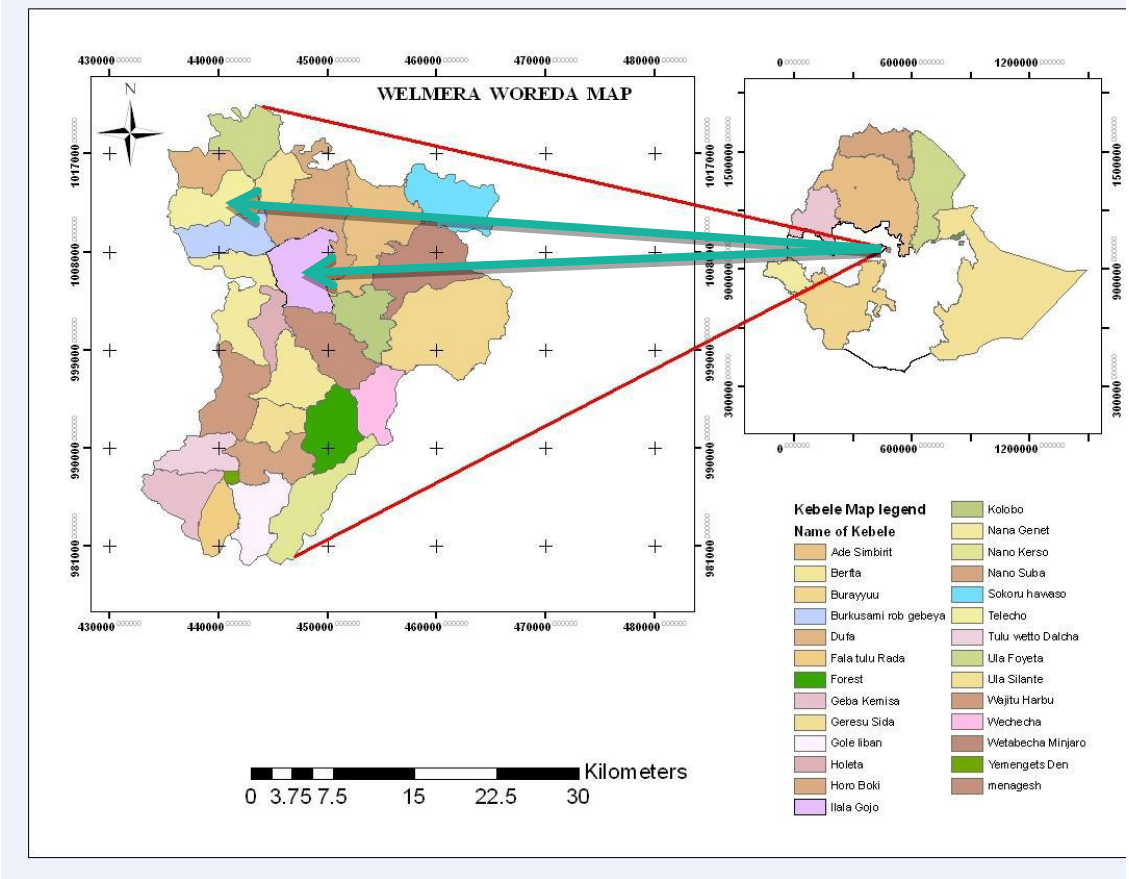
RESEARCH METHODOLOGY

This chapter discusses how the research was conducted. The chapter consists of description of the study area, selection of the study area, sampling procedure, and data collection and analysis methods.

3.1 Description of the Study Area

Welmara is one of the weredas in the Oromia Region of Ethiopia. It is part of the Oromia Special Zone Surrounding Finfinne, which is bordered in the south by the Sebeta Hawas, on the west by Mirab Shewa Zone, on the north by Mulo, in the north east by the Sululta, and in the east by Addis Ababa. The highest point in this wereda is mount Wechacha3191 meters above sea level (masl) located in the southern part and also possesses other notable peaks including mount Menagesha (between 2800 and 2900 masl. The Menagesha National Forest which is about 2500ha covers the southern and western slopes of the Wechacha Mountain. Welemera Wereda is located in West Shoa Zone about 21 km West of Addis Ababa, it is situated between 08^0 50' 04"N to 09°12' 55"N latitudes and 42° 55' 32"E to 43^o 14' 19"E longitudes and at altitude of 2390 masl. The area has a bimodal rainfall pattern, receiving an annual rainfall more than 1060mm. The short rains extent from March to April, and the long rains from July to October.

The two kebeles IlalaGojo and Telecho in welmera wereda are located at 43o02' 02"E to 43o05' 38"E longitudes and 09o 02' 34"N to 09o 06' 46"N latitude Farmers in the area are engaged in vegetable, crop-livestock mixed agriculture.



Source: WelmeraWoreda Agriculture office. **Year 2012**

Telecho kebele

IlalaGojo Kebele

3.2 Sample size and sampling procedure

Multi-stage sampling methods were employed. As a First step, one Wereda and two kebeles (Telecho and IlalaGojo) were selected purposefully because of the presence of different FRGs operating in the Kebeles. Then from the two kebeles, a total of 217 potato

growers were registered in the cropping season 2005EC. Among the registered farmers 150 were from Telecho Kebele and the remaining 67 from IlalaGojo Kebele. From Telecho Kebele 88 farmers were Non-FRG participants and 62 farmers belonged to Woleda Gudeni potato producer FRG .Among the registered farmers 67 from IlalaGojo Kebele 37 were non-FRG participants and 30 belonged to Didimtu Burka Misoma potato producer FRG. Using non replaceable lottery method and proportional to size sampling techniques 54 FRG members and 76 non participant member farmers which, totally 130 samples were selected.

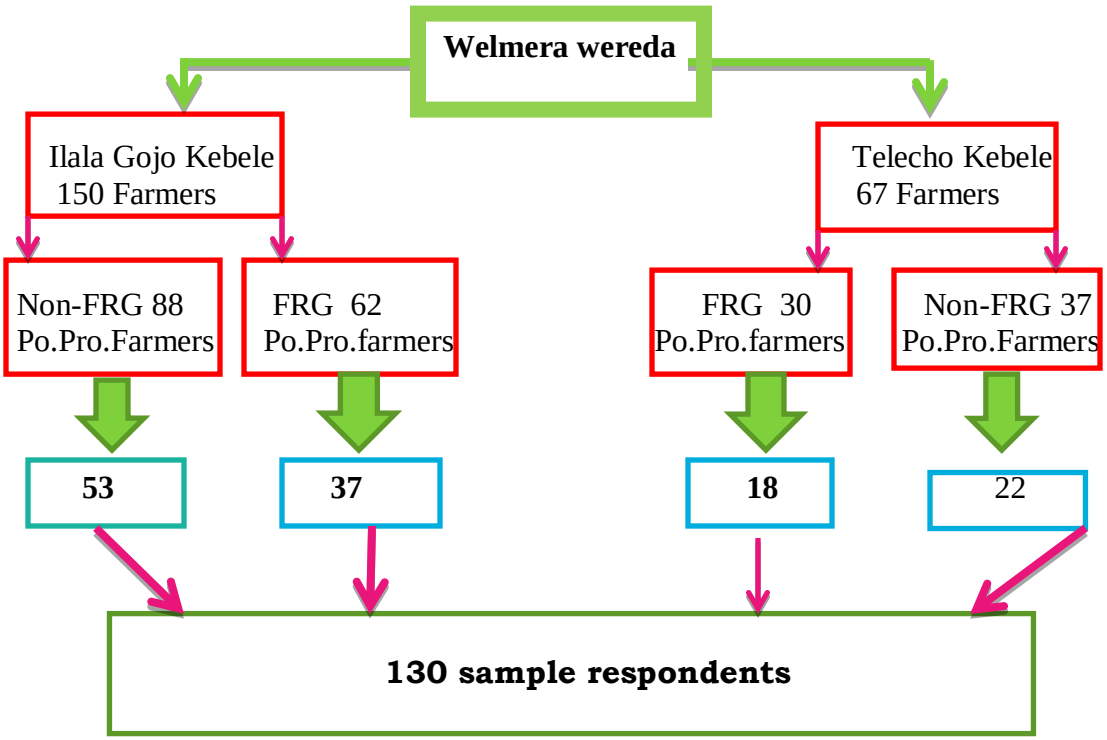


Figure 3: Sampling procedure

3.3 Data Sources and Method of Data Collection

3.3.1 Primary data

Using structured interview schedule, both qualitative and quantitative primary data were gathered from FRG participant farmers and non-participant farmers. Group discussions were also conducted with the two FRGs. Woleda Gudeni and Didimtu Burka Misoma potato producer. Interview schedule and group discussions have been conducted to gather the information of demographic characteristics, socio economic, institutional dimensions to find out the extent and determinant factors of adoption of improved potato production.

To strengthen the group discussion result, key informants from respective stakeholders' institution i.e. Welmera wereda districts Agricultural office expertise, HARC researchers which directly involve in organizing FRG, DAs and FRGs leaders were interviewed to know the strength and weakness of FRG approach by SWOT analysis.Relevant secondary data were collected from annual reports, journals, articles, book in chapters, and manuals from Holetta research center and Welmera Wereda Agricultural Office. Interview schedule for the quantitative research was prepared.

Then seven enumerators were hired based on their ability in communicating with farmers using the local language oromifa and who have experience in survey research from Holeta. Agricultural research center half day training for enumerators on methods of data collection was organized. During the training contents of the interview and schedule were also discussed, how to approach respondents and collect quality data. Enumerators were involved in pre-testing the interview. And then these the survey was conducted for nine consecutive days under close supervision.

3.3.2 Data Analysis

Data were analyzed using different quantitative and qualitative statistical procedures and methods. Qualitative data collected using group discussion and key informant interview techniques were analyzed using explanation. To validate and strength the qualitative finding, quantitative data of the survey result were used Quantitative data were also statistically analyzed.In addition to that different analytical techniques were applied to examine the survey data. These include t-tests, chi-square tests, one way ANOVA and Tobit regression model. The t-test and one way ANOVA were run to see if there is statistically significant difference in continuous variables between adopters and non-adopters on potato technology adoption between FRG and non-FRG members. The chi-square test was used for categorical variables to see the dependency between adoption of improved potato production packages and the specified variables. To enrich this study findings SWOT analysis was done with FRG representative, DAs, district experts and agricultural researchers as technical advisors.

3.3.3 Definition of variables and hypotheses

Dependent variable, Adoption Index (AI) is the dependent variable for this study. It indicates the extent of adoption of improved potato technology packages. It is a type of constrained continues dependent variable.

1. Adoption index: measures the extent of adoption at the time of the survey
2. Adoption quotient: measures the degree or extent of use with reference to the optimum possible without taking time into consideration.

3. In this study, the first option was employed. Accordingly, adoption index which shows to what extent the respondent farmer have used the more important practices out of the whole set of recommended package for potato production was calculated.

$$AI = \sum_{i=1}^{N} \left[\frac{Fai + CAi + VAi + Cui}{TNP} \right] X\ 100$$

Where: i=1, 2, 3……n, and n= total number of farmers

Np = No of practices

AIi = Adoption index of the ith farmer

Fai = Amount of fertilizer applied per unit of area in the cultivation of improved variety of potato by ith farmer,

CAi = Amount of chemical (Fungicide) applied by ith farmer per unit of area in the cultivation of improved variety of Potato,

VAi=Varieties land coverage by *i* farmer farm

Cui= Frequency/ number of cultivation practiced by ith farmer in a given cropping season

Table 1 some of very important Recommended package of improved potato production

No	Name of package	Abbreviation	Recommended rate
1.	Fertilizer rate	FR	165Kg UREA, 195DAP/ha
2.	Chemical (Fung.) application	CA	2 times spray 50-55, 70-75days
3.	Varieties	VA	Gudeni and Jaleni
4.	Cultivation frequency	CF	2 times 35-40, 60-70days

Independent variables-independent variables are those factors which influences the extent of adoption of improved potato production packages. In this study, independent variables are household personal and demographic characteristics variables, institutional variables, economical variables, farm characteristics and psychological variables. These variables are explained as follow.

1. Education: Measured in terms of number of years of formal schooling the respondents had completed at the time of data collection. It was assumed that a better educated farmer can understand the information very easily and internalize the information transferred from development agents, researchers, NGOs and other development stakeholders. It is a dummy variable 1 was given for who can read and write farmers and, 0 for otherwise.

Education in this study is measured as continuous variable ranging from illiterate to read and write respondents. Many study reported that education showed positive and significant relationship with adoption (Nkonya*et al.* 1997 and Bekele*et al.*, 2000). Therefore, in this study it is hypothesized to affect level of use of participation and potato technology package positively

2. Age: In rural traditional societies, age serves as an important indicator of the individual's position in the society. Older farmers will be in a position to experience much with their traditional farming practices and are expected to be less responsive to participate in group works and accept newly introduced agricultural technologies. In addition, they are usually risk averters particularly in crops such as potato production because of high risks of product perishability and price fluctuation and they tend to be reluctant to fully adopt the package. Million and Belay (2004) showed age has negative and significant influence on the adoption of fertilizers. Moreover, Mulugeta (1994) on his study on smallholder wheat technology adoption in South Eastern highlands of Ethiopia reported that age had a negative effect on the adoption of wheat technologies. Therefore, in this study it is hypothesized that age is negatively correlated with intensity of use of potato technologies.

3. Land holding: land is an important resource for agricultural production. The same true for potatoes production the farmers who have large land size could show the capability of an individual farmer to adopt new improved potato technologies. Land is measured by hectare. It was assumed that the larger the farm size the farmer has, the better his risk bearing ability and the higher the probability to adopt improved technologies. Different studies reported its effect differently. For example, a study by Mulugeta, (2000), Million and Belay (2004), Mwanga*et al*., (1998) and Yishak (2005) indicated positive relationship between farm size and adoption. Similarly Tesfaye*et al*., (2001) reported that farm size contributed positively in farmers' adoption of improved wheat varieties. In this study the size of irrigable land expected to positively affect extent of use of onion technology.

4. Shortage of labor: - it refers to the availability and shortage of labor face at different farming activities. Labour availability and shortage affected positively adoption (Million and Belay, 2004). Potato production activities are labor intensive thus in this study it is expected to be positively correlated with adoption and intensity of use of the package and It is a dummy variable 1 was given for shortage of labor and, 0 for has not.

5. Livestock ownership: -Livestock are also an important income sources which enables farmers to invest on adoption of improved agricultural technologies. No doubt that in most cases, livestock holding has positive contribution to household's adoption of agricultural technologies many adoptions Studies have reported positive effect of livestock holding on adoption. It is the number of livestock the farmer owned. Livestock is so many things for farmers for instance traction power, manure and source of income by selling the animals and by product. It was assumed that livestock affects the adoption of improved potato technologies. A study conducted by Bekele*et al*. (2000) added that adopters of improved wheat technologies owned more livestock than non-adopters Therefore, livestock-holding size assumed affects extent of use of potato package positively

6. Non-farm income positively affects the adoption of modern variable inputs in two ways. One reason for this condition is that availability of off-farm income can help overcome financial constraint to purchase improved technologies and the other reason is that farmers with off-farm income are better risk-takers than those with no off-farm income. A research result by Million and Belay (2004) in Gununo area of Ethiopia revealed a positive relationship between off-farm income and the probability of adoption of chemical fertilizer. Therefore, in this study it is hypothesized positively affect extent of

use of potato technology package Participation in income generating non-farm activities is a dummy variable (1, if yes; 0, otherwise).

7. Accesses to extension: This refers to farmers' access to information on agricultural technologies through participation in training, workshop, and field day/visit and on-farm demonstration arranged by extension organizations. It refers to the number of times the farmer had participated in the three extension events i.e. training; field days and demonstration in the last three years many studies conducted so far have indicated that participation in such arrangements would have positive influence on adoption of agricultural technologies. It is a dummy variable 1 was given for who have extension contact, 0 others. Therefore, participation in these events was hypothesized to positively influence adoption and intensity of adoption of potato technology package.

8. Accesses to research: It refers to farmers' access to research Thus, having access to research centers was expected to influence adoption of potato production package positively. It is a dummy variable, which takes the value 1 if the farm household has accesses to research and 0, otherwise. Number of studies reveled positive relationship of accesses to research with adoption. Among these Getahune (2000), Legesse (1992) some of them therefore, accesses to research were hypothesized that affect extent of use of potato production package positively.

8. Member of FRG: - Refers to whether the respondent is member of FRG or not. It is a dummy variable taking value 1 if the farmer is FRG member or 0 if not. It is hypothesized that if the respondent is member of FRG for at list two cropping season, he/she has higher knowledge accusation through farmers to farmers interaction in the

group and participation in technology generation and verification process. Therefore, FRG membership is assumed to affect the extent of use of potato production package positively.

Table 2 Summary of Variables

No of variable	Variables Code	Operational definition of the variables
Education	EDU	It is dummy variable 1=read and write and , 0=Illiterate
AGE	AGE	Continues variable it measured by years
Land	LADHOLD	Land holding size, a continues variablemeasured in hectare
Labor shortage	LABSHORT	It is a dummy variable,1= if a farmer has shortage of labor, 0 otherwise
Livestock	LIVOWN	It is a number of livestock the farmer own expressed in TLU
Non-farm	NON-FAR	A dummy variable for participation in income generation activities ; 1=for participant and 0, otherwise
Accesses to extension	ACCEXT	It is a dummy variable,1 if farmers have accesses, and 0 otherwise
Accesses to research	ACCRES	It is a dummy variable;1 if farmers have accesses to research, and 0 otherwise
FRG members	FRG MEM	It is a dummy variablerepresenting membership in FRG and,1 if farmers are members , and 0 if otherwise

3.3.4 Analytical method

The qualitative and quantitative research which addresses the two first research questions is presented first which involves the use of descriptive statistics (frequency distribution, mean and standard deviationsChi-square tests, one way ANOVA and to see if there is statistically significant difference in continuous variables between adopters and non-adopters on potato technology adoption.

The third question, of this study was achieved by applying econometric model of Tobit. To predict the influence of independent variables (explanatory variable) on the dependent variable which are determinant factors for the adoption of improved potato production packages. The focuses of these objectives is to analyze the factors which determine the household to adopt improved potato technologies.

In order to identify the level of adoption of improved potato production package, Adoption Index of individual farmer was calculated. The farmers who meet the recommended rates in the packages were given 1 and those who did not were given 0, were calculated by the formula.

The adoption index (AI) varies from 0 to 100% depending up on farmer's degree of adoption of the technology. On the basis of adoption index farmers were classified in to three categories, viz., non, low and high adopter. Adoption index is thus a continuous dependent variable affected by different factors. Tobit model was used to identify the different factors affecting farmers' level of package adoption

Tobit model

The farmer may adopt only some part of the recommended package practices and may also do this on 1% or 100% of his/her farm. So, Tobit model is more

appropriate to give reliable output of both discrete and continuous variable combination. In consequence, this model output gave information for both probability and intensity of adoption of improved potato production package.

Many researchers used Tobit model to measure probability and intensities of adoption byDifferent location and varieties. For example mulugeta(2009) used Tobit model to analyzedeterminant of intensity of adoption of old coffee stumping production technology; Tadesse(2008) also used it to analyze intensity of adoption of improved onion production packages; and Dereje (2006) used the Tobit model to identify intensity of adoption of improved breadwheat varieties.

Model specification

Following Maddala (1992), the Tobit model for the continuous variable adoption index can be defined as:

$AI_i^* = B0 + B_iX_i + U_i$

$AI_i = AI_i^*$ if $B0 + B_iX_i + U_i > 0$ (1)

$= 0$ if $B0 + B_iX_i + U_i \leq 0$

Where:

AI_i= is adoption index for ith farmer

AI_i^*= is the latent variable and the solution to utility maximization problem of intensity of adoption subjected to a set of constraints per household and conditional on being above certain limit,

X_i= Vector of factors affecting intensity or level of package adoption,

B_i= Vector of unknown parameters, and

U_i= is the error term which is normally distributed with mean 0 and variance σ.

The model parameters are estimated by maximizing the Tobit likelihood function of the

Following form (Maddala, 1997;-Amemiya, 1985)

$$L = \prod \frac{1}{\sigma} f \frac{AIi - \beta i X i}{\sigma} \prod F \frac{-\beta i X i}{\sigma} \qquad (2)$$

AIi *.>0 AIi *≤.0

Where f and F are respectively, the density function and cumulative distribution function of AI_i*.$\prod$ means the product over those i for which $AI_i \leq 0$, and $\prod$ which $A_i^* \leq 0$

AI_i*.>0 means the product over those i for which AIi*>0.

Econometric software STATA was employed to run the Tobit model. According to Johnston and (Dinardo, 1997), it may not be sensible to interpret the coefficients of a Tobit in the same way as one interprets coefficients in an uncensored linear model. Hence, one has to compute the derivatives of the estimated Tobit model to predict the effects of changes in the explanatory variables

Maddala (1997), proposed the following techniques to decompose the effects of explanatory variables into adoption and intensity effects. Thus, change in X_i (explanatory variables) has two effects. It affects the conditional mean of AI_iin the positive part of the distribution, and it affects the probability that the observation will fall in that part of the distribution. Similarly, in this study, the marginal effect of explanatory variables was estimated as follows.

1. The marginal effect of an explanatory variable on the expected value of the dependent variable is:

$$\frac{\sigma E(AI\, i)}{\sigma X\, i} = F(Z)\, \beta\, i \qquad (3)$$

where $\frac{\beta i \ X i}{\sigma}$ is denoted by z, following Maddala; (1997).

2. The Change in the probability of adopting a technology as independent variable X_i changes is

$$\frac{\sigma F(z)}{\sigma X i} = f(z)\frac{\beta i}{\sigma} \quad (4)$$

3. The change in the intensity of adoption with respect to a change in an explanatory variable among adopters is

$$\frac{\sigma E(AIi*>0)}{\sigma Xi} = \beta i \quad 1 - z\frac{f(z)}{F(z)} - \quad \frac{f(z)}{F(z)}^{2} \quad (5)$$

Where,

F (z) is the cumulative normal distribution of Z,

f (z) is the value of the derivative of the normal curve at a given point (i.e., unit normal density),

Z is the z-score for the area under normal curve,

βis a vector of Tobit maximum likelihood estimates and σ is the standard error of the error term.

Before running the Tobit model all the hypothesized explanatory variables were checked for the existence of multi-collinearity problem. There are two measures that are often suggested to test the existence of mulit-collineality. These are: Variance Inflation Factor (VIF) for association among the continuous explanatory variables and contingency coefficients for dummy variables. In this study, variance inflation factor (VIF) and contingency coefficients were used to test multicollinearity problem for continuous and dummy variables respectively.

CHAPTER FOUR

. RESULTS AND DISCUSSION

4.1The Roles of FRG in Enhancing Potato Production Technology Adoption

Participatory research is the key approach to generate technologies and knowledge through involving key actors in conection with the research agenda. Participatory research is an approperate approach to linking development and research as experianced by FRG to researchers and farmers including extension workers with the aim to discusese issues and problems identified by farmers.As a result intrercaction and sharing of information and knowledge among farmers, extension workers and researchers to enhance adoption.

Farmers researc groupas technology testing and dissemination (verification) institiute lets farmers to participate so that enables them to choose and adopted the technologies suitable to their situations .This gives an apportunity to farmers to be the part of research and extension which was not considered in the traditional extension and research in the study area.The investigation of the studyis used to follows the steps of resrearch proceduer.

4.1.1 Problem Identification and Prioritization

Problem identification and prioritization is the starting point for the participation of FRG members once they are organized as a group. In the literature review part, it was stated that generally productivity and production of potato were low and in some instance before the start of FRG approch. Farmers always wonderd what to do with their low potato productivity and production. Collecting accurate information about the

problem,need of the client, proper definition of the research problems and prioritization were a prerequisite. According to Ejigu and Pound (2002), whenever needs are incorrectly or unreliably identified, the development inputs are likely to be ineffective and largely wasted.

In the conventional researchapproach research idea is initiated by researchers based on their personal felling which assumed problems by researcher or experience from abroad. Sometimes based on farming system diagnostic report or after passing the review process the plan was implemented for the farmer without active participation of farmers or without due consideration of the farmers priorities and needs.

Unlike in the conventional research approach two FRGs under investigation participatory problem/need identification and priority setting were done by multidisciplinary researchers and FRG members. This provided a chance for farmers to discuss and identify their common problems and as a result their communication skills, attitude and knowledge built through learning from each other. The collaboration provides opportunities for researchers to learn and understand farmers` priority problems. According to Heemiskerk*et al.* (2003), intimate knowledge of farming community and their need was a pre-requisite for client-oriented research to be effective.

Based on this discussion shortage of good quality seed of improved verities, resistance to the devastating diseases as Late Blight and Bacterial Wilt were the top two potato production constraints identified and prioritized. But strong efforts were made by HARC/CIP to capacitate them by forming small scale disease free potato seed production by delivering starters seed to FRG members. But the contribution of other stakeholders other researchers was very minimal in this aspect. Even if the active ADPLAC

(Agricultural Development Partners Linkage Advisory Council) platform in wereda level do not give attention.FRG involves many stakeholders andeach stakeholder has different roles the comprehensive approach offers stakeholders an opportunity to widen their network which may make participation more attractive. In participatory research and extension approach like FRG stakeholders have defined roles (Leeuwis, 2010)

As stated by FRG members who participated in group discussions and interviews the major stakeholders are farmers and agricultural researchers (from HARC) the researchers provided improved potato technologies, training to FRG members farmers and experience sharing with other FRG.Since the beginning of establishment of FRG, agricultural researchers from HARC took the lion share.

Capacitating clients through training and participation is the main element in the client oriented approach where genuine participation is expected. According to Heemskerk*et al.* (2003), Agricultural research agenda cannot be client oriented unless clients have been capacitated to effectively express their demand and client should be capacitated through training to involve in decision making and allocation of resources.

This investigation shows that so far some of the stakeholders have not participated in FRG activity especially the Bureau of agriculture at wereda level so research centers and farmers are considered clients. Because of the nature of the crop (perishability) actors must be considered to transform FRG to the level of adding value to their crop.Traders (whole sellers, retailer), Microfinance, potato processers and exporter play critical roles in the potato production, especially now that potato is becoming a commercial crop.

4.1.2 Conducting Experimental trials on FRG members fields

FRG under review have been engaged in testing, selecting and disseminating improved technologies either initiated by FRG member farmers or released by research centers.Based on their farming problem farmers need improved potato technology and research centers finding solution together with farmers and following the adoptability of technologies. Before the FRG approach came in to practices conventional research method which conducted experiment at restricted research centers or compound in some degree of farmers were participated on farm experimental trials by giving their land.

There are different ways of classifying on-farm trials. One common way is to classify them according to the balance of researcher and farmer involvement in their design and implementation.

Type 1: Trials Designed and Managed by Researchers

Type 2: Trials Designed by Researchers and Managed by Farmers

Type 3: Trials Designed and Managed by Farmers

The FRG approach unlike that of conventional research method which conducted experiment at restricted research centers, experimental trials have been conducted on the farmers' fields to the adoption of different potato variety, verification and popularization. From the three typology of on farm trials classified the investigated FRGs adopted between researcher designed and farmer managed, farmer designed and managed type.

At the beginning of every year at off-season FRG farmers meet with researchers and the researchers conduct some training for the coming planting season and explain options of new cultivars, new fungicides and their usage especially for control of potato devastating diseases.If researchers intend to evaluate new variety is equal opportunity was given toall

members of FRG to conduct trial on his/her field. Other FRG members come and participate to evaluate potatoon different development stages by sharing of idea, knowledge their enables to get a feedback from farmers. Fertilizers, chemicals and other agricultural inputs required for the trial supplied by the research center.

The experimentation process was more of mutual type whereby researchers worked with farmers closely and modified the trial based on the feedback suggested by farmers. The level of interaction between farmers and researchers was high. There is flexibility in undertaking trial activities. The farmers were given opportunity to determine size of the trial plot based on the land availability; time of planting in consultation

The two FRGs under investigation had been conducting experiments starting from establishment of FRGs until now in different years. During these periods the on- farm experiment involved only adoption of different improved potato varieties, screening of different fungicide, verification and popularization different potato variety technologies to be tested and adjusted by FRGs under investigation.

However, these were far from being reflected in actual practice Development of technology was one of the planned activities in the FRG project implementation document (FRG project proposal, 2005). Even though, the project document used the planning tools logical framework analysis (LFA) it didn't clearly put demonstrable indicators for technology development activities based on the objective of FRG implementation.

The result of the group discussion showed that, FRG members conducted on- farm trials on their plot are not interested because of shortage of land if they are agreed, farmers need compensation to their plot which is occupied by trial to which researchers agreed.

Majority of the FRGs members on the group discussion explained that they were not happy to give their land to conduct on- farm experiments because of shortage of land and they suggested paying compensation for the land as a solution. The investigation shows that farmers lost interest to conduct different potato on farm trials on their piece of land because of shortage of land and most of them cultivate lands by renting from non-participant farmers

FRGs is small group of farmers who are interested to working in group in collaboration with relevant stakeholders in particularly agricultural research. Starting from the formation time to the continuous consecutive years the two investigated FRGs have very good working relationship with different stakeholder's especially agricultural researchers in problem identification period and following the day to day the activities of FRG. The study revealed that in the last two years multidisciplinary team has not conducted any meeting to review the progress and short coming of FRG implementation.

4.1.3. Scaling up of technologies

FRG members not only select the good performing technologies for multiplication, dissemination of technology and information. Farmers Field-days are organized by researchers on FRG members` plot. Usually, wereda Agricultural office, development agent, Wereda administrative representatives and kebele leaders are involved in mobilization of the community as well as provide feedback on the status of technology utilization by farmers. Non FRG member farmers are usually invited to the field-day events. FRG members explain how they conducted and managed their field and what outputs are expected from this intervention to the participants.

This creates favorable condition for dissemination of technology and exchange of information to farmers especially to those non participants in order to observe the performance of the new technology and have the sense of hearing about the benefit of the technology from fellow farmers in addition to the outsiders.

The investigated FRG members totally produce improved potato varieties by with their adopting full technological package. Those FRGs are in the position to produce potato seed and store improved storage technology called (DLS) Diffused Light Stores. DLS have proven to maintain the quality of seed tubers, especially in the Central Highland region (Gebermedhin et.al. 2001) enabling farmers keep their seed longer and thus reduce their dependency on other sources.

Investigated FRGs were active in producing high quality improved potato seed and disseminating in different region of the country through selling. This has a positive impact on rapid potato technology dissemination and addressing food security.Empirical investigation of the study also showed that almost all potato growers' farmers were cultivating improved potato cultivars introduced by Holeta Agricaltural Research Center (HARC). This perhaps in the result of efforts invested through adoption, demonstration and popularization accomplished through the established FRGs. Therefore, FRGs played better role in diffusion of improved potato varieties to neighboring farmers and different regions in the country

At time of Group Discussion all FRGs member's cultivated improved potato with full package. The majority of non-participant FRG members showed interest to visit FRGfarmer's plots and participated in the field day events. Furthermore, they mentioned that they discussed about the FRGs activities with non-participant farmers and

information dissemination was high and ensures informal technology diffusion network among the groups in adjacent villages and among the farming community to copy the activity. .

4.1.4 Monitoring and evaluation

Participatory monitoring and evaluation is one of the key activities in the FRG approach.The FRG evaluation exercise can prove a crucial research-extension activity not only to identify the strength or weakness and achievement of the group, but also to recognize the difficulties encountered in the day-to day activities and management of opportunities within the participatory process (Abera and Adam, 2001).

FRG members also participated in evaluating the performance of improved potato verities onceit is released from research centers by following the standard procedure. The activities and results of FRG must be properly recorded and documented but in the investigated FRG lack of records on the group activities is one of the major drawbacks to measure the outcome and development it is difficult to know what progress has been made ,what difficulties are encountered ,what outcomes have been achieved who did what in the group activity .This has not be the case in the investigated FRGs ninety five percent of them described that there is no as such recorded document at FRG level but fivepercent of respondents indicated they have documented their own information at their home.Most of the time FRGs that were under investigation evaluated potato plantation together with respective researchers at the time of flowering but if there is an occurrence of diseases there is no as such planned evaluation program in those FRGs

4.2 Linkage with researchers and agricultural extension workers

The study focused mainly with the vital link to the successful technology development of FRG. FRG is a functional framework of research extension and farmer linkage which

motivated farmers, researchers, extension institutions and other stakeholders that involve in participatory research, Direct linkage of researchers with the farmer through on - farm research on potato seed multiplication and dissemination, has been used for testing, adopting, multiplying and disseminating improved technologies by the FRGs (Leeuwis, 2004, Ponniah*et al.*, 2004).In the study area, different institutions and social groups are working for socioeconomic development of individuals as well as the community which include; HARC, Melka Ethiopia, kebele council, FRGs, union, Women association, youth association, Micro finance Association, traders, brokers and input suppliers. From those FRGs members, researchers and DA were the only active participants in FRGs activities. Usually only the researchers and FRGs members participate in the implementation, monitoring and evaluation of potato technology. Kebele administrative body sometime participated in training which organized by (HARC) and community mobilization activity at a time of farmer's field- day conducted.

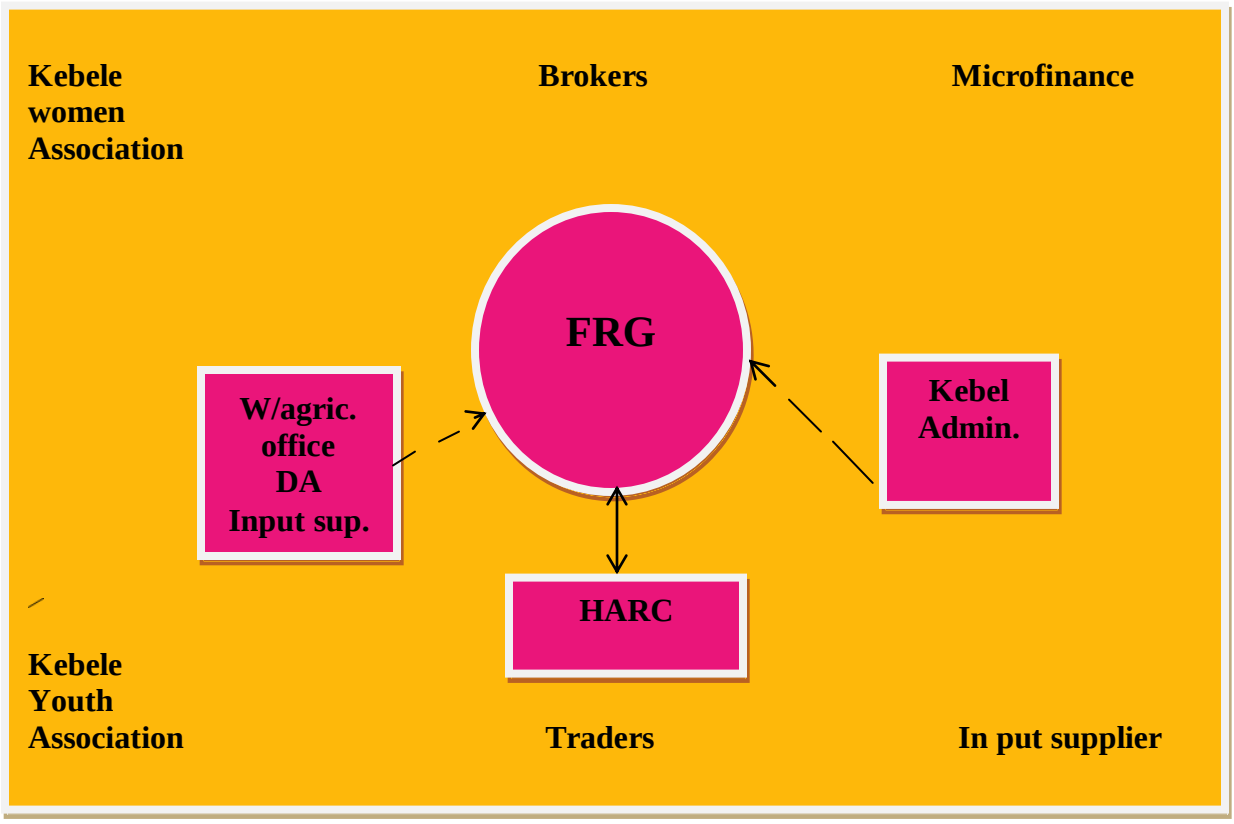


Figure 4 Stakeholders Map

Participatory task analysis (Table 3) was conducted together with researchers from potato team and agricultural extension to assess the role, functions and division of task in the system.Task analysis helps to know the linkage between different stakeholders

Table: 3 Task analysis sheet

List of Task	FRG	DMOA	Kebele Administration	HRC
Need Assessments	*			*
Set priority	*			*
Training	*	*		*
Provide improved Technology				*
implementation	*			*
Monitoring	*			*
Evaluation	*			*
Community Mobilization		*	*	
Field day organization	*	*	*	*

The result of mapping and task analysis shows that zonal and wereda level partner of ADPLAC were not involved in FRGs activities.

FRG members actively create linkage in all aspect to agricultural researchers whereas Wereda Agricultural office (DA) creates linkage in the forms of participating in training, community mobilization at the time of field day. According to the investigated FRGs the result shows that they have a close and very strong linkage with researchers but have

weak linkage with development agent Usually only the researchers and FRGs members participate in the need assessments, Setting priority, training, implementation, monitoring and evaluation of the improved potato techno technology (Table 3).The result from group discussion and individual's interviews indicated that all FRG members have gained benefits substantially. The benefits included that the FRG approach is basically full participatory in which farmers are enabled to empower themselves to identify their problems and needs. Through intensive exchange of information between members and decide how to manage their own affairs to adopt improved potato technologies. Under FRG approach farmers are the one who decide to take or leave the technology provide by researchers but in the regular (conventional) approach farmers don not have an alternative but accept the package provided by regional government if they want to get any input (improved seed, fertilizer and different in puts) The survey result shows that all the sample respondents grew improved potato cultivars introduced by HARC, rejecting the local disease susceptible cultivars. There was high demand for improved potato seed especially, for Jaline, Gudeni before five years ago currently FRG members are demanding the new cultivar: Belete.

From agricultural researcher's point of view FRG approach provides a chance to researcher to save time and effort required to interact with farmers. On this subject, researchers mentioned that previously individual farmers approach (conventional approach) was difficult to ensure participation at grassroots level, adoption and dissemination of technology whereas this group approaches such as FRG saved both researchers' and farmers' time. Researchers also mentioned that, relationship with farmer regularly provides opportunities for researchers to learn about the farmers` real situation

through feedback obtained from them. The investigation was supported by all of the FRG members who indicated that farmers raise question and discuss with researchers frequently about potato technology and FRG activity without difficulty.

According to group discussions, all members reported that the approach improved their skill and knowledge of potato cultivation and potato seed production by using improved seed storage mechanism (DLS) FRGs implementation also improved farmer-researchers interaction, improved skill and knowledge of the researchers to realize real farmers' problems and the way to solve.

FRG is a mechanism to reach resource poor farmers and women but Information obtained from the two investigated FRGs indicates that from the total 54 member's farmers: (42=Male and 12= Female), the groups are dominated by male members that is truly reflect the usual observable facts in many rural areas of the country. FRG approach is generally gender responsive However, in these two FRGs there were limited membership of women's (6.48%), but, noted that wives of the FRG members farmers are indirectly beneficiaries of the technologies since they are part and particles of the household.

During the group discussion with FRG members it was observed that farmers were proud of being FRG members since it enabled them to open their mind and become receptive to improved potato technologies

4.2.1. Benefits Working with FRG

Multidisciplinary researchers team including extensionst, potato agronomist and pathologist working with FRG agreed with all the above mentioned benefits and limitations with implementation of FRG approach ranking was done by multidisciplinary team indicate that 100% of the respondents reported that it improve

participation of stakeholders.60% agreed that it improved the problem identification capacity , 100% agreed to improve the time management of researchers and ,(100%) of them confirmed that it improve the capacity of client skill and knowledge (Table 4)

Table: 4 Ranking in %

Benefit from FRG implementation	1st	2nd	3rd
Improving participation	100		
Improving problem identification	60	30	10
Improving time management for researchers	100		
Improving the capacity of client in skill and knowledge	100		

Source: Own survey data 2014

4.2.2 Challenges working with FRG

FRGs is a new participatory approach expected to shift the pattern of traditional top down approach. However, it has been implemented by the researchers who practiced with the traditional approach for many years. In the investigated two FRGs cases there is very little recorded data and information. Only imperfect memory of the effort exists among the members. In Didimtu Burka Misoma potato producer FRG farmer started recording some information.

The survey result also showed that, 100%of the FRGs members reported that, there is no sufficient meeting time of the members specially the last two to three years (Table 3) About 80 % ofrespondents reported that the members are not reviewing plans(Table 3). Nearly, 70 % of the respondent reported that their leaders have no ability to lead the team(Table 5). During the group discussion also some members raised that FRG leaders are selfish to sell their potato tuber seed when market from different regions comes to

them, Theyindividually communicate to the buyers even to determine the price of potato tuber seed this finding agrees with finding of Sherif*et al*. (2005), who reported existence of a serious leadership problem among FRGs, based on his study in Ad`a Wereda.

Table: 5 Evaluation of FRG performances by respondent members

Statement	**Response**	**Number**	**%**
Group evaluation of technologies	Yes	44	81.48
	No	10	18.52
Leaders potential to lead FRG	Yes	16	29.62
	No	38	70.03
Reviewing plan	Yes	11	20.41
	No	43	79.6
Having sufficient meeting time	Yes	-	-
	No	54	100
Felling proud to be a member of FRG	Yes	54	100
	No	-	-

4.3 Lessons learnt from Summary of the qualitative research

There are good lessons learned through the implementation of the FRG.FRG has contributed significantly to bringing farmers and researchers together that led to acknowledgement by researchers of the rationality of farmer's practices. The two FRGs were assessed to observe the contribution of the approach to enhance client-oriented andDemand-driven technology generation and adoption based on the frame work of research cycle Benefit, opportunities and limitation of its implementation was also assessed.

The result shows that farmers were actively participating in potato variety evaluation and dissemination, increased the interaction between farmers, researchers, extension workers and traders which helps to understand each other and there problem. . However new improved high yielding potato varieties were not realized by research centers in the last five to six years, Leadership problems in FRGs, weak relation among the group member,

Poor incentive mechanism established for the staff of researchers very less attachments of development agent (DA, MoA) was also considered as a very serious obstacle for the proper implementation of FRG.

4.4. Use of improved potato production package

Potato is becoming the popular tuber crop in the study area which was previously dominated by cereals. It is now widely produced, as a source of food and income and also implemented improved potato tuber seed production technologies in the study area.

Potato technology is recommended by agricultural research system in full package to potato farmers. These included; varieties; seed rate; fertilizer rate; chemical application rate and time, spacing between plant and row, frequency of cultivation. However, due to several reasons farmers used components of the package practices with slight variation from the recommendation.

This study intended to analyze the extent of adoption and determinant factors for the adoption of improved potato technologies in the study area of two FRG and non-FRG members. In this section descriptive statistics such as mean, standard deviation, frequency tabulation, percentage, F-test, t-test and chi-square test were employed.

In this, study adopter of technology refers to farmers who adopt improved varieties with some of the recommended practice of potato production packages. Those farmers who never been grown improved potato varieties were considered as non-adopter. Four packages were used to determine the extent of adoption of potato growers these are varieties, cultivation frequency, fertilizer rate and chemical spraying. Adoption Index was calculated by adding up weight of each practice. Equal weights for each practice were given.

The overall adoption index was categorized in to three categories that are none, low, and high adopter. The actual adoption index scores were ranged between 0 to 1. The adoption index scores of 0 point implies non adopter of improved potato technologies and the adoption index scores above 0 grouped in to different adoptions categories. The adoption index score of 1 implies the respondents adopted all practices according to the recommendation. To evaluate the significance of the difference between dependent and independent variables and to test the hypothesis Chi-square, t-test and F-test were used

4.4.1 Extent of adoption of improved potato production package

In order to know the level of adoption of each respondent the Adoption Index score was calculated. Before the calculation the technology packages were listed and weighted. Equal weights were given to all technology packages considered through discussion with researchers and Development agents in the study area. A total of four improved production packages were used .These are varieties, fertilizer application rate, chemical spraying, cultivation frequency, The sample respondents adoption index scores were categorized into three adopter groups' namely non-adopter, low and high adopter. The actual adoption index score ranges from 0 to 1. Adoption index score of 0 point implies non-adoption of the overall improved potato production package.

Statistical analysis of ANOVA indicated that there was significant variation (F= 34.47,P=0.000) among the adoption index score between the three categories at 1% level of significant which indicates difference of adoption of potato technology packages among sampled non-FRG (Table 6).

As indicated in Table 6, non-adopter accounts for 38% with the mean adoption index of 0.0000. This indicated that non adopter was not practicing any of the recommended

package and the technologies in the production year of 2013. Next to non-adopters, low and high adopters constituted about 17 %. Low adopters have mean adoption index of 0.4670 while high adopters constituted about 3.04% mean adoption index were 0.0956.

Table 6.Distribution of non-FRG member's respondents by adoption category of improved potato technologies

Adoption Category	N	percent	Adoption Index score	Mean	SD	F Value	P Value
Non adopter	50	38	0.00	0.000	0.00000		
Low	22	17	0.01-0.30	0.4670	0.06858		
High	4	3.04	0.31-1	0.0956	0.00762		
Total	76	100	0.00-1	0.2212	0.22124	34.47***	0.000

Source: Own survey data, 2014. *** = significant at 1% level.

In FRG members respondents indicated that there is no significant difference of using improved potato technology packages adoption index score is 1 or 100% all FRG members adopted improved potato packages (Table 7).

Table 7 Distribution of FRG member's respondents by adoption category of improved potato technologies

Adoption Category	N	Percent	Adoption Index Score
High	54	100	1
Total	54	100	

Source: Own survey data, 2014

Therefore, statistics applied to assess the difference between FRG members and non-member farmers in the use of improved technology package such as improved potato

cultivars, recommended fertilizer rate, recommended chemical (fungicide) application, recommended cultivation frequency summarized in different forms.

4.4.2. Improved potato cultivars

In the last twelve to fifteen years different improved varieties of potato were introduced into the farming system of the study area. Among these Awash, Tolicha, Guassa, Gera, Menagesha, and wochcha, Jalene, and Gudene are also the most widely introduced varieties into the area. The farmers were dominantly depending on cereal production earlier than potato production. After the release of those improved new varieties, farmers started reducing cultivating their local potato varieties Gudene and Jalene were the dominant verities widely adopted by the farmers in the study area. However, during the study period farmers` made a dramatic shift away from to producing their local potato variety and cereal crop. The survey result shows that, 100% of the surveyrespondents from FRG members were growing Gudene and Jalene variety whereas from non-participant farmer's respondent 18.4% growing improved varieties 81.6% cultivated local potato and cereals (Table 8).For its yield advantage and resistance to late blight farmers preferred to grow Jalene. The majority of the respondent 95 % from non-participant farmers wanted to grow improved potato varieties butcould not get seed of improved potato variety. Moreover, published Impact assessment report 2009 showed that farmers obtained 240-300qt/ha from Jalene variety.

Table 8 Improved potato cultivars

Farmers category	N	yes	No	Yes%	No%	$\chi 2$	P= value
FRG	54	54	-	100	-		
Non- FRG	76	14	62	18.4	81.6		
Total	130	68	62	52.31	47.69	84.218	0 .000

Source: own survey, 2014, *** ($\chi 2$=84.215[a], p=0.000) significant 1% level

The statistical analysis of Chi-Square tests Tablerevealed that the existence of significant difference between FRG members and Non- FRG groups at 1% significant level (Table 8).

FRGs member farmers have close contact with the research center and better acquainted with the package practices through frequent training and demonstrations. However non participant farmers are also use some technologies separate from the package.

In general, sample respondents have selected three most preferred attributes which can be used for selecting among improved varieties of potato these were yield advantage, diseases resistance and market demand(Table.9).

Table: 9 Farmers preference attribute to Jalene variety

Criteria	% of Respondent
Yield advantage	92
Disease resistance	75
Market demand	100

Source: Own survey data, 2014

4.4.3. Fertilizer usage

Fertilizer application is one of the most important practices recommended by the research system and proper application of the recommended rate is important to obtain the required yield.

The two commonly used fertilizers by all the respondent are UREA and DAP. DAP is applied once at planting while urea spilt application at planting andat first cultivation after planting. The group discussion explained that farmers are very excited by immediate and fast vegetative growth in response to UREA than the response of DAP.

Among FRG members there were significant variation on the application of fertilizer in type and rate as 100% of the members used the recommended type and rates, however in non-FRG members there is a huge gap 32.9% used the recommended amount (Table10).

Table 10 Fertilizer usage

Farmers category	N	yes	No	Yes%	No%	$\chi 2$	P= value
FRG	54	54	-	100	-		
Non- FRG	76	25	51	32.9	67.1		
Total	130	79	51			59.636^{a}	0 .000

Source: own survey, 2014, *** ($\chi 2=59.636^{a}$, p=0.000) significant 1% level

The statistical analysis of Chi-Square Tests Tablerevealed that the existence of significant difference between FRG members and Non- FRG memberson application of fertilizer at 1% significant level (Table 10).

4.4.4. Fungicides usage

In study area, late Blight and bacterial wilt are critical disease problems in potato production. The incidence and severity varied from season to season, year to year and variety to variety. Research recommends 2kg of Ridomil or Mancozeb per hectare to

control late blight Farmers in the study area applied fungicide and recommended cultural management practices by research. The latter included among others crop rotation and using diseases free seeds. During the group discussion farmers mentioned that disease tolerant varieties need spraying of fungicide to get higher yield. The survey result shows that there is no big difference between FRG members 100% and non-members farmers 90.8% in fungicide application to control diseases outbreak (Table11).

Table: 11 **Fungicide usages**

Farmers category	N	yes	No	Yes%	No%	$\chi 2$	P= value
FRG	54	54	-	100	-		
Non- FRG	76	69	7	90.8	9.2		
Total	130	123	7			5.277^{a}	0 .0221

Source: own survey, 2014, *** ($\chi 2=5.277^{a}$, p=0.0221) Not significant

The statistical analysis of Chi-Square Tests Tablerevealed that there is no significant difference between FRG members and Non- FRG memberson fungicide application (Table 9)

4.4.5. Cultivation Frequency

In the study area, farmers practice cultivation along with weeding. Regarding the number of cultivation, research recommended 2-3 times in a production season. First cultivation should be performed 30 days after planting supported by UREA application Survey result showed that, 92.6% of the survey respondent from members of FRG practices cultivation 2 to 3 times while 84.2% from non-FRG members practice 2 to 3 times (Table 12). Unlike other practices, there is no much variation among farmers in frequency of cultivation used between FRG members and non-members. As well as the frequency of

cultivation used by sample potato grower farmers was almost similar to the research recommendation, which is 2-3 times of cultivation in one production season.

Table 12 Frequency of cultivation

Farmers category	N	yes	No	Yes%	No%	$\chi 2$	P= value
FRG	54	50	4	92.6	7.4		
Non- FRG	76	64	12	84.2	15.8		
Total	130	123	7			2.055^{a}	0 .152

Source: own survey, 2014, *** ($\chi 2=2.005^{a}$, p=0.152) Not significant

The statistical analysis of Chi-Square Tests Tablerevealed that there is no significant difference between FRG members and Non- FRG memberson frequency of cultivation (Table 12)

4.5 Determinant factors for the adoption of improved potato technologies`

Improved technologies are disseminated to user farmers in the form of packages. These packages are transferred by researchers,development agents, and by other development stakeholders who have close linkage to farmers. However, due to many reason some farmers applied few practices in the packages.

This kind of conditions creates variation among farmers in their level of package adoption. Variation among adopters could be related to personal characteristics, economic, social, psychological and institutional factors. For this reason, identifying the variation due to influencing factors of adoption of improved potato production package in FRG member's farmers and non-FRG participant is the main objective of this study. Table 6 in the previous pages illustrates the sample respondents in to 3 distinct adoption categories in FRG and non-FRG.

As shown in table 6 based on adoptions index the adopters categorized in FRG members and non-members in two groups. The sampled respondents who scored 0.01-0.30 and 0.31-1 were categorized in to low and high adopters.The mean adoption index of non-FRG member's farmer's non-adopter, low and high adopters was 0.00, 0.47, and 0.10 respectively. The larger share of the categories is non-adopter who comprises38% of the respondents Low and high adopters followed by 17% and 3.04% respectively from non-FRG members. From FRG membersthe larger share of the categories is high adopter who comprises100% with adoption score value 1.

4.5.1 Household's personal characteristics

Age is one of the household characteristics important to describe households and can provide a hint as to age structure of the sample respondent and has controversial sides in terms of technology adoption. Older farmers could be fast adopters because they have enough farming experience in the field of agriculture (Tadesse, 2008)On the other hand, because of risk averting nature older farmers are more conservative than younger farmers to adopt new agricultural technologies (Tadesse, 2008).The age ranged from 25 to 65 years. The mean average age of sample respondent was 45.54.years the independent t-test result shows that there was no significant difference between adopter categories in terms of ageto the adoption of improved potato technology (t=1.747, p 0.991) (Table 13) The finding of this study is in agreement with the one conducted by Tesfaye*et al*. (2001) on the adoption of improved bread wheat varieties and inorganic fertilizer by small scale farmers indicated that and adopter of improved bread wheat varieties there was no significant difference in age between non-adopter and adopter of improved bread wheat varieties.

Table 13 AGE status of sampled respondents

Variables	Adoption Category	N	Mean	SD	t	P =value
Age	Non-adopter	50	46.2	15.37		
	Low adopter	22	45	11.63		
	High adopter	58	37.5	11.33		
	Total	130	45.54	13.92	1.747	0.991

Source: own survey result, 2014 (t=1.747, P=0.991).NS

Education enhances the capacity of individuals to obtain, process, and utilize information from different sources. Farmers need enough information about the technology to make the right decision.A better educated farmer can understand the information very easily and internalize the information transferred from development agents, researchers, NGOs and other development stakeholders.

Table: 14 Education statuses of sampled respondents

Adoption Categories	Illiterate	Read write	1-4	5-8	9-10	>10	Total	$\chi 2$	P
Non adopter	18	12	10	3	6	1	50		
Low	2	2	8	5	2	3	22		
High	3	6	9	16	10	14	58		
Total	23	20	27	24	18	18	130	17.257^{a}	0.004

Source: own survey 2014, ** ($\chi 2=17.25^{a}$, P=0.004).

From the sample household heads 13.85% of respondent farmers are illiterate and the rest 86.15% are educated. Majority of high adopters have been educated from grade 5 to >10grade (Table 14).It helps them to internalize what agricultural experts said and applied the technology packages properly. Chi-square test also shows the significant

difference between adopter categories of improved potato technologies ($\chi 2=17.25^{a}$, P=0.004).

4.5.2 Economic factors

Land is perhaps the single most important resource as it is a base for any economic activities especially in rural and agricultural sector. In the study area, the maximum land size owned by sample households was 1.25 ha while the minimum was 0.25 ha. In this study,from non-FRG members large size landholder farmers are adopters of new potato technologies. The mean land holding of non-adopters, low and high adopters are 0.36, 0.66 and 1hectares respectively. Analysis of variance also shows significant difference among adoption categories (t=17.65, P=0.000) (Table 15).

Table: 15 Non-FRG Land holding of sampled respondents

Land in hectare	Adoption Categories	N	Mean	SD	t	P value
Total land holding	Non-adopter	50	0.36	.351		
	Low adopter	22	0.66	.182		
	High adopter	4	1	.204		
	Total	76	.480	.237	17.65^{***}	.000

Source: own survey, 2014 ***, significant at 1% probability level

FRG members are high adopters with mean land holding 0.86ha.Analysis of variance also shows significant difference with in FRG members(t=26.092, P=0.000) (Table 16).

Table: 16 FRG members Land holding of sampled respondents

Land in hectare	Adoption Categories	N	Mean	SD	t	P value
Total land holding	High adopter	54	.86	.246		
	Total	54	.86	.246	26.09***	.000

Source: own survey, 2014, ***, significant at 1% probability level

Livestock holding is an indicator of household's wealth position in the rural context.Livestock production is an important component of the farming system in the study area farmers used mixed farming systems. Livestock means so many things for farmers for instance traction power, manure and source of income by selling the animals and by-products

The average livestock ownership of the non-FRG respondent farmers was 1.92. The minimumand maximum livestock ownerships of the farmers were 0 and 6 TLU respectively (Table 17).

Statistical test shows insignificant difference (t 6.262,p=0.293) between livestock ownership and the adoption of improved potato production packages as indicated in (Table 17) This finding has similarities with Tadesse (2008).

Table: 17 Non-FRG Livestock ownership (TLU)

Adoption Categories	N	Mean	SD	t	P value
Non-adopter	50	1.86	1.09		
Low adopter	22	1.95	.844		
High adopter	4	2.5	1.29		
Total	76	1.92	1.20	6.262NS	.0293

Source: own survey, 2014,

FRG member's average livestock ownership of the respondent farmers was 3.04 Statistical test shows significant difference in between FRG member's respondent's livestock ownership and the adoption of improved potato production packages.Analysis of variance also shows significant difference with in FRG members(t=28.75, P=0.000) (Table 18)

Table: 18 FRG members FRG Livestock ownership (TLU)

Land in hectare	Adoption Categories	N	Mean	SD	t	P value
Total land holding	High adopter	54	3.04	.776		
	Total	54	3.04	.776	28.75***	.000

Source: own survey, 2014, ***, significant at 1% probability level

Labor Potato production is labor intensive activity at different stage starting from land preparation to harvesting. The survey result shows that, 85.5% of the total respondent answered there were shortage of labor 14.5% there is no shortage of labor.

Chi-square test also shows that there is no significant difference between FRG members and non-members Shortage of labor($\chi 2$=.184[a], P=0.668). (Table 19)

Table 19 Labor shortage

Farmers category	N	yes	No	Yes%	No%	$\chi 2$	P= value
FRG	54	47	7	87.04	7.4		
Non- FRG	76	64	12	84.21	15.8		
Total	130	111	19	85.5	14.5	.184[a]	0 .668

Source: own survey, 2014, *** ($\chi 2$=0.184[a], p=0.668) Not significant

Off-farm activity

Mostly during off-farm periods many farmers can earn additional income by engaging in various activities.Those respondents who have off farm income assumed to have better gross annual income. In the study area, grain trading, vegetable trading, animal products trading, daily laborer are some of the off farm activities which the sampled respondents accomplished in year 2013. The survey result indicates that from the all respondents farmers 95.73% involved in off-farm activity 4.27% did not participated. Chi-square test also shows that there is no significant difference between FRG members and non-members in participating off-farm activities($\chi 2=2.514^{a}$, P=0.113) (Table 20).

Table 20 Off-farm activity

Adoption Categories	No	Yes	NO	Yes%	N %	$\chi 2$	P=value
Non-adopter	50	47	3	94	6		
Low adopter	22	22	-	100	-		
High adopter	4	4	-	100	-		
FRG high adopter	54	48	6	88.9	11.1		
Total	130	121	9	95.73	4.27	2.514^{a}	.113

Source: own survey, 2014, $\chi 2$ value 2.514^{a}, P=0.113, NS = Not significant

4.5.3 Institutional factors

Institutional factors are believed to have an influence on adoption of potato production packages. In this section access to research, access to extension is discussed here below.

Access to research

Holeta Agricultural Research Center is the main source of information on new technologies for potato farmers in the study area. This center has made its services accessible to farmers mainly through formed FRGs, by arranging training, workshop,

field day visit, on-farm demonstration and on-farm trial.It is hypothesized that frequent contact with agricultural researchers will increase farmers' probability of adopting improved agricultural technologies

Non-FRG members with adoption categories non-adopter 100%,low adopter 90.9% and high adopter 50% of the respondents have no accesses to research but 100% of FRG members have assesses to research Chi-square test also shows that there is a significant difference between FRG members and non-members in assesses to agricultural research ($\chi 2=101.307^{a}$, P=0.000). (Table 21)increasing farmers' participation in research activities can increase participation in improved potato technology package adoption the result of this study is in agreement with the findings of many authors. For instance, Tesfaye*et al*. (2001), in the study on adoption of improved bread wheat varieties and inorganic fertilizer by small-scale farmers, reported that participation in on-farm demonstration and participation of training contributed positively to farmers' participation and adoption.

Table 21 Accesses to research

Adoption Categories	No	Yes	NO	Yes%	N %	$\chi 2$	P=value
Non-adopter	50	-	50	-	100		
Low adopter	22	2	20	9.1	90.9		
High adopter	4	2	2	50	50		
FRG high adopter	54	54	-	100	-		
Total	130	58	72	39.77	60.22	101.31^{a}	.000

Source: own survey, 2014 ***, significant at 1% probability level

Access to Extension

In the study area the common extension events that were used as a substitution for participation in extension include demonstration, farmer's field day, and training. These extension activities are the major source of agricultural information that equip farmers with the necessary knowledge and skill about the new agricultural technologies and as a result farmer would be more likely to participated and adopt new improved potato technologies. Non-FRG members with adoption categories non-adopter 90%, low adopter 27.78% have no accesses to research, high adopter from non FRG 100% have accesses to extension but 69% of FRG members have assesses to extension which directly organized by wereda level agricultural office. Chi-square test also shows that there is a significant difference between FRG members and non-members in assesses to agricultural extension ($\chi 2=18.590^{a}$, P=0.000). (Table 22) This implies that FRG member farmers and high adopters from non-FRG members participated in the extension events.Edlus's (2006) findings also agree with this finding.

Table 22 Access to Extension

Adoption Categories	No	Yes	NO	Yes%	N %	$\chi 2$	P=value
Non-adopter	50	5	45	10	90		
Low adopter	22	16	6	72.22	27.78		
High adopter	4	4	-	100	-		
FRG high adopter	54	37	17	68.52	31.48	-	
Total	130	62	68	62.98	37.02	18.590^{a}	.000

Source: own survey, 2014 ***, significant at 1% probability level

The following part presents the results of the maximum-likelihood estimates of the Tobit model of the determinants of adoption and extent of use of improved potato technology package.

Educational: education level increases farmer's ability to get process and use information and increase farmer's willingness to adopt a new technology. Several studies, for example, those conducted by itana (1985),Chilot et al.(1996),kansana(1996),Asfaw et al.(1997),Mwanga *et al*. (1998) and Tesfaye *et al*. (2001) had reported that education had positive and significant relationship withadoption.

In this part education had positively and significantly influenced the adoption and extent of adoption of improved potato production package at 5% probability level.

This explanatory variable accounts 18.5% of variation on probability and extent of adoption of improved potato production package. On the other word, it said that it would increase by 18.5% the probability of potato technology package adoption. Therefore, it was hypothesized that education influences adoption of improved potato production technology positively.This result has similarity with Yitayal (2004) research findings.

Total land holding: Total land holding had positive and significant influence on the adoption and extent of adoption of improved potato production package at 1% probability level. The explanatory variable accounts 10.2% of variation on adoption and extent of adoption of improved potato production packages. The result indicates that farmers who have larger land size are in a better position to adopt the potato package.

Accesses to research: Had positive significant influence on the adoption and extent of adoption of improved potato production package at 1% probability level. This independent variable accounts 32.5% of variation on adoption and extent of adoption of

improved potato production package. On the other word farmers who have more accesses to research more exposure to have information on new agricultural technologies. Similarly, on the adoption of improved potato production package adopter FRG member's farmers have more frequent contact with researchers than non FRG farmers.

Accesses to Extension**:**Many research findings across space andtime agree in the positive association of accesses to extension and adoption oftechnologies. In a similar manner the result of the Tobit model in this study reveals thatadoption of improved potato technology package by the respondent farmers were positively influenced by accesses of extension and it is statistically significant atless than 1% probability level.This independent variable accounts 25.4% of variation on adoption and extent of adoption of improved potato production package.

FRG membership: Participant Farmers in FRG has increases farmers ability in technology adoption and dissemination and also it create favorable condition to farmers exchanging information and participate in different agricultural training it serves as platform to the intervention and adoption of technologies

In this part farmers participate as a member in FRG has significantly influenced the adoption and extent use of improved potato production package and it is statistically significant at less than 1% probability level.This independent variable accounts 29.2% of variation on adoption and extent of improved potato production package.

Table23**.** Maximum likelihood estimates of Tobit Model

Variable	Estimated coefficient	Standard error	T	P=value
AGE	-.0013105	.9966604	-0.03	0.897
EDU	.185146	.0857708	1.88**	0.040
LANHO	.1023712	.0271121	2.81***	0.000
LIVSTO	0002305	.0268286	0.01	0.881
ACESSRES	3257437	.0772683	3.38***	0.000
ACESSEXT	2543525	.0.543362	4.12***	0.000
FRGM.	292717	0.428348	3.05***	0.000
Constant	-215274	.1224055	-1.56	0.064
/sigma	.3226762	.0316416		

Log likelihood function=21.045534
ANOVA best fit measure =0.4244
P=0.000

Source: Model output, ***, **,* represents 1%, 5% and 10% level of significant

Based on the above fact, in this study a percent increase in explanatory variables there will be certain to increase the probability and intensities of adoption of improved potato production packages

4.6 SWOT analysis

To develop the study findings SWOT analysis was done with FRG leaders, Agricultural researchers, wereda Agricultural office (extension division), and development agents in terms of successes, problems faced and finding solution for the future developments of FRGs assessed.Result of SWOT is summarized as follow

Table: 24

Strength	Weaknesses
Structure -Voluntary organization -Simple chain of command -Improve interaction with group -Strong linkage with researcher center **Working Modality** -Democratically elect their leaders -Discussion with members -Discussion with leaders -Discussion with researchers -Training and field visit conducted to FRG -Problem identification **Implementation** -Very good link with researchers -Field day organized -Experience sharing organized -Practical trainings organized	**Structure** -No recording Information(data) documented -No Body can organized market to potato tuber seed -Market assessed by individual FRG farmers **Working Modality** -No regular meeting time - very limited support To FRG by weereda agricultural office level - No stakeholders support except research **Implementation** -Most of the time leaders participate training -No regular trainings (refreshment) program -Not organized and documented plan -No follow up of different stakeholders -Very less attention by office of Agriculture
Opportunity	**Threats**
Structure -Policy and enabling policy favored group work -Non participant farmers need to form new FRGs -Availability of improved potato technologies -Very positive perception about researchers by FRG members **Working Modality** -Mutual understanding of researchers and farmers -Trainings organized and conducted by HRC -FRG members can plan implement and managed their farm activities -Present of HRC near to them very good opportunity	**Structure** -Have no expected support from weereda agricultural office level -No support of stakeholders except research -Less women participation **Planning** New potato varieties not available on time to FRG -Increasing the price of inputs **Implementation** - No body take to organized value chain work to FRG members to their potato tuber seeds -No stable market opportunity **Role of stakeholders** Low participation of supposed to be members

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATION

5.1Summary and Conclusion

Welmera woreda is one of the eight Woredas in Oromia Special Zone Surrounding Addis Ababa, at about 32 Km east of Addis Ababa. The area is found one of the four zones which are well known by potato production in Ethiopia. The main focuses of this study was to assess the role of FRG in adoption and extent of improved potato technology packageand determinant factors for the adoption of improved potato production package. The sample size of the study was 130respondents, out of it 54 and members of FRG and 76 non-FRG members. The sampling was taken from two administrative kebeles. The sampled respondents were interviewed by using structured interview schedule. Group discussion also undertaken with selected farmer, development agent and researchers to find out the qualitative data and SWOT analysis.

For data analysis one way ANOVA tests were used to test the variation of mean among the adoption groups and chi-square test was used to see the dependency of the adoption group's t-test were used to test potato technology adoption within FRG and non-FRG members. The econometric model Tobit was run to identify some of the effect of the hypothesized variable on dependent variables

The adoption decision of each respondent affected by different kinds of factors these determinant factors are categorized as personal, demographical, economical and, institutional factors. Each factor was assumed to have positive influence on the adoption of improved potato production package

On personal and demographic characteristics educational statues of the household head also show significantly and positive difference on the adoption of improved potato production package

On resource ownership variable total land holding of the respondent farmers have showed positive relationships between the adoptions of improved potato production Package in the FRG members and non-members farmers.

In institutional factors access to research and accesses to extension events shows significant relationships between the adoptions of improved potato production package with FGR and non- FRG members. This indicates that potato production demands more institutional supports and involvements of different stakeholders.

An econometric model was run to identify the effect of the hypothesized explanatory variables on the adoption of improved potato production package. The model finds out the effect of the explanatory variables on the probability and intensity of adoption of improved potato production packages. Thus, education status of the respondents, total land holding, access to research and access to extension events were found significantly influence the probability and intensity of adoption of improved potato production packages with in FRG and non-FRG farmers

In general, this study found that participated with FRG creates more favorable condition to the adoption of improved potato production technology package has contributed to significant improvements of farmers participation to identified their problem and find solution and FRG non-participant farmers showed high interest of to become FRG participants. The major problems are lacks of active participation of different stakeholders in FRG day to day activities.

5.2 Recommendation

1. The established FRGs has been achieving improved potato technology package adoption through verification, demonstration and popularization. The roles of FRG should be strengthened to address participatory methodology using multidisciplinary team of researchers.

2. Site specific technology generation and modification for each package components and specific to potato varieties through FRGs is highly recommended. Therefore, linkage of the multidisciplinary team should be strengthened.

3. Researchers must be developed new potato cultivars to address the demand of market and add value to FRG potato producer farmers to be transform them to a supplier of small scale potato processing industries

4. FRG must be broaden and has the scope of participatory research from a functional consultative type to a more collegial and empowering type, and from variety selection and adoption to broader natural resources management.

5. It is highly recommended to strengthen/reform the groups to have and clear plan of action and role of respective clients spelled out and written group norms developed by participants for respective FRGs.

6. Besides, developing sustainable financial mechanism to reinforce organizational capacity, periodic performance review meeting and monitoring on specific FRGs is crucial.

7. Considering of women Participation in FRG must give attention.

8.Farmer show very greet interest to be organized by FRG in different circumstance However there is very few FRGs with very few members yet organized so the respective

stakeholders must take the responsibility to give chance to farmers organized themselves and participate in Agricultural technologies Adoption.

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Appendix

1: Interview Schedule

1) General information

Kebele_____
Respondent's name_____
Sex of respondent _____
Ethnic origin of the respondent_____
Date of interview _____
Name of interviewer_____ Signature_____

2. Household personal characteristics

2.1 Household demographic characterizes

No	Name of the HH members	Sex	Age	Relationship	Marital status	Education
1						
2						
3						
4						
5						

Family relationship 1) Husband 2) Wife 3) Son 4) Daughter 5) Relative 6) Dependent 7) other (specify) ----------

Marital statuses 1) Married 2) Single 3) Divorced 4.Widow

Education of HH members 1) Illiterate 2) Read and write 3) 1-4grades (First Cycle) 4) 5-8 grades (Elementary) 5)9-10 (Secondary) 6) above 10

3. Household resources ownership and income

3.1 Present land ownership (in year 2006 E.C) Land allocation

Land size(kerti)	Self-cultivated	Rented out	Shared out	Contracted	Rain fed	Irrigated	Total land

1.1(Kerti) 1.Yes 1.Yes1.Yes1.Yes1.Yes1.Yes
2 .2 2.No 2.No 2.NO 2.NO 2.No 2.No
3. 3
4. 4
5.More

3.2 Livestock ownership and annual income from sale of livestock (2005 EC)

No	Category	Number owned	Number sold	Total Income
1	Cows			
2	Oxen			
3	Heifers			
4	Calves			
5	Bulls			
6	Sheep			
7	Poultry			
8	Donkey			
10	Horse			
	total			

3.3 House type and number of houses

No	House type	Number	purpose
1	Grass roofed		
2	Corrugated iron sheet		
3	Others specify		

1. One
2.Two
3.Three
4.Four
5. More

1.Living
2.Gust
3.Children
4.Livestock
5. Others

4. Crop Production and income

4.1 Production of major crops by the household and income in 2005 E.C

No	Crops grown	Area coverage (kerti)	Total annual Harvest (Qt)	Amount Consumed	Amount sold	Total income
1	Potato					
2	Tef					
3	Barley					
4	Wheat					
5	Faba bean					
9	Others (specify)					

1.1(Kerti)	1.10Qt	1.>3Qt	1.≥ 5
2.2	2.20-40	2.>5Qt	2.10-30
3.3	3. 40-60	3.>7Qt	3.30-50
4.4	4. 60-80	4.>9Qt	4.50-70
5.More	5. More	5.More	5.More

5. Socio-economic characteristics and participation of the household

5.1 Household labor availability and their activities share in potato production.

No	Age category	Activities engaged	Male	Female	total
1	<10 years				
2	10-14 years				
3	15-50 years				
4	>50 years				

1) Land preparation 2) sowing 3)Hoeing 4) Weeding 5) Harvest 6) Transportation 8) Storage 9) Marketing

1. Male 2.Female

5.2 Do you face labor shortage problem in potato production? 1) Yes 2) No

5.3 If yes during which farm operation? 1) Land preparation 2) sowing 3) Hoeing 4) Weeding 5) Harvest 6) Transportation 7) Storage 8) Marketing

5.4 based on Q. 5.2 how do you solve labor shortage problem? 1) By hiring 2) asking for cooperation (Jigi) 3) All

5.5 Household's participation in off-farm activities in 2005E.C

No	Who participate	Type of activity
1	Husband	
2	Wife	
3	Elder son	
4	Elder daughter	
5	Others (specify)	

1) Vegetable trading 2) Cattle trading 3) Grain trading

5.6 Household's participation in non-farm activities in 2005 E.C Yes/ No If yes

No	who participate	Type of activity	Duration (for how long)
1	Husband		
2	Wife		
3	Elder son		
4	Elder daughter		
5	Others (specify)		

1) Permanent employee 2) Daily laborer 3) 4) Petty trade 5.wood work

1. >4months 2.>7Months 3.> 10Months 4.12 Months

5.7 For what purpose do you use the income from off-farm/non-farm activities?

1) To purchase cloths for the family 2) To pay school fee 3) To purchase farm inputs 4) To settle debts 5) To buy food grains for the family

6. Specific to Potato FRG Members

6.1 **Name &Kebele of the FRG_____**?
6.2 **When did you become member of FRG? Year:** ----------
6.3 **Are you organized in to FRG voluntarily?) Yes 2) No**
6.4 Who initiate you to organize in to FRG?
1) Yourself 2) HARC 3) friend 4) other specify _____
6.5 Would you involved in workshop, meeting, and training on participatory research? Yes/ No
6.6 Are you frequently raising problems and questions with researchers on agricultural technologies? Yes/ No
6.7 Is the Potato technology developed based on your interest? Yes/ No
6.8 Are all members sufficiently participating in the technology development and evaluation process? Yes/ No If No, what are the major factors hindering equal participation?
1) Lack of commitment 2) poor leadership 3) other specify
6.9 Based on question number 6.8 If the answer is yes, at which stage of the research Process?
1) Research problem identification 2) Designing research experiment 3) executions of the experiment 4) monitoring and evaluation 5) others specify _____
6.10 Are there sufficient meeting of members? Yes/ No if yes, how frequently
1) Quarterly 2) Monthly 3) every six month 4) other specify_____
6.11 Is group reviewing plan and expenditure? Yes/ No If yes how frequently
1)Yearly 2) Quarterly 3) Monthly 4) other specify _____
6.12 Are you happy to participate in FRG for future? Yes/No
6.13 Was there enough motivation by researchers to adapt/modify technologies to your liking? Yes/No
6.14 Is being a member of FRG Improved your confidence? Yes/No
6.15 Has your group has been making self-evaluation? If yes when?
1) Every month 2) every quarter 3) every year _
6.16 Have you been selected to involve in conducting trial? Yes /No if yes, specify the trial?
1) potato variety trial 2)potato fertilizer ret 3)potato rust and light blight control 4.irrigation frequency trial 5) potato seed rate6) frequency of spraying 6) spacing
6.17 Do you know the objective of trial? Yes or No If yes what it is?
6.18 Do you get any benefit from improved activities? Yes/ No if yes what it is
1) Income 2) knowledge of optimum rate 3) Identify promising variety
6.19 Non- Participant farmers show interest in visiting your on-farm improved practice? Yes/No
6.20 Based on Q. No 6.19 are there non-participant farmers who copied your on farm improved activities?
1) All 2) Some 3) Non at all
6.21 If HARC stop supply of inputs and technical support to the FRG, will You continue conducting your own technology development Yes/No
6.22 Have you ever discussed about FRG activities and its result with non-participant farmers in your locality? Yes/No

6.23 Change in the last one year in HARC communication with your group and provides adequate feed –back.

1) Situation deteriorated 2) Situation was bad and remains the same 3) Situation was good and remain the same 4) Situation improved 5) Situation improved considerably

6.24 Rate of satisfaction and your own motivation with the service and collaboration With HARC

1. Situation deteriorating 2) Situation was bad and remained the same 3) Situation was good and remained the same 4) situation improved 5) situation Improved considerably

6.25 Would you recommend HARC to other needing similar service?

Yes/ No

6.26. HARC staff attitude in terms of collaboration and helpfulness for farmers

1) Very good 2) good 3) bad 4) very bad

6.27HARC staffs are

1) Friendly 2) Co-operative 3) dictators and autocrats 4) Correct in their dealing with us 5) other _____

6.28 Are all technical and material support from HRC is available up on request? Yes/No

6.29. Was your group leader has potential to properly lead the group? Yes/No

6.30. Was your local solutions appreciated? Yes/ No

7. Technical information specific to potato Production

7.1 When did you start producing potato? 1. Before 5 years 2.Before 7Years 3.Befor 10 Years 4.Befor 15 years 5. More than

7.2 Have you heard of improved potato variety? 1) Yes 2) No

7.3. If yes, when have you heard for the first time? Year heard 1. Before 5 years 2.Before 7 Years 3.Befor 10 Years 4.Befor 15 years 5.More than

7.4 From whom you heard about improved potato variety?1) MoA 2) Researchers HARC 3) Individual producers producing potato in the area 4) NGO 5) Cooperative society 6) Neighbor farmers

7.5 Have you ever grown improved potato variety(s)? 1) Yes 2) No

No	Variety	Year First grown	when stopped usingthe variety	Reason for Stopping
1	Gudeni			
2	Jalni			
3	Tolechae			
4	Others (Specify)			

7.5.1.1. Before 5 years 2.Before 7Years 3.Befor 10 Years 4.Befor 15 years . 5.More than

7.5.2. 1. Before 3 years 2.Before 5Years 3.Befor 8 Years 4.Befor 10 years 5.More than

7.5.3. Reason for stopping 1) Reduction of yield 2) Unavailability of seeds 3) High purchase price of the seeds

7.6 Area Coverage by improved variety of potato in 2005 E.C and preference rank

No	Name of the Variety	Area coverage (kerti)	Preferencerank	Reasons Forpreference
1	.Gudeni			
2	Jalni			
3	Tolechae			
4	Others (Specify)			

7.6.1. Area 1.1 Kerti 2.2Kerti 3.3Kerti 4 4Kerti 5.More

7.6.2. **Preference Rank** 1.Gudeni 2.Jalni 3.Tolecha **(1st 2nd 3rd 4th)**

7.6.3. Reasons for preference1) Better yield advantage 2) Good tuber size 3) Good tuber color 4) Earliness 5) Higher market demand 6) Better price 7) Better storability 8) Suitability for seed production 9) Resistance to disease and pest

7.7 Who are your potato seed sources?

1) Market 2) MoA 3) HARC/CIP 4) Individual producer 5) NGO 6) other specifies

7.8 Which seed source you prefer? 1) Market 2) MoA 3) HARC 4) Individual producer 5) NGO

7.9 Had you produced Potato seed? Yes/No If yes

7.10 How do transfer seed to neighbors/others?

1) Gift 2) sale 3) borrow 4) exchange with local

8. Market related variables

8.1 Where do you sell your Potato tuber and to whom you sell

1. At farm get 2. At market 3Your house

8.1.2. To whom

1) to whole seller 2) to retailer 3) to direct consumers 4) other specify

8.2 How was the market /selling price of Potato last year (2005 E.C)? -- -birr/kg/qt

1.> 400 2.500 3.600 4.700 5.More than

8.3 In your view, how do you see the selling/Market price of Potato?

1) Very poor 2) Poor 3) Medium 4) Good 5) Very good

8.4 Who determines the Market/selling price?

1) Traders 2) farmers/producers FRG members 3) Brokers 4) supply and demand of the product on market 5) others

8.5 Do you get information on Potato selling price 1) Yes 2) No

If yes, specify your source of information

1. DA 2.Traders' 3.Neighbor farmers 3. Cooperatives 4.Researchers 5.Middle men

8.6 How often you get access to it?
1. Sometimes 2.Often 3.very often4. Rarely 5.Never

8.7 What do you think are the major marketing problems with regard to particularly Potato? (Rank them in order of importance)
1) Low selling price 2) High input purchase price 3) Exploitation by middle- men
1. 1st 2.2nd 3.3rd

9. Access to credit

9.1 Could you afford input purchasing from own savings? Yes/No

9.2 Have you ever obtained credit for your Potato farming operations in the last three years?
Yes/ No If yes
9.2.1. Credit source 1.Government 2.Private 3.Individuals

9.2.2. Year 1.one year 2.Two years 3. Three years

9.2.3. Purpose 1) For purchasing fertilizer 2) For purchasing improved seeds 3) For purchasing chemicals 4) For other purpose

9.3 If no, why?
1) High interest rate 2) No money for down payment 3) No money for payment4) others

9.4 What are the major problems to take input on credit?
1) Inaccessibility of credit agent 2) high interest rate of credit 3) Fear of risk 4) Not allowed individually 5) others

10. Use of farm inputs for Potato production

10.1 Quantity of inputs purchased for Potato production in 2005 E.C

No	Type of inputs Specific name	Unit Amount purchased	Unit price (Birr)	total cost
1	Improved Potato tuber Kg/Qt			
2	Fertilizer Dap/ Urea Qt			
3	Chemicals Insecticide , pesticide&Fungicide			

10.2 In your view, how do you see the price of inputs used for potato production? Price condition)
10.2.1. Improved potato seed 1. Not expensive 2.Less expensive 3.Medium 4.Expensive 5.Very Expensive

10.2.2. Fertilizer 1. Not expensive 2.Less expensive 3.Medium 4.Expensive 5.Very

Expe

10.2.3. Chemicals 1. Not expensive 2.Less expensive 3.Medium 4.Expensive 5.Very Expensive

10.2.4. Labor1. Not expensive 2.Less expensive 3.Medium 4.Expensive 5.Very Expensive

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

10.3.1. Improved potato seed 1. Low Supply 2.Not timely 3.Poor quality 4.Expensive

10.3.2. Fertilizer 1. Low Supply 2.Not timely 3.Poor quality 4.Expensive

10.3.3. Chemicals 1. Low Supply 2.Not timely 3.Poor quality 4.Expensive

10.3.4. Labor 1. Low Supply 2.Not timely 3.Poor quality 4.Expensive

10.4 Which of the following problems did you face with inputs purchased from market?

10.4.1. Improved potato seed 1. Low Supply 2.Not timely 3.Poor quality 4.Expensive

10.4.2. Fertilizer 1. Low Supply 2.Not timely 3.Poor quality 4.Expensive

10.4.3. Chemicals 1. Low Supply 2.Not timely 3.Poor quality 4.Expensive

10.4.4. Labor 1. Low Supply 2.Not timely 3.Poor quality 4.Expensive

11. Extension services

11.1 Do you get advisory services from extension agents on potato production?
1) Yes 2) No

11.2 Extension contact

11.3 Have you ever got the extension agents advice on the practices of the new potato technology?

1. Yes 2. No _____

11.4 Did the extension agent visit/contact your farm last year?

1. Yes 2. No

11.5 If yes, how many times? (Number of contact) _____

11.2 If yes, how frequent the extension agents visit you during the production season?

1) Once in a week 2) Monthly 3) Only during plantation 4) during input provision 5) during credit collection 7) others

11.3 Do you invite extension agent by yourself? 1) Yes 2) No
11.4 If yes, when do you invite? 1) During plantation for technical advice 2) During input provision to obtain inputs 3) It depends (any time when there is technical problem)

11.5 Who are your other sources of information on potato production and how often do you use/ have contact with them?
How often you contact/use them

11.5.1 Researchers 1.Never 2.Rarely 3.Occasionally 4.often 5.Very often
11.5.2 Have you ever got the researchers advice on the practices of the new potato technology?

1. Yes 2. No _____

11.5.3 Did the researchers visit/contact your farm last year?

1. Yes 2. No

11.5.4 If yes, how many times? (Number of contact) _____

11.5.5. Private producers 1.Never 2.Rarely 3.Occasionally 4.often 5.Very often

11.5.6. Coming from other areas 1.Never 2.Rarely 3.Occasionally 4.often 5.Very often

11.5.5 .Fellow farmers 1.Never 2.Rarely 3.Occasionally 4.often 5.Very often

11.5.6. NGOs 1.Never 2.Rarely 3.Occasionally 4.often 5.Very often

11.5.7. Unions 1.Never 2.Rarely 3.Occasionally 4.often 5.Very often

11.6 Please, indicate your participation in the following extension events related to potato production in the last few years
1. Field day 2. Training 3.Demonstration

11.6.1 Who arrange the events?
1) MoA 2) HARC 3) NGO 4) Others

11.7 have you been selected to any demonstration of potato production technologies in the last few years yes/ No If yes how many times
1) Once 2) two times 3) three times

12. Knowledge/awareness related variables

12.1 indicate whether you are aware of the recommended rate of the Following potato production package practices by answering the following questions

Score 1 if yes 2 if No

1 Do you know the recommended seeding rate/ha or Kerti --------

2 Do you know the recommended fertilizer rate/ha or kerti ----------

3 Do you know the recommended chemical (fungicide) application rate/ha or kerti --

4 Do you know the recommended number of cultivation? ----------

5 Do you know the recommended irrigation frequency? ----------

13. Adoption of potato production package components

13.1 What is your level of adoption of the following potato production package practices by the last few years?

13.1.2. Seeding rate 1.R. rate of application 2.Not recommended Rate

13.1.3. Fertilizer rate 1.R. rate of application 2.Not recommended Rate
DAP 1.R. rate of application 2.Not recommended Rate
UREA 1.R. rate of application 2.Not recommended Rate

13.1.4. Chemical 1.R. rate of application 2.Not recommended Rate
Fungicide 1.R.rate of application 2.Not recommended Rate
Insecticide 1.R. rate of application 2.Not recommended Rate

13.1.5. Frequency of Cultivation 1.R. rate of application 2.Not recommended Rate

13.1.6. Frequency of Irrigation 1.R. rate of application 2.Not recommended Rate

13.1.7. Storage Techniques 1.R. rate of application 2.Not recommended Rate

13.1.8. DLS construction 1.R.rate of application 2.Not recommended Rate

13.1.9. Tuber selection for Planting 1.R. rate of application 2.Not recommended Rate

13.1.10. Reasons for not implementing according to the recommendation

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

13.2 Generally, what are the major problems in potato production? (Rank them in order of importance) 1.1St 2.2nd 3.3rd4.4th5.5th 6.6th7.7th 8.8th 9.9th

1) High production cost _____

2) Low selling price of Potato _____

3) Exploitation by middle men due to lack of market information and poor bargaining power _____

4) Shortage of improved seed _____

5) Lack of credit _____

6) Lack of irrigation water _____

7) Lack of enough extension support _____

8) Lack of enough knowledge and experience on Potato production _____

9) Lack of Agricultural researchers _____

Check list for Researchers, wereda MOA, Kebeleadministrartives, Development agents and FRG Leaders
SOWT analysis

1. Who are the relevant actors that have been involved in the FRG extension systems?.
2. What are the extension activities in FRG?
3. How the FRG program is going on?
4. What are the experiences gain by the members through FRG?
5. What are the technologies tasted in FRG fields?
6. What are the relationship between Development agents working around?
7. What are the relationship between agricultural researchers and FRG members?
8. How do non-participating farmers benefit from active FRGs?
9. How do FRG members organized?
10. What are the challenges with working with FRG members farmers?
11. What are the challenges faced by FRG members during implementation?
12. How do Researchers assist you at time of implementation?
13. How frequents extension worker from wereda level visit your FRG activity?

14. What are the working modality of FRG?
15. What are the relevant actors working with FRG?

GOD Bless You

Conversion factors used to compute tropical livestock units

Animal category	LU
Calf	0.25
Weaned calf	0.34
Heifer	0.75
Cow and ox	1.00
Horse	1.10
Donkey (adult)	0.70
Donkey (young)	0.35
Camel	1.25
Sheep and goat (adult)	0.13
Sheep and goat (young)	0.06
Chicken	0.013

Source: FAO, 1987a