ADOPTION OF IMPROVED SESAME VARIETIES IN MEISSO DISTRICT, WEST HARARGHE ZONE, ETHIOPIA

M.Sc. Thesis

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October 2010

Haramaya University

ADOPTION OF IMPROVED SESAME VARIETIES IN MEISSO DISTRICT, WEST HARARGHE ZONE, ETHIOPIA

A Thesis Submitted to the Department of Rural Development and Agricultural Extension, School of Graduate Studies

HARAMAYA UNIVERSITY

In Partial Fulfillment of the Requirements for the Degree of

MASTER OF SCIENCE IN AGRICULTURE

(RURAL DEVELOPMENT)

By

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October 2010

Haramaya University

School of Graduate Studies

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As thesis Research advisors, we here by certify that we have read and evaluated this thesis prepared, under our guidance, by **Bayissa Gedefa Woyessa**, entitled "**Adoption of Improved Sesame Varieties in Meisso District, West Hararghe Zone, Ethiopia."** We recommend that it be submitted as fulfillment of the thesis requirement.

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As member of the Board of Examiners of the M.Sc.Thesis Open Defense Examination, We certify that we have read, evaluated the Thesis prepared by Bayissa Gedefa Woyessa and examined the candidate. We recommended that the Thesis be accepted as fulfilling the Thesis requirement for the Degree of Master of Science in Agriculture (Rural Development).

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DEDICATION

I dedicate this thesis manuscript to my mother who sacrificed much to bring me up to this level but not lucky to see the final fruits of her effort.

STATEMENT OF AUTHOR

First, I declare that this thesis is the result of my own work and that all sources or materials used for this thesis have been duly acknowledged. This thesis is submitted in partial fulfillment of the requirements for an advanced M.Sc. degree at Haramaya University and to be made available at the University's Library under the rules of the Library. I confidently declare that this thesis has not been submitted to any other institutions anywhere for the award of any academic degree, diploma, or certificate.

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BIOGRAPHICAL SKETCH

The author was born in West Shoa Zone, Jeldu woreda in 1982. He completed his primary education in jeldu primary school which located in the Gojo town. He attended his high school education at Ambo Comprehensive Senior Secondary School (1997-2000). He then joined Haramaya (the then Alemaya) University in September 2001 and graduated with B.Sc. degree in Agricultural Extension in July 2004.

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ACKNOWLEDGEMENTS

First, I would like to thank the almighty God for he gave me health, strength and patience to withstand the inconveniencies, which I came across through all the lines of life.

I would like to extend my heartfelt thanks to my major advisor Dr. Tesfaye Lemma for his valuable advice, insight and guidance starting from proposal development to the completion of the research work. I am again thankful to my co-advisor, Dr. Beyene Tadesse, for his willingness to advise me as well as his valuable guidance and support throughout my research work. Both have worked hard to keep me on the right track and timely accomplishment of the study.

I would like also to express my sincere appreciation to ILRI-IPMS Project for funding my research and other study expenses and Oromia Agricultural Research Institute for giving me chance to pursue my post graduate study. I would like also to thank all management and staff members of Bako Agricultural Research Center for their hospitality and kindly cooperation in all aspects. Though not to exclude others, my special thanks go to Mr. Mesert Negash, Center Manager of Bako Agricultural Research Center for encouraging me morally and facilitating every arrangement required for my study. Really with out his cooperation I could not complete my research work on time.

I also remain thankful to all the enumerators who assisted me in data collection with patience, commitment and dedication. Their cooperation was not on the basis of their material benefit but is really their own commitment to help me. I am grateful to farmers of Meisso district who responded to all questions with patience and gave necessary information for this research work. I would like also to thank Meisso IPMS project staff members and district office of Pastoralist and rural development for their hospitality and cooperation in provision of all the relevant secondary information for this study.

Last but not the least I would like to express my sincere appreciation and gratitude to my family, relatives and friends for being with me all the time providing me a moral support and encouragement.

LIST OF ABBREVIATIONS

ADLI	Agricultural Development Lead Industrialization
BoARD	Bureau of Agriculture and Rural Development
CSA	Central Statistical Authority
EEPA	Ethiopian Export Promotion Agency
EIAR	Ethiopian Institute of Agricultural Research
EARO	Ethiopia Agriculture Research Organization
FAO	Food Agriculture Organization
FDRE	Federal Democratic Republic Ethiopian
GOs	Governmental Organizations
GDP	Growth Domestic product
Ha	Hectare
ILRI	International Livestock Research Institute
IPMS	Improving Productivity and Marketing Success of Ethiopia Farmers
LPM	Linear Probability Model
MLE	Maximum Likelihood Estimation
m. a.s.l	Meter above sea level
MoARD	Ministry of Agriculture and Rural Development
NGOs	Non Governmental Organizations
OLS	Ordinary Least Square
PAs	Peasants Associations
Qt	Quintal
SD	Standard Deviation
TLU	Tropical Livestock Unit
VIF	Variance Inflation Factor
WOoPRD	Woreda Office of Pastoralist and Rural Development

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ABSTRACT

Achieving national food security and diversifying export earning agricultural commodity is one of the major challenges currently facing developing countries like Ethiopia. Oils crop in general and sesame crop in particular play a great role in improving household's food security, increasing income for the local population and export earnings for the country. Despite the high production potential and the economic importance of the crop, sesame producers particularly small scale farmers did not economically much benefited from its production. Low production and productivity, which is mainly associated with poor adoption of improved technologies and poor marketing system, was among the major problems. To this end, the objectives of this study were: to assess the relative financial profitability of improved sesame varieties, to assess the perception of farmers about improved sesame varieties attributes and to explore the contribution of farmer-to-farmer knowledge sharing to adoption decision and finally to determine the relative importance of the various factors associated with adoption of improved sesame varieties. For this study, a three stage of sampling procedure was employed to select the sample households. First, Meisso district was purposively selected. At the second stage, four PAs were randomly selected among sesame growers PAs using random sampling method. Finally, 140 sample respondents were selected from the sampling frame based on probability proportional to size of sesame growers (PPS) random sampling method. In this study, data were obtained from 140 randomly selected households through personal interview conducted by trained enumerators using pre-tested interview schedule and from group and individual discussions, as well as the researcher's personal observations. In addition, secondary data were collected from relevant sources such as research, zonal and district office of agriculture and others. In order to describe and compare different categories of the sample units with respect to the desired characteristics, mean, standard deviation and percentage were computed. Furthermore, chi-square and an independent sample t-test were used to identify variables that vary significantly between adopters and non-adopter.Logistic regression (binary logit) analysis was used to identify the relative importance of the various factors associated with adoption of improved sesame varieties. The economic analysis using the partial budgeting method and price sensitivity analysis was also used to ascertain the profitability of the adopted improved sesame technologies. The result of the study indicated that about 42.9% of the sample respondents were adopters of the improved sesame varieties, while 57.1 % non- adopters.The survey result also revealed that knowledge/information from farmer to farmer knowledge sharing at their work and market place was found to exert a significant impact on the probability of improved sesame varieties adoption by farmers. This was due to the farmers perceived that the information is most relevant, trusted and frequently accessible for the farmers decision making to adopt improved sesame technology. Innovative farmers are not only as source of knowledge of technology but also they are the source of improved seed for the majority of the adopters in the study area.Results of the logistic regression analysis indicate that among ,18 *identified explanatory variables nine of them significantly influenced adoption of improved sesame varieties.Education,sex, family labor supply, livestock onwership,total farm income earned ,perception on varieties attributes, farmer to farmers knowledge sharing and experience in sesame crop production have associated singificantly and positively with adoption of improved sesame varieties.whereas,distance from market center has associated significantly but negatively. The partial budget results also indicate that improved sesame varieties was highly profitable as against local cultivars sesame .The overall finding of the study underlined the high importance of institutional support in the areas of extension service to insist farmer-to-farmer knowledge sharing and market to enhance adoption of improved sesame varieties. There is also need to consider farmers' views during the new sesame technology development, evaluation and dissemination process because farmer views help scientists to design, test and recommend new technologies in light of information about farmers' criteria for usefulness of the innovation. Moreover, due attention and policy consideration has to be given by government to those significant variables which have a potential impact in determining farmer's adoption decision in the study area.*

1. INTRODUCTION

1.1 Background of the Study

The population of Ethiopia is estimated about 74 million with demographic distribution of 50.45% men and 49.55% women with an annual growth rate of 2.36%. The population growth is fast and 11,956,170 of its population reside in urban whereas, 61,962,335 live in rural area and are engaged in agricultural based economic activities (CSA, 2007). Hence, agriculture plays a vital role in Ethiopian economy.

Agriculture is the pillar of Ethiopia economy, providing employment for more than 85% of the country's population and is the main income-generating sector for the majority of the rural population, accounting for more than 45.9% of the total GDP of the country. It also serves as the main source of food and generates 90% of the foreign exchange earnings. It provides raw materials for more than 70% of the country's industries With in agriculture, 60% of the output of the agricultural GDP comes from crop production, whereas, 30% and 7% is from livestock and forestry, respectively (World Bank, 2007).

Despite its importance in the livelihood of the people and its potential, the sector has been still dominated by smallholder subsistence production and traditional technologies are predominant. Hence, level of productivity in agriculture is very low due to, among others, low rate of the adoption of improved technologies. Consequently, the agricultural sector has failed to meet adequately its primary objectives such as providing food, raw materials, exports earning, and resources inevitable in itself and other sectors of the economy. The poor performance in agriculture coupled with rapid population growth which aggravated the problem of low export commodities, household food security and per capita food production. Consequently, this has forced the country to be one of the major recipients of food aid and importer of commercial food grain in the third world countries (Million and Belay, 2004).

In order to reverse these horrifying situations, the present government has put agriculture at the heart of its policies so that it accelerates economic growth and development. The agricultural development program focuses on agricultural growth and provides support to small farmers, pastoralists and large-scale commercial farmers. In particular, attempts have been made to increase agricultural production in the country through increasing, among other things, the use of fertilizers, improved seeds, trained manpower, improved cultural practices and reclamation of waste lands .Moreover, to come out of the food insecurity problem and low export earning from agricultural commodities, the country need to focus on diversification of agricultural production, high value commodities for export and adoption of appropriate newly introduced crops and livestock technologies. In this regard, adopting of the newly introduced and released sesame varieties and other additional oils crops is as an alternative vital for the production of commercially oriented high value crops (ADLI, 2001).

At present, the Ethiopian government devotes considerable resources to research and extension in view of encouraging small scale farmers to increase their productivity and to be focused them on international high market demanded crops to increase export earnings of the country. One of such crop is improved sesame. In this regards, efforts were made over the country to develop and disseminate better performing sesame crops in the potential area.

Oromiya region is a major producer of sesame, crop which next to Tigray and Amhara region; due to it has relative potential area especially in the arid and semi arid low land environment. A rift valley is among major producing area of oils crop in general and sesame in particular, due to its arid and semi aridness which is very suitable for sesame production. The study area, Meisso woreda, being part of the central rift valley area of West Hararghe Zone, is one of the potential sesame crop growing areas in the Zone. Melka Werer research center, which is a center of excellence in oil crops research in the country, on top of releasing several varieties, it has been making efforts to introduce the improved sesame varieties in the area. There were also the extension interventions programs had been made by MoARD, NGOs and IPMS project in collaboration with woreda office of pastoralist and rural development for last ten years. As a result of such interventions, farmers in the study area widely cultivated improved sesame varieties as an alternative cash earning crop. Thus, the present study is proposed to assess its relative financial profitability, farmers' perception to improved varieties attributes, role of farmer to farmer knowledge/ information sharing and factors that influence adoption of improved sesame varieties in the district.

1.2. Statement of the Problem

Achieving national food security and diversifying export earning agricultural commodity is one of the major challenges currently facing developing countries like Ethiopia. Oils crop in general and sesame productions in particular play a great role in improving household's food security. It also is one of Ethiopia's fastest growing and important sectors, both in terms of its foreign exchange earnings and as a main source of income for over three million Ethiopians. It is the second largest source of foreign exchange earnings after coffee (CSA, 2008). Hence, an oils crop plays a vital role in Ethiopian economy.

Among the oils crop, sesame is one of the biggest export earner for Ethiopia .Due to its organic seed (with out use of inorganic fertilizer and pesticides), currently, the demand of Ethiopian sesame is growing in the world market. For instance, the Ethiopian white sesame seed is used as a reference for grading in international markets. Because of this fact Ethiopian government indicates the oils seed particularly sesame as the top priority export crop. In the last few years, sesame production has demonstrated highly significant growth. In 1997 the total area under sesame production was about 64,000 ha. In nearly ten years' time (up to 2007), the total area of sesame production has increased by more than 200% to about 211,000 ha. Similarly, the quantity of sesame produced during the same period, which is mainly intended for export, has also increased from 42,000 tones in 1997 to about 149,000 tones in the year 2007, which is again an increment of over 250% (CSA, 2007).It also one of the leading export oil crops in Ethiopia where by 90% of the production is directly towards export (EASE, 2007).

However, despite the country has high potential to increase production, the yield of this crop is low as compared to its potential yield. Some of the contributing factors to the low productivity level are low yield potential of seed cultivars, low quality of seeds, erratic rainfall, and susceptibility of seeds to biotic and a biotic stress, low adoption of improved technologies mainly seed and recommended management practices (Asnake *et al.,* 2005). Farmers in the districts of West Hararghe Zone in general and the study area, in particular are among those who are suffering from the problem of low yield.

In order to increase productivity and production of the crop, Ethiopian agricultural research organization was made effort over the country to release improved sesame technology. Since the establishment of Ethiopia Institute of Agricultural Research (EIAR) particularly during the period 1980–2005/06, about ten improved sesame varieties were developed and recommended for the suitable agro ecology (Hailu, 2005). Besides the technology generation, efforts were also made to promote this technology in potential production areas in the country. A Meisso district is among the area where this improved sesame varieties were introduced to improve the income and food security status of farmers. This has been done through on farm demonstration and seed dissemination through the collaborative efforts of various institutions such as Melka Werer research center, IPMS project, woreda Office of pastoralist and Rural Development and some NGOs. The produced seeds were also popularized to the farming community through farmer-to-farmer seed exchange system.

In spite of such intervention, information with regard to adoption of improved sesame varieties on locally specific factors influencing adoption, and the financial profitability of improved sesame technologies being promoted in the woreda was not systematically and empirically studied and documented in the study area. In addition to this fact, information about farmers' perception on improved sesame varieties attributes and contribution of farmer to farmer knowledge/ information sharing in adoption decision are also found to be insufficient and are not well understood. Hence, this study was aimed at assessing financial profitability and factors that influence the adoption of sesame varieties and farmers' perception about improved sesame varieties attributes.

1.3. Objectives of the Study

The specific objectives of the study are:-

1. to assess the relative financial profitability of improved sesame varieties adoption
2. to assess the perception of farmers about improved sesame varieties attributes
3. to explore the contribution of farmer-to-farmer knowledge sharing to adoption and diffusion of improved sesame varieties
4. to determine the relative importance of the various factors associated with adoption of sesame varieties

1.4. Research Questions

1. What are the factors influencing farmers decisions to adopt improved sesame varieties in the study area?
2. What is the relative financial benefit of the adoption of improved sesame varieties?

1.5. Significance of the Study

Increasing agricultural production in the developing world had been a primary concern of the policy makers and development agencies for many years. By now some sort of consensus exists about how increased production can be achieved. Improved farming technologies which are the results of scientific research, must be available to farmers, along with full information on how to use the new technologies. If researchers lack understanding of farmers' problems and the conditions under which they are operating, it may result in development of inappropriate technologies and fail to accelerate the process.

In this respect, all development partners like extension educators, technical assistants, NGOs and other development agents involved in agricultural development must be aware and understand the financial profitability of the technology, farmers' perception on technology attributes, contribution of farmer to farmer knowledge sharing in adoption decision and factors affecting the adoption of new technologies in order to target and extend appropriate technologies to farmers. It is also important for policymakers to know the benefit of new technologies and the critical factors that could accelerate there use. This could facilitate efficient allocation of major resources for research, extension and development programs. Hence, this study attempted to figure out the financial profitability, farmers' perception, contribution of farmer to farmer knowledge sharing in improved sesame varieties adoption and factors affecting its adoption by smallholder farmers in the study area. It is expected that this study would serve as a springboard (facilitator) to undertake detailed and comprehensive studies in the country.

1.6. Scope and Limitation of the Research

This study is only a piece of a huge effort to unfold realities regarding agricultural technology acceptance and its consequences. Therefore, its scope is limited in terms of coverage and depth owing to financial and time resources available. It is limited to only sesame varieties and also limited to Meisso district in terms of area coverage. Nevertheless, the result of this study can be used as a reference for other similar areas.

1.7. Organization of the Thesis

This thesis is organized in to five chapters. It begins with the introduction chapter that gives highlights on the background of the study, statement of the problem, objectives of the study, significance of the study and scope and limitations of the study. The Second Chapter elaborates a review of some theoretical and empirical studies in respect to the area under discussion. Three while the methodology part which includes a brief description of the study area, sampling procedure, data and data collection methods and methods of data analysis applied for the study are discussed. The results and discussion are discussed in Chapter Four. Finally, Chapter five deals with the summary and important policy implications of the study.

2. LITERATURE REVIEW

In this chapter a key concepts, theoretical explanations and empirical evidences relating to technology adoption are explored. The chapter is divided into ten sections. The first section discusses the key concepts such as, adoption and perception. The remaining nine sections discuss a review of adoption of new technologies, impact and technique used to assess impact of technologies, adoption model, sequence of new technology adoption, knowledge sharing, sesame production and research in Ethiopia, empirical studies on the adoption and conceptual framework for analyzing the determinants of improved sesame varieties on the basis of the insights gained from literature review and the actual context of the study area.

2.1. The Concept of Adoption and Perception

2.1.1 Basic concepts of adoptions of innovation

Innovations are new methods, ideas, practices or techniques, which provide the means of achieving, sustained increases in farm productivity and income. The innovation may not be new to people in general but, if an individual has not yet accepted it, to that person it is an innovation. Some innovations originate from agricultural research stations, others from farmers (Van den Ban and Hawkins, 1998). Diffusion is a process by which new ideas are communicated to the members of a social system over certain period of time (Rogers and Shoemaker, 1971).

Rogers (1962) defined the adoption process as, the mental process an individual passes from the first hearing of about an innovation or technology to a final adoption. According to Feder *et al.* (1985) adoption may be defined as, the integration of an innovation into farmers' normal farming activities over an extended period of time. The author also noted that adoption is not a permanent behavior. This implies that an individual may decide to discontinue the use of innovation for variety of personal, institutional and social reasons one of which might be the availability of another practice that is better in satisfying needs.

However, for rigorous theoretical and empirical analysis, a precise quantitative definition of adoption was given Feder *et al*. (1985).They distinguished individual (farm level) adoption from aggregate adoption depending on the coverage. Individual (farm level) adoption was defined as the degree of use of new technology in long- run equilibrium when the farmer has full information on potentiality of new technology. This type of adoption is the area of concern for our study. In the context of aggregate adoption behavior, the same authors defined the diffusion process as the spread of new technology with in a region. This implies that aggregate adoption is measured by the aggregate level of use of specific new technology with a given geographical area or within the given population.

2.1.2 Basic concepts of perception

Different scholars define perception in different ways. People grown up in a certain physical and social environment and through socialization processes become aware of certain issues in their environment. Such awareness of phenomena takes certain shapes in people's minds. This involves the transformation of own experience into certain image. This is called perception (Gutu *et al.,* 2003). According to Berelson and Steiner (1964), perception is the more complex process by which people select, organize, and interpret sensory stimulation in to a meaningful and coherent picture of the world. Van den Ban and Hawkins (1998) defined perception as, a process by which we receive information or stimuli from our environment and transform it into psychological awareness. Therefore, through their senses, farmers receive and gather stimuli that indicate the attributes of improved sesame varieties is superior over the local one or not.

As clarified by Duvel (1991), perceptions are understood to be of a more specific nature and are analyzed on the basis of attributes of innovations. For this purpose an inventory or list of attributes is required that is as encompassing as possible. Unlike the Roger's (1983), classification of innovation attributes that are of broad and unspecific categories, they are more specific and possibly address the causes of changes. A number of studies have analyzed the relationship between characteristics of an agricultural technology and its rate of adoption. Most have used more or less objective judges, or have assumed that all farmers perceive these characteristics in the same way. A person's perception of an innovation may, however, differ widely from the actual characteristics of the innovation. Perception is influenced by our values, beliefs and attitudes, and objective assessment of relative advantage, compatibility, etc, is difficult for every one to act (Adams, 1992).In the research perception is to mean any criteria, methods or stimuli by which a given farmer uses to differentiate one aspect of improved sesame varieties in terms of its characteristics. In addition, any criterion used by farmers to differentiate the quality of a given varieties from other is also considered as perception.

Farmers use various frame of reference in appraising the relevance and usefulness of research and development products accessible to them. In appraising intervention from various sources, farmers refer to the expected added value in respect to their objective functions; practicability of what is being proposed and it's fit within the ongoing farmers' practices (Leeuwise, 2004). Therefore, considerations of reference used by farmers in appraising different interventions are crucial in promoting new crop production practices in order to increase the productivity of the crop in a given area.

2.2.Adoption of new Technologies

It is a fact beyond dispute that the world food supply in the future largely depends on achievements in agricultural researches that require substantial investments. Because researches produce variety of new technologies with which farmers can increase production. There is a general agreement that the efficient application of the results agricultural research is one of the primary means for accelerating the rate of agricultural; development in developing countries (Aron, 1981, cited in Berhanu, 2002).This indicates the need for generating agricultural technologies and creation of mechanism for the adoption of the developed technologies. Because society cannot benefit from agricultural research, if research results are not adopted Aregay, 1979). In other word, the adoption of agricultural innovation in developing countries attracts considerable attention because it can provide the basis for increasing production and productivity.). It is, therefore, important that the process adoption and diffusion of new technologies in agriculture be clearly understood.

However, all innovations do not diffuse at the same rate. Various innovations are objectively different and probably are perceived as being different by farmer decision maker. Thus, it seemly likely that such perception of differences would affect decisions to adopt or reject a particular innovation (Van den Ban and Hawkins, 1998). The same authors have identified that the important traits of innovation, which influence rate of adoption are: (i) relative advantage; (ii) compatibility; (iii) complexity; (iv) traibility; (v) availability. At the most basic level, an economic agent is assumed to make decisions to adopt or not to adopt a new innovation based on its objectives and constraints as well as cost and benefit it is accruing to it (Million and Belay, 2004).

The economic advantage of new technologies and the economic profitability of adopting would attract farmers towards these improved practices. According to Dasgupta (1989), the utility or usefulness of an item, as understood by a potential adopter determines its rate of diffusion. Moreover, the extent to which the practice is simply a modification of the existing one or totally foreign to the knowledge and experience of the adopter will also determine whether or not it will be accepted. A technology is sometimes accepted for its prestige-giving quality rather than its utility. Dasgupta (1989) also reported that the incompatibility of high yielding variety of wheat with local norms, values and habits contributed to the failure of recommended practices in Western Uttar Pradesh villages, India. The author further explained that when a high yielding variety of wheat was introduced in villages, it gained immediate acceptance by the farmers for its economic profitability but its use slowed down perceptibly in subsequent years because of its diffusion in these villages. Generally, farmers will adopt technologies in a stepwise pattern based on the criteria of profitability, initial capital requirements, complexity and availability (Feder *et al.,* 1985).

Actual experience in the adoption, however, showed that farmers were not as prompt in adopting improved practices as was expected (Dasgupta, 1989). The implication is that the time span between the introduction of improved agricultural practices to farmers and their adoption by farmers was often unexpected long. The expectation on the part of researchers and practioners is that once these factors identified, it will be possible to predict the adoption behavior of farmers effectively and to shorten the length of the time lag in the diffusion of innovation. That is also the reason why researchers are encouraged to undertake adoption studies in different part of the world including Ethiopia.

Adoption process generally includes five stages: awareness, interest, evaluation, trial and adoption. However, in practice the adoption process does not follow these sequences (Rogers and Shoemaker, 1971; Van den Ban and Hawkins, 1998).On this issue Vanclay and Lawrence, (1994) added that adoption does not necessarily follow the suggested stages from awareness through knowledge; trial does not always lead to adoption. In some cases, particularly with agricultural innovations, farmers may hold awareness and knowledge but because of other factors affecting the decision-making process, adoption does not occur. In most cases, adoption behavior differs across socio-economic groups and over time Some innovations have been well received, while others have been adopted only very small groups of farmers.

Therefore, the adoption of new technologies and production approaches in farming activities is become crucial for developing countries in order to meet the challenges in agricultural production and productivity. Farmers' exhibit differential behavior to words new technologies and it is important to understand and predict such behavior in designing and implementing agricultural programs.

2.3.Mode and Sequence of Agricultural Technology Adoption

Attentions have also given to explaining the mode (approach and the sequence of agricultural technology adoption. Two approaches are common in agricultural technology adoption literature. The first approaches the adoption of the whole package while the second one stresses step wise or sequential adoption component of a package. Opponent of the whole package approach strongly argue that farmers do adopt technologies as package, but rather adopt a single component a few suitable technologies (Beyrlee and Hesse de Polanco, 1986). They conclude that farmers choose to adopt input sequentially. Initially adopt only one component of the package and sequentially adding components over time one at a time. The major reasons often given for sequential adoption of a package of technologies are profitability, riskiness, uncertainty, limpness of investment and institutional constraints. A farmer selects a technology that exhibit these attributes. Therefore, this process continues until a whole package is full adopted.

2.4. Knowledge Sharing and Diffusion Technology

Since every society is built around relationships, the behavior of an individual actor cannot be fully understood unless we relate it to the actions of others with whom the individuals are connected through various social ties (Granovetter, 1985). Social and informational networks do exist within the farming community; they exert a significant influence on farm-level decision making; and such networks affect different decision domains. In exchange of agricultural knowledge, crucial issue is the mode of communication between farmers, their organization and scientists. Appropriate communication tools are needed to enhance the sharing of knowledge .Farmers to farmer's communication is among of the appropriate tools for knowledge sharing.

Given the limited scope of formal extension programs, informal exchange is often the primary source of information about new technologies in sub-Saharan Africa. Farmers actively or passively seek information from neighbour or observe neighbour experiments during social interaction. Since information may come in the form of externality, social capital reduces the cost information accumulation and enables to adopt new farming practice. Therefore, small-scale producers often rely on informal mechanisms of information exchange and knowledge sharing to address agricultural problems and challenges. The increasing role of informal mechanisms for information sharing has been recognized in the literature through farmer-to-farmer models of agricultural development (Eveleens *et al*., 1996).

Farmers share their knowledge and experiences in their immediate surroundings such as neighbors, friends, family and others. Similarly, farmers can disseminate innovations better than official extension agents because they have an in-depth knowledge of local crops, practices, culture and individuals; they communicate effectively with farmers and are almost permanently available in the community (GTZ, 2004).

Even in areas were social organization and infrastructure exists, farmers prefer their fellow farmers as their primary information source and Feder and Slade (1985) study India shows farmers without access to formal extension service use farmer-to-farmer communication; and most farmers in India preferred fellow farmers as their major source of information despite the existence of Training and Visit Extension System at the time of the study.

As the more literature demonstrates, information diffusion may be a function of social capital suggesting the possibility of differences in access to information from early adopters by potential adopters that may leads to difference in adoption rate. Social capital may influence social learning and technology adoption in a numbers of ways. First, social capital reduces the cost of information acquisition since it can be acquired passively during social interaction or actively from people who already know each other. Second social capital reduces uncertainty about the reliability of information. Information likely to be given higher value if it comes from trusted people. Third, social capital facilitates a willingness and cooperation in sharing, thereby revealing tacit information that would be difficult to exchange otherwise (Burger *et al.,* 1996).

2.5. Econometrics Models for Analyzing Adoption Decisions

Adoption decisions can be analyzed with different binary choice models. Results of earlier studies showed that models of aggregate adoption follow pattern of S-shaped curve (Mahajan and Peterson, 1985; Feder *et al*., 1985). Models that generate S-shaped curve include logistic function and cumulative normal distribution function. Among these models, the logistic distribution function is the most widely used function in adoption and diffusion studies. Mulugeta (2000) pointed out that, the logistic function represents a close approximation to the cumulative normal functions.

Beside the qualitative choice models, there are also another analytical tools used in adoption studies, such as descriptive statistics (mean, percentage, frequency) and inferential statistics (t-test and chi-square test etc.). These tools are often their own merits, as well as limitations in the ex-post analyses of adoption. For instances, using chi- square contingency tables to perform non-parametric hypothesis tests does not enable measurement of the qualitative importance of an explanatory variable or the effects of several variables taken together on the adoption decision (Feder *et al*., 1985).Moreover, since these studies provided no information on the quantitative importance of the explanatory variables, policy makers could not appreciate the significance of these factors.

Regressions models, which include a yes or no type dependent variable, are called dichotomous or dummy- variable regression model. Such models have been proposed for the analysis of dichotomous outcome variable (Amemiya, 1981; Pindyck and Rubinfeld, 1981). These include the linear probability function, Logitistic distribution function, and normal distribution function, (probit). These functions were used to approximate the mathematical relationships between explanatory variables and the adoption decision that is always assigned qualitative response variables (Gujarati, 1995). The major point that distinguishes the binary response model from the linear regression model is that the outcome variable in these functions is dichotomous (Hosmer and Lemeshow, 1989).

Although Ordinary Least Squares (OLS) estimates can be computed for binary model, the econometric problems such as non normality, (i.e. disturbance term (U_i) is not normal distributed), heteroscedasicity of the disturbance term (U_i), and lower value of R^2, however, linear probability models where dependent variable takes only either 0 and 1, are not appropriate to test the statistical significance of estimated coefficient (Amemiya, 1981 and Gujarati, 1995).

These deficiencies could be avoid through the use of a monotonic transformation (probit or logit specification), which guarantees that predictions lie within the unit interval (Capps and Kramer, 1985). The fact that the models exhibit a cumulative distribution function enables to solve these problems. The use of probit and logit models, which give maximum likelihood estimates, overcome most of the problems associated with linear probability models and provide parameter estimators which are asymptotically consistent, efficient and Gaussian so that the analogue of the regression t-test can be applied.

The exact form of each S-shaped curve, slope and asymptote of diffusion pattern may differ depending on the theory and models used to describe the diffusion process (Legesse, 1998). The models that generate S-shaped curve include logistic function, the Gompertz function, the modified exponential function, the cumulative normal distribution function and the cumulative log-normal distribution function.

The choice of a model with non-linear specification is dependent strictly upon the distribution of the disturbance term, u, and among these the normal and logistic are two of the most commonly assumed distributions, providing still another rationale for their importance (Aldric and Nelson, 1984). The authors added that the choice between the logistic and normal curves revolve around practical concerns such as the availability and flexibility of computer programs and personal preference.

Available evidence shows that the logistic function is the most frequently used function in adoption studies. According to Hosmer and Lemeshow (1989), there are two primary reasons for choosing the logistic distributions: from mathematical point of view; it is an extremely flexible and easily used function; and it lends itself to a meaningful interpretation. Maddala (1983) has recommended probit models for functional forms with limited dependent variables that are continuous between 0 and 1, and logit models for discrete dependent variables.

2.6.Impact of Agricultural Technology on Farm Income

Research evaluation refers to judging, appraising, or determining the worth, or quality of research. This is often done in terms of its relevance, effectiveness, efficiency, or impact (Horton *et al*, 1993). Hence, research impact is an evaluation that deals with the effects of the research output on the target beneficiaries. Impact also implies a behavioral change in target population due to the technology (Anandajayasekeram *et al*., 1996).

According to Echeverria (1990), impact refers to the physical, social, and economic effects of new cultivation and post-harvest methods on crop and livestock production, distribution, and use and on social welfare in general.

Impact assessment can be carried out to study the impact of a particular innovation/ technology, on a research program, or on a research program plus complementary services (such as extension, marketing, etc). Impacts can also be measured at the individual household level, target production level, as well as national and regional levels (Anandajayasekeram *et al.*, 1996).

In discussing impact of any research program, one can identify two broad categories of interpretation. In the first category, some people look at the direct output of the activity and call this impact, e.g., a variety, a breed, or a set of recommendations resulting from a research activity. Most of the biological scientists belong to this category. The other category goes beyond the direct product and tries to study the effects of this product on the ultimate users. This one looks at the fit of the program within the overall R&D of the country. Most social scientists, donors, planners and policy makers belong in this category. This second type of impact deals with the actual adoption of the research output and subsequent effects on production, income, environment and/or whatever the development objective may be (Anandajayasekeram *et al.*, 1996).

The impact or the potential of any improved technology under real farm situations is generally assessed from the magnitude of the differences in the mean yields, net economic returns or benefit-cost ratios of the improved technology and those of the traditional or existing farmers' practices (Kiresur *et al*, 1996).

Adoption of new technology aims at impacts or changes that are intermediate to livelihood outcomes and that relate more to the income of the user to the policies and structure in the sustainable livelihood framework (Asres, 2003).Any change (monetary or non monetary) faced by farmers when they toggle to varieties worth maintaining (adopting) is called impact of changing of variety use computing impacts that has come due to the use of new technology. Varieties can have important role in the income status of beneficiaries because the bargaining power of the farming household is mainly a function of the income that has come due to the use of that variety (Goldfeld and Quandt, 1973).

2.7. Techniques used for Assessing Relative Profitability of Technology

In production economics, a number of techniques and methods are used for assessing the impact and relative profitability of different technological and non-technological factors. Among these tools, partial budgeting estimation is the commonly used ones.

Partial budgeting is the most familiar and age old tool, which translates the pros and cons of a particular organization or changes in the organization in to financial terms so as to make judgments based on income and profit basis. It is an appropriate tool to evaluate the effect of relatively small changes in farm organization or method.

It is also a technique for assessing the benefits and costs of a practice relative to not using the practice. It thus takes into account only those changes in costs and returns that result directly from using a new practice. Therefore, to analyze impact of improved sesame varieties use on farm income, partial budgeting technique was considered for this study.

2.8. Sesame Research and Production in Ethiopia

2.8.1 Sesame research

Sesame research in Ethiopia has been carried out under the national program on oil seeds. Sesame is considered as a lowland crop and the field research is carried out in the lowland research station at Melka Worer in the Central Eastern parts of the rift valley, 250 Kilometers east of Addis-Ababa on the way to Dire Dawa. The station coordinated experimental works on sesame, groundnut, safflower and castor bean. Research selection work is geared towards varieties with uniformity of growth, fewer tendencies to shatter, good number and size of capsules as well as disease resistance. Exotic varieties with shuttering and non-shuttering characteristics are also under study at the station (Mbwika, 2003). Mbwika has also indicated that in 2003, Alemaya University of Agriculture, now (Haramaya University) has also carried out research work on sesame and other oil crops in Babile area.

Different studies (EARO dry land Crops Research Strategy, 2000; Getnet and Adugna, 1992) indicated that testing of introduced and local germplasm at irrigated, high rainfall and low rainfall areas have helped to release different sesame varieties. Abasina is bacterial blight resistant and suitable for high rainfall areas of western Ethiopia whereas Mehado-80 does not perform better under irrigation, particularly in Awash Valley. Varieties E and S have adopted well around Dedesa and Gutin in Oromiya Regional state but it is less demanded due to their less disease resistance and poor colors. Tate sesame seed variety has been identified as a highly productive and highly adaptive particularly for Hararghe area.

According to Getnet and Adugna (1992), the average national yield per hectare of all oil seeds was quite low, compared to what researchers commonly obtain from demonstration plots. In general, the average yield has improved from 4.9 quintals per hectare during (1967-1971) and to 6 quintals per hectare during (1982-1986). Rapeseed and linseed showed the highest average yield increment, probably because of the relatively improved cultivation techniques and varieties availability to farmers.

2.8.2 Sesame production

Agriculture is the mainstay of the Ethiopian economy, not only by virtue its substantial contribution to the livelihood of a large majority of Ethiopians but also for its significant contribution to the country foreign exchange earnings. Cognizant of this fact, the Ethiopian government has pursued the Agricultural Development Led Industrialization (ADLI) strategy since 2001 as a means of economic development. The strategy document specifically indicates that the success of the effort is assured if the performance of the agricultural sector is transformed from a generation’s long period of subsistence to a market oriented commercial production system. To this effect, all responsible ministries and agencies of the federal and regional governments and different multilateral and bilateral collaborative efforts are in the process of implementing the strategy.

As the most responsible body for this strategy, the Ethiopian Ministry of Agriculture and Rural Development (MoARD) has developed a master plan to enhance market oriented production for priority crops and livestock commodities (MoARD, 2004). The oilseeds sub sector, of which sesame is an important product, is one of the priority crops within the master plan. According to the master plan document, in 2000 the total production of sesame seed was 156,600 tones, and yet this volume of production could potentially increase three fold. Consistent with this, the Ethiopian government aimed to double the production and export of oilseeds between 2005 and 2010.The existing production system suffers from traditional farming practices, unimproved seed, lack of fertilizer use, etc. This situation has caused productivity of the crop per hectare to be far below the estimated FAO potential, which are about 16 qt/ha.

According to the Ministry of Agriculture and Rural Development (MoARD) master plan, the 2000 average productivity of sesame per hectare was 4.58 quintals. However, the Ethiopian Statistical Authority report of 2007 indicates that the crop’s productivity level is 7.07 quintals per hectare countrywide, although total production is slightly less (149,400 tones) than what was reported by the MoARD master plan for 2000 (156,600 tones). However, it is understood that the current productivity level of sesame in Ethiopia is far below the expected average, and therefore there is room for improvement by means of a better farming system and the implementation of improved inputs. Moreover, since there is still land available in the northwestern, western and southwestern areas of the country, the potential for increasing production volume is great.

Despite the potential for increasing the production and productivity of sesame, there are also a number of challenges inhibiting sesame production and productivity. Among the many production constraints, the most important include a lack of improved cultivars, a poor seed supply system and a lack of adequate knowledge of farming and post harvest crop management. In addition, there are severe biotic stresses, such as bacterial blight

(Xanthomonas campestris pv. sesami), phyllody (Mycoplasma like organism), Fusarium wilt (Fusarium oxysporum), Powdery mildew (Oidium erysiphoides), Alternaria leaf spot (Alternaria sesame) and Cercospora leaf spot (Cercospora sesame), which are the common sesame diseases registered in Ethiopia .The disease caused by mycoplasm like organisms and transmitted through Jassid (Orosius albicinctus) bacterial blight –very common in humid and high rainfall areas, transmitted by infected seeds and phyllody –is a highly destructive disease .Sesame leaf roller or webworm(Antigasta catalaunalis) is also an important and widespread insect that damages sesame in Ethiopia (Daniel, 2008).

Pests attack the crop in all stages of its development. The most important storage pests of sesame in Ethiopia are the red flour beetle (Tribolium confusum) and rice moth (Corcyra cephalonica). These are cosmopolitan insect pests that attack a range of stored products. Moreover, sesame is a poor competitor of weeds. The crucial period for weed competition is about four weeks after emergence (IAR, 1991). Sesame has high agronomic importance as it has the ability to adapt to harsh environments in which other crops cannot be cultivated. Hence, in many sesame growing regions the crop is indispensable not only for its economic importance but also for its suitability in such harsh areas. Therefore, developing improved cultivars and production technology is required to increase sesame yields and establish stability in different growing areas. More productive sesame cultivars that have been adapted by breeding are expected to be the major strategy for increasing yield and establishing stability in Ethiopia.

2.9.Empirical Studies on the Technology Adoption

A number of empirical studies have been conducted by different people and institutions on the adoption of agricultural innovations both outside and inside Ethiopia. But the studies are mainly conducted around major cereals crop and due to this fact that studies conducted in the area of oils crops, particularly on improved sesame technologies is very limited. As a result of this, the review mainly included the studies conducted on cereals, particularly maize and wheat with very few related oils crops. This suggests that there is a need to bridge this information gap through further research on the adoption of sesame technologies. This necessitates the study of the adoption of improved sesame technologies in Meisso Woreda.

Sex of the household head influences the adoption of new improved technologies. Several past adoption studies revealed that male headed households are more likely to adopt new technologies than their female headed counterparts. For instance, Fitsum (2003) reported the negative and significant relation between fertilizer use intensity and female-headed households. His explanation for this bias is the existence of difference in wealth status between male and female-headed households. Similarly Burger *et al.* (1996) have revealed a significant relationship between adoption decision and sex of the household head. They reported that the likelihood of adoption is higher among male headed farm households than female headed households. Legesse (1992) also indicated that the likelihood of adoption is higher among male headed farm households than female headed ones.

Education is associated with adoption because it is believed to increase farmers' ability to obtain, and analyze information that helps him/her to make appropriate decision. A study carried out by Mwanga *et al.* (1998) in Tanzania has indicated that education level significantly affected the adoption of improved wheat varieties. Similarly, Asfaw *et al.*(1997), Bekele *et al.*(2000) and Tesfaye and Alemu (2001) ,indicated positive relationship between education and adoption as well as Teferi (2003) who conducted adoption study in Gozamin Woreda, Amhara Region of Ethiopia indicated that education, affected the adoption of fertilizer use positively. Contrary to this, a study conducted by Asnake *et al.* (2005) in Ethiopia showed that education had no significant effect on the adoption of improved chickpea varieties.

Households' income position is one of the important factors determining adoption of improved technologies. In the context of rural households, annual farm income obtained from sale of crop and/or livestock, off-farm and non-farm income are important income sources. Regarding annual farm income, almost all empirical studies reviewed shows the effect of farm income on household's adoption decision is positive and significant. To mention some of them for example, Kidane (2001); Degnet *et al.* (2001) and Getahun (2004) reported positive influence of household's farm income on adoption of improved technologies. In the same line, Gockowski and Ndoumbe (2004) found positive effect of cocoa revenue on intensive mono cropping horticulture.

Livestock holding of a household influences the adoption of improved technologies differently by different people across different areas. An adoption study conducted by Kristjanson *et al*. (2000), in evaluating adoption of new crop-livestock-soil management technologies in the dry savannas of West Africa indicated that intensity of adoption was significantly and positively influenced by both the perceived importance of livestock and by the number of livestock owned (TLU) within the village. Contrary to this result, Wubeneh (2003) showed that livestock holding influenced negatively the farm level adoption of improved sorghum varieties. His explanation for this reason is that livestock are generally considered a symbol of wealth and farmers with large livestock herd sizes tend to focus more on their livestock operations and pay less attention to their crop production.

Distance from market center usually affects the adoption of improved technology negatively. Households near market centers tend to have easier market access to dispose of their production. A study by Berhanu (2002) showed that distance from market was one of the significant variables explaining the adoption of crossbred dairy cows negatively. In contrast to this finding Kebede (2006) has found that distance of the dwelling from market center affected the adoption of fertilizer use positively. A possible explanation by the author is that farmers near market center may divert from agricultural to non agricultural activities. A study conducted by Tesfaye *et al.* (2001), on the adoption of improved maize varieties and inorganic fertilizer also indicated that distance from near market was not significant in explaining the adoption decision of the farmers.

Family labor supply is another important household related variable that has relationship with adoption. Arellanes (2003) reported a positive and significant relationship between family labor supply and adoption. On the other hand, Vander (1990) established that household labor supply is not significantly related to adoption. Lelissa (1998) and Techane (2002) have found family labor was positively related with adoption and intensity of fertilizer use.

Farming experience is another important household related variable that has relationship with adoption. Longer farming experience implies accumulated farming knowledge and skill, which has contribution for adoption. Many studies supported this argument. For instance, Legesse (1992); Kidane (2001); and Melaku (2005) have reported farming experience positive and significant relation with adoption. In contrary, Ebrahim (2006) found that farming experience is to have negative relationship with over all dairy adoption. However, Chilot (1994) and Rahmeto (2007) reported that farming experience has no statistically significant relationship with adoption.

Land related variables influence farmers' adoption behavior, as land holding is an important unit where agricultural activities take place. Concerning land holding, different studies reported its effect differently. For example a study carried out by Mwanga *et al.* (1998) in Tanzania has indicated that farm size level significantly affected the adoption of improved wheat varieties. Tesfaye and Alemu (2001) reported that farm size contributed positively in farmers' adoption of improved wheat varieties. Asnake *et al.* (2005) conducted a study on adoption of improved chickpea varieties in Ethiopia and found that farm size was positively related to the adoption of improved varieties. Similarly, Mulugeta (2000), Million and Belay (2004) and Taha (2007) reported positive relationship of farm size with adoption.

Concerning social participation, different studies reported its effect in different way. For example, Ban and Hawkins (1996) indicated that people who are quick to adopt an innovation may be characterized by having active participation in many organizations. Moreover, Haji (2003) also found that social participation contributed positive and significant influence on the adoption of cross-bred cows and Ebrahim (2006) social participation contributed positively to the adoption of diary technologies. Similarly, Dereje (2006) reported that social participation had significant and positive relationship with adoption.

The relationship between farmers' access to extension services and adoption has been repeatedly reported as significant by many authors. For example, study conducted by Dasgupta (1989), indicated that participation in training, access to communication sources and number of information sources had significant association with level of knowledge and adoption of nontraditional cash crop technologies. Many other authors such as Chilot *et al.*, (1996); Degnet, (1999) and Tesfaye *et al.*, (2001) also reported significant relationship of access to extension to adoption of agricultural technologies. Generally, in this study the relevant information sources for farmers are considered. Since the mere presence of the sources of information is not sufficient, frequency of contact with the sources, timeliness of the information and other related issues will be assessed.

Another communication variable is attendance in extension events like involvement in demonstration, training and participation on field days. They are also crucial in improving farmers' experience, building capacity and developing confidence on the advantages of improved agricultural technologies. Asfaw *et al.* (1997) revealed that participation on field days had influenced adoption of maize technologies positively and significantly. Tesfaye and Alemu (2001) reported that participation in on-farm demonstration and attendance of training contributed positively to farmers' adoption decision. In the same line, Yishak (2005) in his study of determinants of adoption of improved maize technology in Damote Gale district found that farmers' participation in demonstration had positive and significant relationship with adoption. Similarly, Abrhaley (2006) revealed that farmers' experience in on farm trial has influenced adoption and intensity of use of ISM technology positively and significantly. Moreover, Minyahel (2007) found that participation in extension events had positive and significant relationship with adoption. .

Mass media exposure is also one of communication variables. The role of information in decision-making process is to reduce risks and uncertainties to enable farm households to make right decision on adoption of improved agricultural technologies. Mass media play the greatest role in provision of information in shortest possible time over large area of coverage. However, as compared to other communication channels, its effect on behavioral change is weak as it is limited to awareness creation than skill development. Many studies reported the positive and significant relationship of mass media with adoption of agricultural technologies. In line with this, Yishak (2005) in his study on determinants of adoption of improved maize technology in Damote-Galedistrict, Wolaita, Ethiopia indicated that ownership of radio had positive influence on adoption of improved maize technologies. Similarly, Ebrahim (2006) also found the same result.

The other institutional support that farmers need to get to improve production and productivity is, credit service and other inputs. Capital and risk constraints are key factors that limit the adoption of high value crops by small scale farmers because these crops generally are much more cost to produce per hectare than traditional crops and most growers require credit finance their production. In the same line, study conducted by Gockowski and Ndoumbe, (2004) on the adoption of intensive mono-crop horticulture in Southern Cameroon indicated that cash requirements for intensive horticulture production combined with the failure of formal rural credit institutions significantly affected adoption of especially resource poor households. Other authors who conducted study on adoption of cereals (wheat and maize) such as Mwannga *et al*, (1998); Legesse, (1992); Chilot *et al*, (1996); Asfaw *et al*, (1997); Tesfaye *et al*, (2001) and Bekele *et al*, (1998) have also reported significant relationship of credit with adoption of improved technologies by farmers.

Kiptot *et al.* (2006) in their study of sharing seed and knowledge farmer to farmer dissemination of agro forestry technologies in western Kenya, confirm that informal social networks such as relatives, friends and groups are important avenues for spreading new technologies. The impact of knowledge being shared along kinship ties is indeed considerable. What this means is that family linkages indicate a potential for sharing within and between villages and thereby expanding a network of seed and knowledge sharing.

Based on primary data collected from 192 farmers in two districts of the central highlands of Ethiopia, Workneh (1998) assessed the impact of improved wheat varieties and their recommended fertilizer rate on smallholder farmers' food status. The methodology followed was comparison of the total grain food production in calories with the recommended annual calorie consumption of 243 kg of cereal-equivalent per adult. The results of the study show that food status of farm households in one district was significantly associated with the adoption of new wheat variety while it was not significant in the other district. However, in both districts, users of the recommended fertilizer rate had significantly higher food status than the non-users

2.10. Conceptual Framework for Study

Based on his general behaviour analysis model, Duvel (1991) showed the relationship between behaviour determining variables in agricultural development (figure 1) that provides the guides line and conceptual framework for this study. As clearly illustrated, three categories of variables associated with the behaviour change in agricultural development are the independent and dependent variables. Based on the literature review, such factors as personnel (eg. Age, sex, experience,), socio economics (e.g farm size, capital,) and communication aspect (extension, mass media exposure), which assumed to be important across all development theories and behavioural change model will be considered in this study. The thirds component of the model is behaviour which specifically adoption of technology (Practices) followed by consequence of the behaviour such as yield and profitability. The content of variables to be measured is adoption behaviour and the ultimate sesame production yield. The assumed influence the relationship between the various categories of variables involved in decision making or adoption of sesame behaviour or is technologies in figure 1(Duvel,1990).

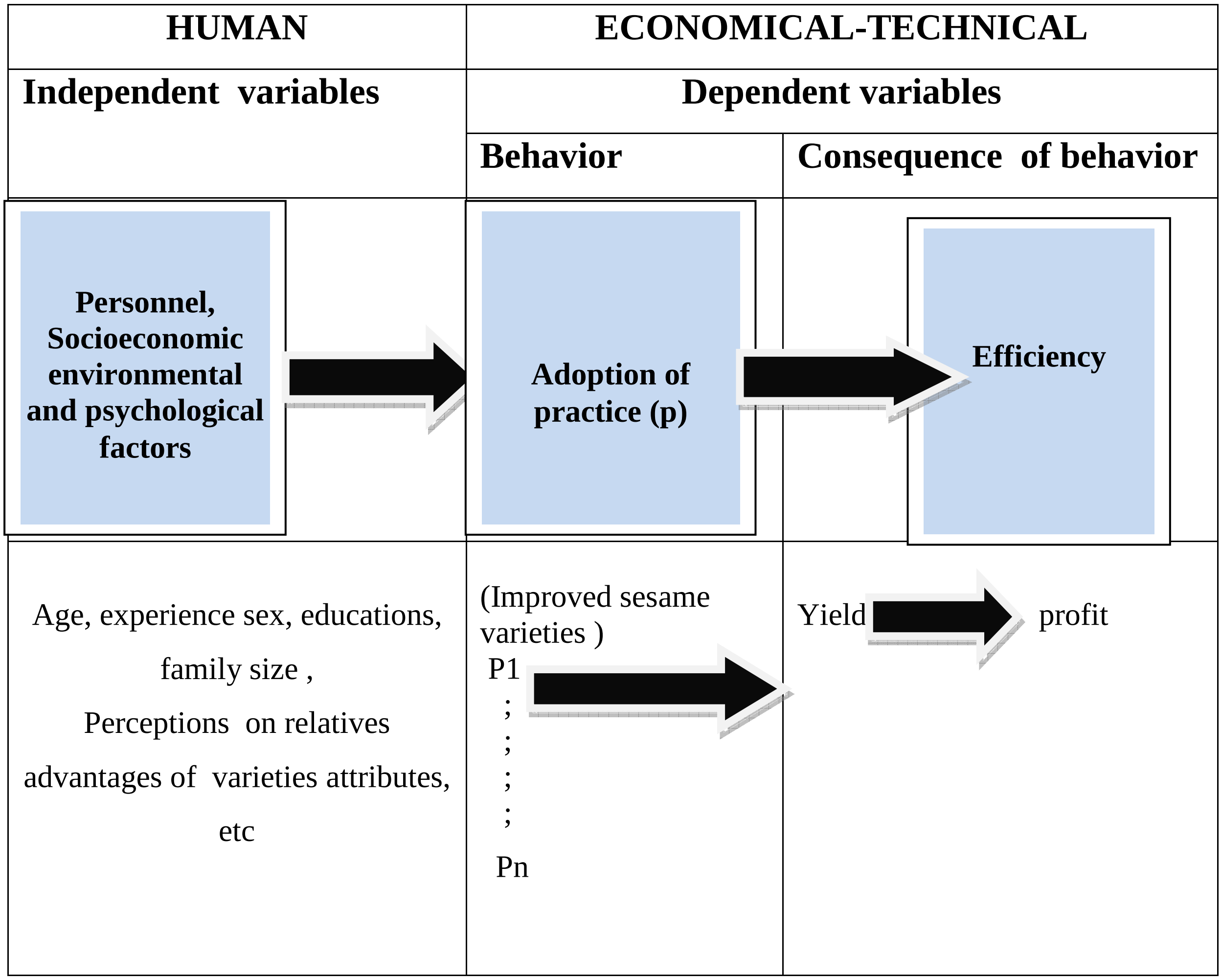

Figure 1. Conceptual framework show the relationship between behaviors of determining in adoption of agricultural technology adapted from (Duvel, 1990)

3. RESEARCH METHODOLOGY

Chapter three begins by providing a brief description of the Meisso district, where the study was conducted. This followed by the description of the population and sampling procedures, instruments and data collection, the statistical analyses procedure used and finally definition of the variables.

3.1. Description of the Study Area

3.1.1. Location and physical features

The study was undertaken in Meisso District of West Hararghe Zone of Oromiya National Regional State (Figure2). Meisso is located at a distance of 300 kms away from Addis Ababa along the main road to Dire Dawa. It is situated between latitude of 40^0 9"30 E and 8^0 48 12" N and 9^0 19"52$^{"}$ N (IPMS report, 2006). The woreda has shares boundaries with East Doba, north of Chiro & Guba Koricha, northeast of Anchar woredas; and northwest of Somali and south and southwest of Afar Regions. The woreda has a total land area of 196,026 hectares. The altitude of the woreda ranges from 900 to 3106 m.a.s.l. and the wide range of the area has gentle slope and sloppy at the border. The most common and dominating soil type is vertisols. The annual temperature varies between 24 ^oC to 28 ^oC .The mean annual rainfall ranges from 400 to 900 mm with an average of about 700 mm and it is erratic in nature. A small rain occurs between March and April, while the main rainy season occurs between July and September .The woreda has a total of 45 kebeles. Of the total kebeles, 34 belong to agro-pastoral and 11 pure pastoralists (Meisso Pastoralist Office, 2009). The location of Meisso woreda is shown in Figure 2.

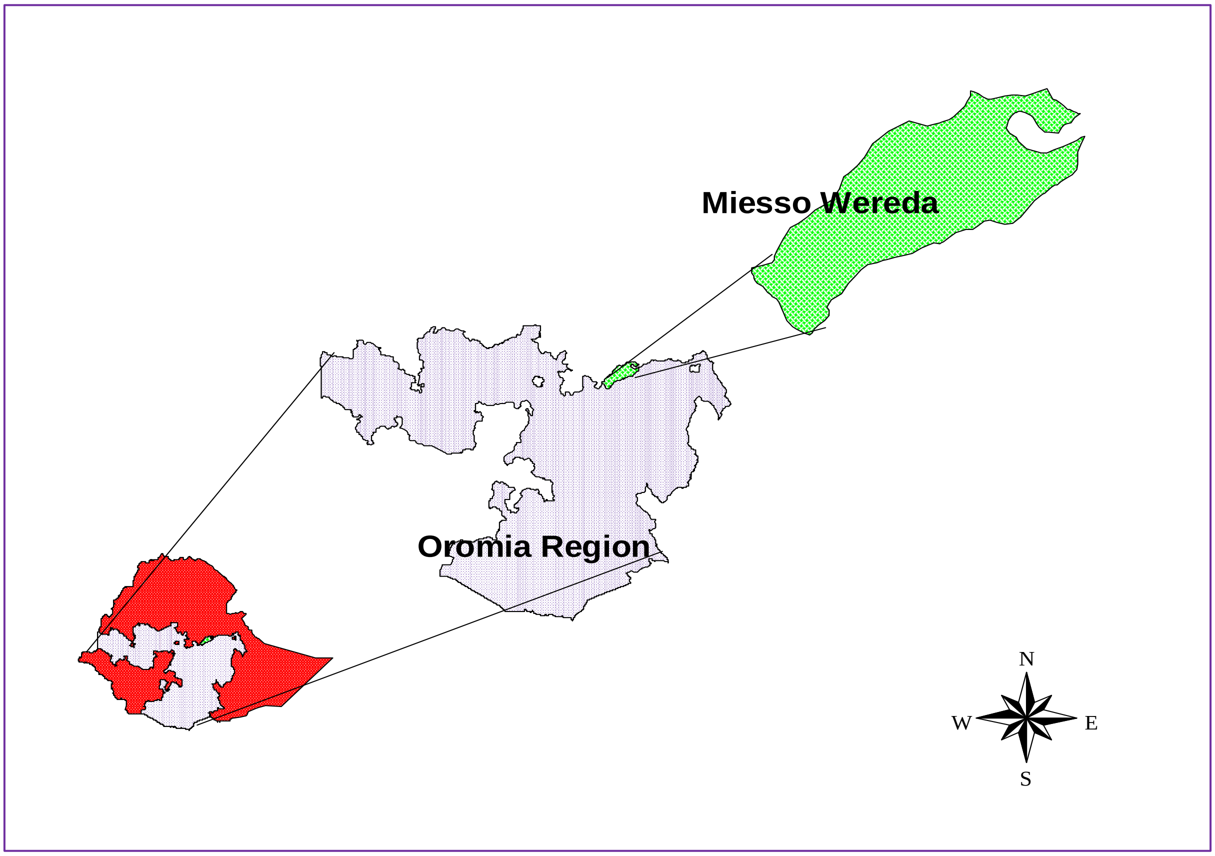

Figure 2.Map of Meisso district

3.1.2. Population and area coverage

The total population of the woreda is estimated at 140,458 of which 76,762 are males and 63,696 are females. Of the total population, 105,088 are rural households of which 53,896 are males and 51,192 are females. The estimated average family size was 6.97 persons per household. Average family size of the study woreda was larger compared to that of the region (5 persons per household). Of the total population, 105,088 (about 93.25 percent) in the woreda were rural dwellers and 25,370 (6.75 percent) are urban dwellers. The population density of the study area is 98 persons per km^2 (CSA, 2007).

The total land area of the woreda is 196,026 hectares. The pattern of land use indicates that 22,487ha (12.05 percent), 17,362ha (13.94 percent), 56,296 (6.33 percent), 46,415 ha (7.74 percent), 48,466 ha (1.33 percent), 5000ha (0.63 percent) of the total area were used for cultivation, grazing, forest and shrubs, uncultivable (hills) ,construction for housing, mosques, clinic, churches and others, respectively (Meisso pastoral office report, 2006).

3.1.3 Agriculture

Agriculture is the economic base of the zone. Agriculture is mainly rain-fed and is characterized by low productivity. The majority of the residents depend on agriculture for their livelihood. The farmers are using traditional technologies and with limited / no accesses to agricultural inputs. Moreover, the sector in the zone is characterized by low-level use of farm inputs, traditional farm practice, and other related problems. Farmers believe that the soils are reasonably fertile, but the major problem which makes the soils to yield low is shortage of rainfall. Otherwise, farmers believe that what they get during good rains is reasonably good. Use of commercial fertilizer is not common in the area. There is hardly any fertilizer distribution in the woreda.

There are two types of farming systems in the district; agro-pastoral and pastoral production systems. In agro-pastoral production farming system both crop and livestock production is undertaken side by side. Sorghum, maize, sesame, haricot bean, teff, groundnut and chickpea are the main crops grown in this production system. The area under these crops, other than sorghum is very low (Table 1). Among this major crops grown sesame, haricot bean and ground nut are the major cash crop. Sesame manly produced to the market purpose. Majority of farmers intercropped sesame with sorghum and maize to reduce the risk of drought in the area but, farmers believe that sole cropping could be more profitable. In addition to food crops chat is also grown in the area however the total land allocated for chat not recorded because all farmers intercropped chat with other cereals crops .Farmers are used to growing chat in their backyards and also in the farmlands. Chewing chat is a very common practice due to that majority of the obtained agricultural information from others farmers. Majority of the farmers grown Sesame is mainly for market purpose and hence is the cash crop for farmers in the area but Sorghum and maize mainly produced for home consumption.

Livestock is one of the important resources of farm families. It provides traction and manure to crop production. In Meisso Woreda, livestock are means of production and sources of income for farmers. Data from Meisso Woreda Office of Agriculture and Pastoralist Development (WoAPD) indicates that livestock population in the area was estimated to be 112,081 cattle, 54,914 goats, and 32,665 sheep, 32,091 camels, 9271 equines, 53,553 poultry and 3858 beehives. Of the total 143,458 hectares of cultivable land 24,737 hectares of land was covered by crops in 2009/01 crop year. Of the cultivated land, sorghum covers the largest area covering about 12,847 hectares followed by maize and sesame crops (Meisso WoAPD, 2009).

Table 1.Type of crop grown and area in hectare in Meisso district in 2009/2010

Type of crop		Area in (hectare)	Production in quintal
1	Sorghum	15,418	28606.5
2	Maize	2890	1870.4
3	Teff	13	15.9
4	Chickpea	90.8	70
5	Haricot bean	328	1090
6	Sesame	220.9	1026.5
7	Groundnut	8.4	27.8

Source: Meisso office of pastoralist development, 2009

3.2. Sampling Procedure

A three- stage sampling technique was employed to select sample respondents. In the first stage, Meisso district was purposively selected for this study, because of the fact that improved sesame technology is widely popularized by various governmental and non governmental organizations in the area. At the second stage, four PAs namely; Ittisa Roro, Hunde Misoma, Oda roba and Harmero deyima were randomly selected among sesame growers PAs using random sampling method. Before the selection of PAs, lists of a total of 45 PAs in Meisso Woreda were obtained from the WoAPD. Among a total PAs found in the woreda, 11 PAs belong to pure pastoralist farming system while the remaining 34 PAs are agro pastoral production system. The latter farming system where sesame crop is extensively produced by the farmers and improved sesame technologies have been widely popularized by research centers, WoAPD and others organizations. The list of sesame producing households in the selected PAs were obtained from the concerned office and finally, 140 sample respondents were selected from the sampling frame based on probability proportional to size (PPS) random sampling method (Table2).

Table 2. Sampled PAs and number of households selected from each sampled PAs

Sampled PA	Number of sesame grower HHs per pA	Number of HHs selected
Oda roba	4838	52
Ittisa roro	2365	25
Harmero deyima	2649	35
Hunde Misoma	3245	52
Total Households	13097	140

Source: WOoPRD, 2009

3.3. Data and Data Collection Methods

Both primary and secondary data were used for this study. Primary data on sesame varieties grown, production practices, associated farm and farmers characteristics, institutional and psychological(perceptions) related factors and other relevant Variables like various input used sesame for production, cost of input, area of sesame in hectare, yield obtained per hectare and, price of output were collected. Secondary data for this study obtained from book, journals, IPMS project reports and other published and unpublished documents from Haramaya University, Zone and district agricultural offices, internet and other related sources to supplement primary data.

Primary data were collected using quantitative approach by means of household survey using a set of pre-tested questionnaires. The household survey was carried out from December to January, 2009. The qualitative method of data collection was also employed. It consisted of in depth open- ended interviews, direct observations and written documents. The interview method was mainly emphasized. Group discussion and individual interviews were held to have reactions of the farmers concerning their detail experiences and their perceptions of the technology and their experience in sesame knowledge sharing. Discussions were also conducted with experts of Meisso Woreda Pastoralist and Rural Development Office and key informants.

The respondents were informed about the objectives of the survey before the administration of the structured and semi-structured interview schedules, and exploratory farm surveys were conducted. Five experienced enumerators, three of them graduates of junior college and the remaining two BSc holders, were recruited and briefed on the objectives of the research and the contents of the interview schedule. The interview schedules were pre-tested before actual data collection and amendments were made to modify some of the questions to make them fit to the context. The enumerators conducted the interview with close supervision of the author in the local language, Afan Oromo. The enumerators had experience in conducting farm household surveys, were familiar with the study woreda, and could speak the local language and know local customs and traditions. Experts of Meisso Woreda Postural and Rural Development Office provide assistance in arranging appointments.

3.4. Method of Data Analysis

The coding of data collected for the analysis was performed after collection and before feeding the data in to the computer. The data were analyzed using software SPSS version 16.0 and stata version 10.0. Appropriate techniques and procedures were used in the analysis to identify the influence of personal, socioeconomic, technical and institutional variables on farmers' improved sesame varieties adoption decision. Descriptive statistics such as mean, standard deviation (SD), frequencies, and percentages were used to have a clear picture of the characteristics of sample units. Chi-square test and an independent sample t-test were used to identify variables that vary significantly between adopters and non-adopter. The chi-square test was conducted to compare some qualitative characteristics of the adopters and non adopters, whereas t-test was run to assess whether statistically significant differences exist in the mean values continuous variables for adopter and non adopter. The Logitistic regression was employed to for modeling and parameter estimation on the determinants of improved sesame varieties adoption decision by the sample household. Following the convention, VIF (Variance inflation factor) for association among the metric explanatory variables and contingency coefficients for categorical variables were used as tests of multi-collinearity. The data analysis methods employed to address each of the specific objectives are elaborated in the subsequent sub-section.

3.4.1. Analysis of the role of farmer-to-farmer knowledge/information sharing

Analysis of the role of farmer- to- farmer knowledge/information sharing in facilitating adoption and diffusion of improved sesame crop varieties was carried out through knowledge /information network analysis .The score of each group of actors was calculated to be ranked in order from most to least importance of the each actor in information sharing. Finally, ranking method was used to find out Source of information, perceived importance and perceived trust worth of sesame technological package information in the study area.

3.4.2. Improved sesame varieties adoption analysis

3.4.2.1. Selection of appropriate econometric model

The logit and probit are the two most commonly used models for assessing the effects of various factors on the probability of adoption of a given technology. These models can also provide the predicted probability of adoption. The logit model follows a logistic distribution function, whereas the probit model follows a normal distribution function. Yet both models usually yield more or less similar results. The choice between the two models is thus a matter of convenience to the analyst (Gujarati, 1995). However, often logit model is preferred as it simplifies the estimation and interpretation of parameters (Aldrich and Nelson, 1984; Pindyck and Rubinfeld, 1981). Hence, the current analysis opted for the logit model and employed in modeling demographic, socio-economic, institutional and psychological (perceptions) factors influencing the probability of adoption of improved sesame varieties by farm households in the research area.

In this study, dependent variable representing adoption of the improved sesame varieties is a dummy variable that takes a value of one if sample farmers used improved sesame varieties during the survey period and before, and zero otherwise. This binary dependent variable was related to several sets of explanatory variables (continuous and/or dummies) that are believed to influence adoption decision of the improved sesame varieties in the study area.

Following Maddala (1983) and Gujarati (1995) the logistic distribution function for the adoption of improved sesame varieties can be specified as:

$$P_i = \frac{1}{1+e^{-Z_i}} = \frac{e^{Z_i}}{1+e^{Z_i}} \quad \text{……………………………………….. ………………………(1)}$$

Where, P_i = is the probability of adoption of improved sesame varieties for the i^{th} farmer and it ranges from 0-1 (i.e., the binary variable, P = 1 for an adopter, P = 0 for a non adopter).

e^{zi} = stands for the irrational number e to the power of $Z_{i.}$

Z_i = a function of n-explanatory variables which is also expressed as:

$$Z_i = B_0+B_1X_1+B_2X_2+\ldots+B_nX_{n.} \text{...(2)}$$

Where, $X_{1,}$ $X_{2,}$ X_n = explanatory variables. $B_{0\text{-}}$ is the intercept, $B_{1,}$ B_2 $_{\ldots}$ B_n are the logit parameters (slopes) of the equation in the model. The slopes tell how the log-odds ratio in favor of adoption of improved sesame varieties changes as an independent variable changes. The unobservable stimulus index Z_i assumes any values and is actually a linear function of factors influencing adoption decision of improved sesame varieties. It is easy to verify that Z_i ranges from $-\infty$ to ∞, P_i ranges between 0 and 1 and that P_i is non-linear related to the explanatory variables, thus satisfying two requirements:

- As X_i increases P_i increases but never steps outside the 0 and 1 interval; and
- The relationship between P_i and X_i is non-linear, i.e., one which approaches zero at slower and slower rates as X_i gets small and approaches one at slower and slower rate as X_i gets very large. But it seems that in satisfying these

requirements, an estimation problem has been created because P_i is not only non-linear in X_i but also in the B's as well, as can be seen clearly below.

$$P_i = \frac{1}{1+e^{-(B_0+B_1X_1+B_2X_2+.....+B_n)}} \text{ .... (3)}$$

This means the familiar OLS procedure cannot be used to estimate the parameters. But this problem is more apparent than real because this equation is intrinsically linear. If P_i is the probability of adopting given improved sesame varieties then $(1-P_i)$, the probability of not adopting, can be written as:

$$1-P_i = \frac{1}{1+e^{Z_i}} \text{ .... (4)}$$

Therefore, the odds ratio can be written as:

$$\frac{P_i}{1-P_i} = \frac{1+e^{Z_i}}{1+e^{-Z_i}} = e^{Z_i} \text{ .... (5)}$$

Now $\frac{P_i}{1-P_i}$ is simply the odds ratio in favor of adopting improved sesame varieties. It is the ratio of the probability that the farmer would adopt the improved sesame varieties to the probability that he/she would not adopt it. Finally, taking the natural log of equation 5, the log of odds ratio can be written as:

$$L_i = L_n\left(\frac{P_i}{1-P_i}\right) = L_n\left(e^{B_0+\sum_{i=1}^{n} B_i X_i}\right) = Z_i = B_0 + \sum_{i=1}^{n} B_i X_i \text{ .... (6)}$$

Where, L_i is log of the odds ratio in favor of improved sesame varieties adoptions, which is not only linear in X_i, but also linear in the parameters. Thus, if the stochastic disturbance term, (U_i), is introduced, the logit model becomes:

$Z_i = B_0 + B_1X_1 + B_2X_2 + \ldots + B_nX_n + U_i$ .... (7)

This model can be estimated using the iterative maximum likelihood (ML) estimation procedure. In reality, the significant explanatory variables do not have the same level of impact on the adoption decision of farmers. The relative effect of a given quantitative explanatory variable on the adoption decision is measured by examining adoption elasticities, defined as the percentage change in probabilities that would result from a percentage change in the value of these variables.

To calculate the elasticity, one needs to select a variable of interest, compute the associated P_i, vary the X_i of interest by some small amount and re-compute the P_i, and then measure the rate of change as $\frac{dP_i}{dX_i}$ where dX_i and dP_i stand for percentage changes in the continuous explanatory variable (X_i) and in the associated probability level (P_i), respectively. When dX_i is very small, this rate of change is simply the derivative of P_i with respect to X_i and is expressed as follows (Aldrich and Nelson, 1984):

$$\frac{dP_i}{dX_i} = \frac{e^{Z_i}}{\left(1+e^{Z_i}\right)^2} B_i = P_i\,(1-P_i)\,B_i \ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (8)$$

The impact of each significant qualitative explanatory variable on the probability of adoption is calculated by keeping the continuous variables at their mean values and the dummy variables at their most frequent values (zero or one).

Test for Multicollinearity

Multicollinearity refers to the existence of more than one exact linear relationship, and collinearity refers to the existence of a single linear relationship. But this distinction is rarely maintained in practice, and multicollinearity refers to both cases. Before taking the selected variables into the logit model, it is necessary to check for the existence of multicollinearity among the continuous variables and verify the associations among discrete variables. The reason for this is that the existence of multicollinearity will affect seriously the parameter estimates. If multicollinearity turns out to be significant, the simultaneous presence of the two variables will attenuate or reinforce the individual effects of these variables. In short, the coefficients of the interaction of the variables indicate whether or not one of the two associated variables should be eliminated from model analysis (Gujarati, 2003).

In this study a Variance Inflation Factors (VIF (X_i) technique was employed to detect the problem of multicollinearity for continuous variables (Gujarati, 1995).Each selected continuous explanatory variable (X_i) is regressed on all the other continuous explanatory variables, the coefficients of determination (R_i^2) being constructed in each case. If an appropriate linear relationship exists among the explanatory variables, then this should show up as a 'large' value for R_i^2 in at least one of the test regressions. A popular measure of multicollinearity associated with the VIF (X_i) is defined as:

$$VIF(X_i) = (1-R_i^2)^{-1} \quad \text{.......... (9)}$$

Where, R^2_i is the coefficient of multiple determinations when the variable X_i is regressed on the other explanatory variables. A rise in the value of R_i^2 that is an increase in the degree of multicollinearity, does indeed lead to an increase in the variances and the standard errors of the OLS estimators. A VIF value greater than 10 (this will happen if R_i^2 exceeds 0.90) is used as a signal for the strong multicollinearity (Gujarati, 1995).

Similarly, there may be also interaction between two qualitative variables, which can lead to the problem of multicollinearity or association. To detect this problem, coefficients of contingency were computed from the survey data. According to Healy (1984), contingency coefficient is a chi-square based measure of association where a value 0.75 or above indicates a stronger relationship. Accordingly, there was no strong association between the dummy variables included in the model.

The VIF and contingency coefficients are presented in appendix tables 3 and 4, respectively. The contingency coefficient is computed as follows:

$$C = \sqrt{\frac{x^2}{n + x^2}} \quad \ldots\ldots (10)$$

Where, C = Coefficient of contingency, n = total sample size and χ^2 = a chi- square value

3.4.2.2. Definition of variables and working hypotheses

After the analytical procedure and its requirement are known, it is important to identify the potential explanatory variables and define its measurements as well as the symbol to represent them. Accordingly, the major variables expected to have influence on the adoption decision of households are explained below:

The dependent variable: The dependent variable of the model (binary logistic analysis), has dichotomous in nature representing farmer's adoption decision on improved sesame varieties. The variable takes value of 1 for the household that cultivated improved sesame varieties during survey time and 0 for household that did not cultivate improved sesame varieties.

The independent variables: It is hypothesized that the decision to adopt improved sesame varieties is influenced by a set of independent variables. Based on the review of adoption literature, past research findings and considering the information from informal survey, among the large number of factors which were expected to influence to farmers' adoption decision, only eighteen (18) potential explanatory variables were considered for this study and examined for their effect in farmers' adoption decision on improved sesame varieties. These are presented as follows.

1. Educational level of farm household head (H_EDUC): This is a dummy independent variable, which is represented by 1 if the household head is literate (read and write) and 0, otherwise. This is included as proxy for the capacity of the head of the household to understand technical aspect related to sesame production technology. This improves his/ her access to obtain and use information relevant to the adoption of improved technologies. A previous research result has also revealed that education would influence adoption positively (e.g. Kebede *et al.,* 1990).Thus, the level of education is expected to be positively related to adoption of improved sesame varieties.

2. Family labor supply (FAMLOB):.This is continuous independent variable indicating family labor supply, which is measured in man equivalent. Family labor is the main sources of farm labor. Since improved sesame varieties' is labor intensive, farmers with large family size are expected to adopt improved sesame varieties. Larger family size is expected to increase the probability of improved sesame varieties adoption. It is, therefore, expected to be positively related to adoption of improved sesame varieties.

3. The Sizes of land holding of the household (H_CULL): It is also a continuous independent variable indicating the total size of farmland measured in hectares owned by the household head. The size of land holding is often correlated with farm income. Some studies reported that farmers with larger farm size have more cash to hire labor to undertake land investments that has direct impact on improved sesame uses (Pender *et al*., 2004; Bekele and Holden, 1998). Thus, the size of land holding of the household is hypothesized to affect adoption positively.

4. Sesame crop production experience of the household head (H_SESEXP): This is continuous independent variable indicating the sesame crop production experience of the household head in years. Farmers having a longer experience in sesame crop production are in a better position to know how to produce the crop and about the potential benefits of new crop than farmers with shorter experience in sesame crop production activities. This in turn enables them to adopt improved sesame varieties earlier than farmers with short experience in sesame crop production activities. In this study, this variable is hypothesized to be positively correlated with adoption of improved sesame varieties.

5. Sex of the household head (H_SEX): This is a dummy independent variable indicating sex of the household head. It represented by 1 for males and 0, otherwise. The literature indicates that female-headed households have less access to improved technologies, land and information than male-headed household that helps for the adoption of improved sesame varieties (Burger *et al.*, 1996). Thus, it is hypothesized to affect positively.

6. Total local livestock holding (H_TTLU): This refers to the total number of livestock holding measured in TLU owned by the household head. It is taken as a proxy indicator of wealth in this study. Those households that own larger number of livestock are relatively rich as compared to those who own less number of livestock. Farmers with larger herd size are assumed to have more cash to invest on improved sesame varieties. Thus the size of livestock holding is expected to be positively associated with adoption.

7. Market distance from farmer's residence (MK_DST): This is continuous variable indicating the distance in Km from the farm household's residence to the nearest local market center. Proximity to the markets enables farmers to buy the necessary inputs, sell outputs at fair prices, and minimize marketing cost. Hence, market distance is hypothesized to have a negative relationship with the adoption of improved sesame varieties.

8. Participation in local administration (PARTNADMN): It is a dummy independent represented by 1 if the household head participate in a leadership or membership position in the community organization during the study year and 0, otherwise. Farmers who bear the responsibility to execute and organize on the behalf of the community get the chance to acquire timely and vital information from government officials and change-agents. Thus, being a participated in either of two is expected to affect adoption of improved sesame varieties positively.

9. Total farm income of the household (H_FINCOM): It is continuous independent variable indicating the amount of annual farm income household head earned which is measured in Ethiopian Birr. It is expected that the higher the level of farm income obtained the better would be the ability of farmers to afford improved sesame varieties, and hence it is hypothesized that the variable would exhibit a positive relation with adoption of improved sesame varieties.

10. Timely availability of agricultural input (H_INPUT): It is a dummy independent variable represented by 1 if the household head perceived that the agricultural input is timely available and 0, otherwise. As availability of improved sesame seed at the sowing time increase, farmers' use of improved sesame varieties would be enhanced. On the contrary, if improved sesame varieties seed are not adequate at the time of sowing, farmers allot their land to other crops. Thus, in this study access to timely input supply is hypothesized to influence the adoption of improved sesame varieties positively.

11. Hosting on-farm demonstration (H_PPDEM): It is a dummy variable that takes a value of 1 if households participate in on-farm demonstration and 0, otherwise. The participation of farmers in on-farm demonstration will increase skill and awareness on the existence and importance of new technology. It also creates an access to information on the use of improved technology. Thus it is hypothesized that it influences adoption of improved sesame varieties positively.

12. Use of formal credit service (H_CREDT): This is a dummy independent variable, represented by 1 if the household head has used credit service either in cash or in kind and 0, otherwise. Introduction of improved sesame technology with complementary practices require considerable amount of capital for purchase of inputs (seed).However, smallholder farmers cannot finance these inputs for adoption of the sesame technology. On the other hand, the availability of farm credit especially from formal sources becomes a vital component of the modernization of agriculture and to improve the wealth status of farmers. Previous research result reported by Lelissa (1998) and Tesfaye and Alemu (2001) confirmed that access to credit positively influence adoption of technology. Hence, it is hypothesized that access to credit will influence adoption of improved sesame varieties positively.

13. Participation of HHs on crop production training (H_TRAI): It is a dummy independent variable represented by 1 if the household head participate any formal training in the area of crop production management, 0 otherwise. Participation on agricultural crop technology related training help farmers to create awareness and promote the understanding about the merits of the available information. Therefore, it can be hypothesized that those farmers who got this opportunity are expected to acquire better knowledge about the improved crop technology and motivated to adopt the technologies. And it is expected a positive association between them.

14. Perception of household head on the relative attributes of sesame varieties (H_PERAT): For this study, in order to evaluate the overall quality of new varieties, an index was developed .The procedure involves counting the number of superior, same and inferior traits and multiplied them by their corresponding grades (i.e. 3, 2 and 1 respectively), adding up and diving the sum by the number of traits. Since the over preference index measures the overall quality of the technology attributes, it is used in the adoption models as dummy (defined as 1 if the overall preference is above the indifference value (same value) and 0, otherwise). This variable measures farmers' recognition of the superiority/ inferiority of improved sesame varieties attributes that is the expected influence on the adoption of new technology such as improved sesame varieties. Hence, it is hypothesized that perception is expected to positively influence the adoption of improved sesame varieties.

15. Farmer to farmer knowledge sharing (FFKNWSH): It is a dummy variable taking a value 1 if the farmer shares information on sesame production with other farmers' in the community organization during the study year, and 0,otherwise. It expected that, interpersonal communication with others farmers and neighbors improve farmers' innovativeness' and motivates them to adopt improved sesame varieties. Hence, it is hypothesized to be positively influence the adoption of improved sesame varieties.

16. Participations on experience sharing filed visits (H_FFEXP): It is a dummy independent variable represented by 1 if the household head has participated on farmers experience sharing visits and 0, otherwise. The more a farmer participated on experience sharing visits, the more he/she will have experience in testing other technologies. Thus, this independent variable is hypothesized to influence adoption of the technology positively.

17. Frequency of Extension contact in a given production year (H_FREQUNCY): This refers the number of days contact made between the household head and extension agent with a given production year. Most of extension service is given to the farmers by the development agent at the gross root level. The provision of agricultural extension service will help farmers to be aware of the benefit and the existence of new technologies. Therefore, it is expected that an increase in frequency of contact to have a positive relation on adoption of improved sesame varieties.

18. Radio ownership (RADIO): This is a dummy independent variable represented by 1 if the sample household head has owned a radio and 0, otherwise. Radio plays a significant role in creating awareness about new technologies in a fastest possible time. Therefore, radio ownership was hypothesized to have positive influence on adoption of improved sesame varieties. Study conducted by Yishak (2005) had also revealed that farmers' ownership of radio had significant influence on adoption of improved maize technology.

3.4.3. Partial budgeting analysis

Partial budgeting analysis was used to determine the level of profitability of improved sesame technology over the local varieties. The success of this partial budgeting depends on prediction accuracy, which depends on the accuracy of the information and estimates it contains. It crystallizes ultimately into the statement of costs and returns based on input and output data. They measure changes in income and returns to limited-resources, provide a limited assessment of risk and, through sensitivity analysis, suggest a range of prices or costs at which a technology becomes profitable (CIMMYT, 1988).

One of the major problems in performing a partial budget or an economic analysis is what value to assign to the inputs used in production and marketing activities and the valuation of output resulted from the productive activities. Determining the field price of inputs and outputs can become a difficult exercise especially when dealing with non-market inputs or products. In this case, one example is family labor. Assuming labor market is competitive, rural wages for hired labor can be used as a proxy.

Another techniques commonly which used in measuring the profitability of the new technology over the local one is the marginal rate of return (MRR). MRR measures the increase in net income which is generated by each additional unit of cost. In other words MRR measures the effect on net return of additional capital invested in a new technology, compared to the present one. It is not necessary to calculate MRR if the new technology costs less than the farmer's present technology, or if the new technology yields a lower benefit than the present one for a comparatively higher cost. When this occurs, the technology is said to be "dominated”. According to CIMMYT, (1988), if the calculated MRR is greater than 50%, the new technology is profitable in the study area.

In making recommendations, three criteria must be observed: i) if net income remains the same or decreases, the new technology should not be recommended because it is not more profitable than the farmer's present technology. ii) if net income increases and variable costs remain the same or decrease, the new technology should be recommended because it is clearly more profitable than the farmer's technology; and iii) if both net income and variable cost increase (this is usually the case), the marginal rate of return should be looked at. The greater the increase in net income and the higher the marginal rate of return, the more economically attractive the alternative technology is.

There is no way for researchers to predict prices with any certainty for a few years in the future. Researchers would like to feel that a recommendation would be able to withstand any likely changes in prices of inputs or crops for at least few years.

The best way to test recommendation for its ability to withstand price changes is through sensitivity analysis (CIMMYT, 1988). Therefore, sensitivity analysis was conducted to ascertain the stability of the net-benefit with change in output and input prices. The analysis was conducted based on the assumption of increasing in input price and decreasing of out put price. This trends shows that if market is deregulated both for input and output prices, the profitability will decline and probability threatens the position of smallholders as risk taker owning to the poor infrastructure and week institutional development.

4. RESULTS AND DISCUSSION

This chapter presents and discusses the results of the analysis which has been carried out to address the specific objectives. The chapter has been organized under six sections. The first two sections, section 4.1 and section 4.2 presents background information on socioeconomic characteristics of the sampled households and cropping activities and income, with special attentions to sesame production inputs and management practices and productivity. Section 4.3 deals with the profitability of improved sesame production technologies. The role of perception and farmer to farmer knowledge sharing are discussed in section 4.4 and section 4.5, respectively. The final section, 4.6, discusses the results of logit analysis of the determinant of the decision by farmers whether to adopt improved sesame varieties which leading to the conclusion and recommendations made in the final chapter.

4.1.Description of the Socio-economic Characterstics of Sample Households

As already discussed, this study is based on cross-sectional data collected from a total of 140 farm households selected from Meisso district of West Hararghe Zone during 2009/10 cropping year. Of the total sampled households, 80(57.1%) were non adopters and 60(42.9%) were adopters farmers. The socio economic characteristics of adopters and non-adopters are discussed in this section.

4.1.1. Household size and structure

The number of people living in a household is referred to as household’s size. Household size is normally taken to give an indication of availability of labor for farm, off-farm and household activities. Availability of family labor is important in the adoption of new technologies, particularly if these technologies would require additional labor input. The average family size of sample households was 7.1 persons per households and the average family size for adopters was 7.8 persons, while it was 6.6 persons for non-adopters. The mean difference for family size is also significant for the adopters and non –adopters at 5 percent significant level. The effect of family size on adoption is captured in the other variable dealing with household's labor force to indicate the labor availability measured in man equivalent (EM).

The average number of economically active family members (15-65 years of age) was about 2.99 persons per household for the total sample .If this result is compared with the average family size (i.e. 7.1), on the average only 42.1% of the family members provides labor force and actively engaged in an economic activity. On average, adopters have more number of economic active labors (3.28) than non- adopters (2.7), with mean difference significant at 5% level (Table3).

The average family labor force supply in man equivalent of the sampled households was 3.7 persons, while for the adopters was 4.38 persons and for non-adopters 3.21 persons. An independent sample t-test shows that the mean difference in family labor force supply of the adopters and non adopters is significantly different at 1% level (Table3).This implies that large families in man equivalent could provide relatively more of labor force supply for farm operations associated with it use (such as weeding and land preparation, etc).Shortage of labor supply may lead a household not to adopt improved sesame varieties.

Table 3. Distribution of sampled households by demographic characteristics

Description of Variables	Overall		Adopter		Non-adopter		t- value
	Mean	SD	Mean	SD	Mean	SD	
Households' average family size	7.1	2.3	7.8	2.49	6.6	2.13	3.15**
Average number of economically active members	2.99	1.31	3.28	1.58	2.7	1.02	2.22**
Average labor force (ME)	3.7	1.44	4.3	1.5	3.2	1.1	5.43***
Dependency ratio	1.62	1.05	1.7	1.2	1.55	0.92	0.870

Note, SD= standard Deviation
***, ** Significant at 1% and 5 % level respectively
Source: Own survey, 2010

4.1.2. Characteristics of household heads

This section deals with household characteristics. It discusses the characteristics of heads of household (who take production and marketing decisions) it includes specifically household heads' age , sex, education, experience in crop production, and duration of participation in crop extension, experience in sesame crop production, cooperatives members and kebele administration. It is assumed that characteristics of household heads would have some influence farmers on the adoption of new technologies. Thus, the sample households' characteristics for each group are discussed below.

Table 4.Distribution of sampled households by the characteristics of household heads

Description of Variables	Overall		Adopter		Non-adopter		Test value
	χ / F	SD/ %	χ / F	SD/%	χ /F	SD/%	χ^2/t
Age (χ)	52.77	9.48	52	9.29	53.3	9.6	-0.83
Experience in crop production (χ)	25.23	9.4	29.2	8.49	22.43	9.09	4.34***
Duration of participation in crop extension (χ)	13	8.15	12.4	7.5	13.4	8.84	0.719
Experience in sesame production(χ)	18.9	11.54	21.3	11.45	17.12	11.34	2.12**
Sex of household heads(f)							
Male	112	80	58	97.6	54	67.5	18.2***
Female	28	20	2	3.3	26	32.5	
Educational level (f)							
Literate	74	52.9	49	81.7	25	31.3	34.97***
Illiterate	66	47.1	11	18.3	55	68.8	
Cooperative member(f)							
Yes	25	17.5	17	28.3	8	10	7.8*
No	115	82.1	43	71.7	72	90	
Kebele Administration(f)							
Yes	39	65	42	52.5	81	57.9	2.7
No	21	35	38	47.5	59	42.1	

Note, SD= standard Deviation, f= frequency, %= percentage, χ= mean of sample farmers
***, **,* Significant at 1%, 5 % and 10% level respectively
Source: Own survey, 2010

The average years of crop production experience for the total household heads, adopters and non adopters were found to be 25.27, 29 and 22.43 years respectively. The mean difference was observed in crop production experience of both groups at 1% of probability level (Table4).The result depicts the fact that technology adoption and years of experience in crop production positive relationship.

Experience in sesame crop production of sample households was assumed to influence the adoption of improved sesame varieties. The survey results show that the average years of experience in sesame crop production of the sampled households was 18.9 years with standard deviation of 11.54 years. When the sample households considered independently into adopters and non-adopters of improved sesame varieties, the average years of sesame crop production experience of adopters was higher (21.3years) than that of non-adopters (17.12 years). The mean difference for years of experience in sesame production is also significant for the two groups at 5 percent significant level .This implies that having a longer experience in sesame crop production are in a better position to know how to produce and the potential benefits of new crop than farmers with shorter sesame experience in crop production activities.

Sample households were composed of both male and female household heads. Of the total sampled household, 80% were male and the remaining, 20% were female headed. The proportion of male-headed sample households was 96.7% for adopters while, 67.5% for non-adopters of improved sesame varieties. The figure shows that the male headed household of adopter is higher than that of the female headed. This could be attributed to various reasons, which could be the problem of economic position of female headed households, including shortage of labor, limited access to information and required inputs due to social position. The chi-square test of sex distribution between the two groups was run and the difference was found to be significant (χ 2= 18.2) at 1 percent of probability level. This implies that situations to use improved sesame are not conducive for females compared to males headed (Table4).

Education is also very important variable for the farmers to understand and interpret the information coming from any direction to them. Of the total sampled household heads, 52.9% were literate (can read and write) while the rest, 47.1% of the sampled household heads were illiterate. Regard to the farmers' categories, from the total non-adopters 31.3 % was literate and 68.8 % were illiterate. In the case of adopters 81.7% were literates and 18.3 illiterate. In this study, like our prior expectation, the chi square test results showed that there is relationship between adoption of improved sesame varieties and level of education at 1% level (Table 4). This implies that there is a strong positive relationship between education and improved sesame adoption.

Those farmers who participated at different level of cooperative membership in a community are assumed to have more access to agricultural input, information, and better interpret and use the available information related to new technology. Hence, farmers' participation in cooperative membership in peasant association was used as a proxy for access to input and information in the adoption of the technology. Of the total sampled households, 47.1% have participated in cooperative membership while, 52.9 % of the sampled household heads do not have. When we analyze with in the category, 28.3% of adopter farmers have participated in cooperative memberships, while only 10% of non-adopters have participated cooperative membership, with the percentage difference significant at 5% level.

4.1.3. Cropland holding and acquisition

Productive land is the basic assets of farmers. In the study area on average, 2.13 hectares of crop land was available per household, while an economically active labor in the family can work on 0.7hectare. Adopters cultivated more land (2.24 ha) than non-adopter (2.06 ha). However, the mean difference statistically is not significant between the two groups.

In the study area, the major means of land acquisition was through the land redistribution, inheritance and rented-in land. The survey result revealed that about 66.7% of adopters and 50.6% of non adopters consider their cropland fertile during the survey year. The chi square test shows that farmers perceived crop land fertile has systematic association with adoption of improved sesame varieties at 5% level of significance (χ 2 =3.67).

The survey result showed that from the total respondents, only 0.034% had some access to irrigation water, while majority of the sampled households had not access to irrigation. The average irrigated land was 0.054 hectare for adopters and 0.019 hectare for non-adopters, respectively. In this study, the amount of irrigated land was not found to significantly influence improved sesame varieties adoption.

Table 5.Distribution of sampled households by crop land holding

Attributes	Overall	Adopter	Non-adopter	Test value χ^2/t)
Average holding size (own)	2.1	2.24	2.02	1.27
Average holding size(rented/borrowed)	0.32	0.36	0.29	1.31
Percentage consider their cropland fertile	58.65	66.7	50.6	3.67**.
Percentage having access to irrigation	0.035	0.021	0.014	2.21
Irrigated land area	0.34	0.054	0.019	1.249

** Significant at 5 % level

Source: own survey results data 2010

4.1.4. Livestock holding and oxen ownership

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

The average size of livestock kept by adopters and non-adopters are presented in Table 6. The livestock species found in the study area are cow, oxen, sheep, goat, chicken, donkey, camel, sheep, calves and heifers. To help the standardization of the analysis, the livestock number was converted to tropical livestock unit (TLU).The conversion factors used were based on Freeman et al. (1996) and it is shown in Appendix4.The average cattle ownership of sampled households was 5.81 TLU, while for the adopters was 6.45 TLU and for the non adopters was 5.4 TLU. The mean comparison showed that the cattle owned mean difference between the two groups is significant at 5 percent level. The implication is that adopters have more access to financial capital by selling their cattle to purchase improved seed from suppliers.

On average sample households was 11.48 TLU with standard deviation of 3.75.Adopters owned a large number of livestock compared to non adopters, with mean difference significant at 5 percent level. It could indicate that adopters have better access to financial source through sell of livestock which could be used to purchase farm inputs, such as sesame seed and used for minimizing risk.

The Proportion of sampled household owing at least an ox was 49.6 % while 50.4% of sampled households have no oxen during the survey time. The chi square test result that there is no statistically difference between the two groups in proportion of households owing at least an ox.

Table 6.Distribution of sampled households by livestock holding

Attributes	Overall	Adopter	Non-adopter	Test value χ^2 /t)
Average cattle owned (heads) by households	5.81	6.45	5.4	2.31**
Proportion of household owing at least an ox	49.1	55	45	1.23
Average goats owned by households	0.85	1.0	0.74	1.83**
Households' average total TLU ownership	11.48	12.31	10.48	2.321**

** Significant at 5 % level
Source: own survey results data 2010

4.1.5. Access to knowledge and information

Access to relevant agricultural information makes farmers to be aware of and get better understanding of improved agricultural technologies, which in turn, will facilitate change in the behavior of farmers and may ultimately lead to decision to take risk for technology adoption. (Mahdi, 2005).

Farmers get access to farm information in different ways. These include participation on extension event (like training, demonstration, and field days), farmer-to-farmer information sharing, contact with DAs, Experience sharing visit and listening radio programmes (Table 7).

Frequency of contact with development agent is one of the ways farmers access to agricultural extension service and it was hypothesized to influence farmer's decision to adopt a new technology positively. During the survey period, more than half (about 57.9%) of the sample households have received extension advices, while 42.1% did not receive any advice from extension agents of Ministry of Agriculture sesame production. But the difference in frequency extension contact between adopters and non-adopters were statistically tested and found to be insignificant (Table7).

The other means through which farmers get agricultural information is through participating in different extension events arranged by different institutions. Participation on crop production training and host demonstration are the two most important variables considered for this study. A Farmer who had a chance to participate in these extension events will have enough information about the new technology and as a result would be more likely to adopt new innovation than others do.

Participation on agricultural crop technology related training help farmers to create awareness and promote the understanding about the merits of the available information. The survey result revealed that about 8.3% adopters had chance to take part in crop training programs while about 8.8% non- adopters participated in such training program. However, the chi-square test results show that the rate participation in crop production related training by adopter and non-adopter is statistically insignificant. This may be because of the trainings were not prepared based on training needs assessments and hence are less likely to meet the needs and interest of agro pastoralists. Sample respondents, who received trainings, reported that the trainings were not compatible with their needs and production problems.

Demonstration of new technologies would enable farmers to objectively observe some features of the advocated technologies in order to decide on the weather to accept or reject. The survey result revealed that about 15% of the adopters while 7.5 % of the non-adopters participated in /hosting demonstration. The difference was statistically tested and participation in/ hosting demonstration was found to be insignificant.

The sample households in the study area are also getting access to agricultural information through participating in different informal extension events like farmers experience sharing visit and farmers to farmer's knowledge sharing at market place, religious institution, chewing place and coffee ceremony at the neighbor. Accordingly,about58.3% of adopters farmer were get access to information through farmers to farmers' information sharing, at different place while only 18.8% of the non-adopters had got the information through this mechanism. The chi-square test for both groups (x^2 = 23.8) shows statistically significant difference between adopters and non adopters. This shows that the adopters have got more an opportunity of sharing knowledge on improved sesame technology with other farmers than non adopters. Adopters perceived the information from farmers is more trustable than outsiders. Hence, farmer to farmer knowledge sharing is an appropriate means of introducing improved sesame technology.

Farmers to farmers experience sharing visits which are organized by different institutions also play important role in facilitating access by farmers to reliable information on improved sesame varieties and linking farmers with the formal institutions involved in sesame production package. About 26.3 % of the adopters and 16.7% of the non-adopters participated in farmers to farmers experience sharing visits, the difference was statistically tested and participation in farmers to farmers experience sharing visits was found to be insignificant.

Table 7. Distribution of sample households by access to information and knowledge

Description of variables	Adopters		Non Adopters		Overall		χ^2- Value
	N	%	N	%	N	%	
Farmers knowledge sharing							
Yes	35	58.3	15	18.8	50	35.5	23.8***
No	25	41.7	65	81.3	90	64.5	
Experience sharing visits							
Yes	16	26.7	13	16.3	29	20.7	2.26
No	44	73.3	67	83.8	111	79.3	
HHs Radio ownership							
Yes	30	50	37	53.8	67	47.9	2.51
No	30	50	43	46.2	73	52.1	
Hosted demonstrations							
Yes	9	15	6	7.5	15	10.7	
No	51	85	74	92.5	125	89.2	2.06
Participation on training							
Yes	5	8.3	7	8.8	12	8.6	
No	55	91.3	73	91.7	128	91.4	
Frequency of extension							
No contact	27	45	32	40	59	42.1	
Every week	9	15	33	41.3	42	30	1.31
Monthly	15	25	5	6.3	20	41.3	
Quarterly	7	11.7	6	7.5	13	9.3	
Once in a year	2	3.3	4	5	6	4.3	

*** Significant at 1% level

Source: own survey result, 2010.

4.1.6. Use of credit and timely availability of agricultural input

Credit is an important institutional service to finance poor farmers who cannot purchase input from own savings especially at early stage of adoption. As presented in Table 8, of the total sample households, 45 % have got credit service for different purposes while 55% do not. Out of the total respondents who have got credit in the year, only 0.05% has got credit to purchase sesame seed. About 48.3 % adopters farmer have received credit while 42.5% of non adopter farmers have received credit during the last cropping season (2009/10). The chi-square test result revealed that there is no percentage difference between adopters and non- adopters farmers in relation to use of credit.

Two sources of credit exist in Meisso district. The first one is the formal sector including government and NGOs while the second and the most important one is informal sector. The formal sector provides credit for productive purposes. These include provision of seeds, farm implements, livestock (like goat, sheep and heifers) and drugs for veterinary services. During the study year, 25% of the sample households included in the survey received seed of different crop (sorghum, sesame, and maize and haricot bean) through credit services. The proportions of farmers who received, farm implement, livestock and drugs were 50%, 15%, and 10% respectively. Informal sector credit sector plays a very important role in Meisso. Relatives or money owners provides both cash and non cash credit. The loan period for cash credit ranged between 1 and 60 months. Non cash credit commonly, households who are short of seed or money receive certain quantity of grain in kind. This type of credit has to be repaid with a year (ranging from 1 to 12 months).

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Table 8.Distribution of sampled households by use of credit and agricultural input

Description of variables	Adopters		Non Adopters		overall		χ^2-Value
	N	%	N	%	N	%	
Use of credit							
Yes	29	48.3	34	42.5	63	45	
No	31	51.7	46	57.5	77	55	1.9
Timely availability of input							
Yes	21	35	22	27.5	43	30.7	
No	39	65	58	72.5	97	69.3	2.15
Source of credit							
Formal	11	17.5	9	14.3	20	31.7	
Informal	23	36.5	20	31.7	43	68.3	

Source: Owen survey, 2010

With regard to timely availability of input, out of the total respondents 30.7 percent reported that the input was timely availability. Among the total sample households, 35% of the adopters and 27.5% of the non-adopters reported that the input was timely available. The difference was statistically tested and it was found to be insignificant (Table 8).

4.1.7. Access to market

Sample households in the study area reported that they sold some of their agricultural products right after harvest to cover costs of farm inputs, social obligation and urgent family expenses by taking to the immediate near by local market. The survey result indicated that the average distance of sample household home from the nearest market place was 12.6 km. On average adopters were located about 9.7 km distances whereas non-adopters were about 14.78 km far away from the nearest market. The result also revealed that mean difference of distance to market was significant at 1%of significant level (Table 9).

Table 9.Distribution of distances from market center to residence of sampled households

Variable	Overall		Adopters		Non- adopters		t- value
	Mean	SD	Mean	SD	Mean	SD	
distance in (km)	12.6	8.03	9.7	5.8	14.7	8.8	3.88***

***Significant level at 1% significant level
Source: own survey results 2010

4.1. 8. Non- crop incomes and sources

4.1.8. 1. Livestock incomes and sources

Households' income from sale of livestock and livestock product is one of the important factors determining adoption of improved technologies. The amount of household income obtained from sale of livestock and livestock product after the household consumption requirement is met could be used for purchase of farm inputs specifically improved sesame seed. Improved sesame production often requires an input regime which has great implication on cost of production. Due to this, improved sesame grower households need to have the required amount of financial resources to run the activities. Therefore, a household with relatively higher income from sale of livestock and livestock product was expected to better adopt improved sesame varieties. The major sources of livestock and livestock product income reported in the study area included sale of cattle, goat and milk.

Table 10.Income Sources of sampled households from sale of livestock and product

Sources	Overall (average)	Adopter (average)	Non-adopter (average)	Test value χ^2/t)
Goats sales	358.2	434.1	256.7	2.48**
Cattle sales	1325.03	1803.1	1523	0.671
Milk sales	60.75	83.91	43.01	0.951
Butter	55.47	66.52	47.01	1.67**
Total livestock income	1737.89	1817.66	1677.56	0.436

**Significant level at 5% significant level
Source: own survey results 2010

The average annual income of sampled households from sale of goats was Birr 358.2 (Table10). Adopter farmers earned Birr 434.1 from sale of goats, while non-adopters earned Birr 256.7. Adopter farmers earned more income from sale of goats and the mean comparison between the two groups is statistically significantly different at 5 percent probability level. However, the income from sale of cattle was not statistically significantly different between adopter of improved sesame varieties and non adopter.

4.1.8. 2. Off/ Non-farm incomes and sources

Access to off /non-farm sources of income can affect the decision to adopt new sesame varieties. This is particularly true if the adoption of the new sesame technology would require a minimum investment in purchased inputs. Most of the farmers interviewed reported that they had no access to off/non-farm income because of poor infrastructure development in the area. Only 22% of the sampled households had accessed to off/non-farm income during the time of survey. Type of off/ non-farm activities available for farmers in the study area include, sale of charcoal, goats trade, employee (*daily labor*), and selling of different items in shop.

Sample households on average had earned Birr 183.57 annually from off/non-farm activities during the survey year. The average annual off/no-farm income received by improved sesame adopters and non- adopters were about 188.02 and 179.03 Birr, respectively (Table 11). The mean comparison between the two groups is statistically not significant.

Table 11.Source of income for sampled households from off/ Non-farm activities

Sources	Overall (average)	Adopter (average)	Non-adopter (average)	t-Value
Wage labor	81.79	97.45	66.14	1.071
Charcoal making	64.1	71	57	0.877
Goats trade	476.85	530	423.69	1.149
Rural shop	111.56	53.63	169.50	1.052
Total	183.57	188.02	179.03	1.0372

Source: own survey 2010

4.2. Cropping Activities and Incomes

4.2.1 Major crop grown

As indicate in figure 3, sorghum, maize and sesame were the three top crops grown by the sampled households. This can be explained by the fact that sorghum, maize and sesame have been both staple and cash crops in the Meisso Woreda. Even though the majority of the farmers in the study area produce sesame, the yield per hectare is very low as compared to others crop grown in the area. The average yield of improved sesame varieties was 6.2q /ha while it was 4.2 q/ha for the local ones. However, since the last four years, farmers' interest in sesame crop production has increased. This is because the market price of sesame has increased since then .This explain why more than 85.7% of the sample farmers in the study area produced sesame (allocated their land for sesame production). Teff, ground nut and sweet potato were also grown for cash as well as for home consumption. Very few households grew coffee and chickpea. In the study area, both sole and mixed cropping systems are practiced.

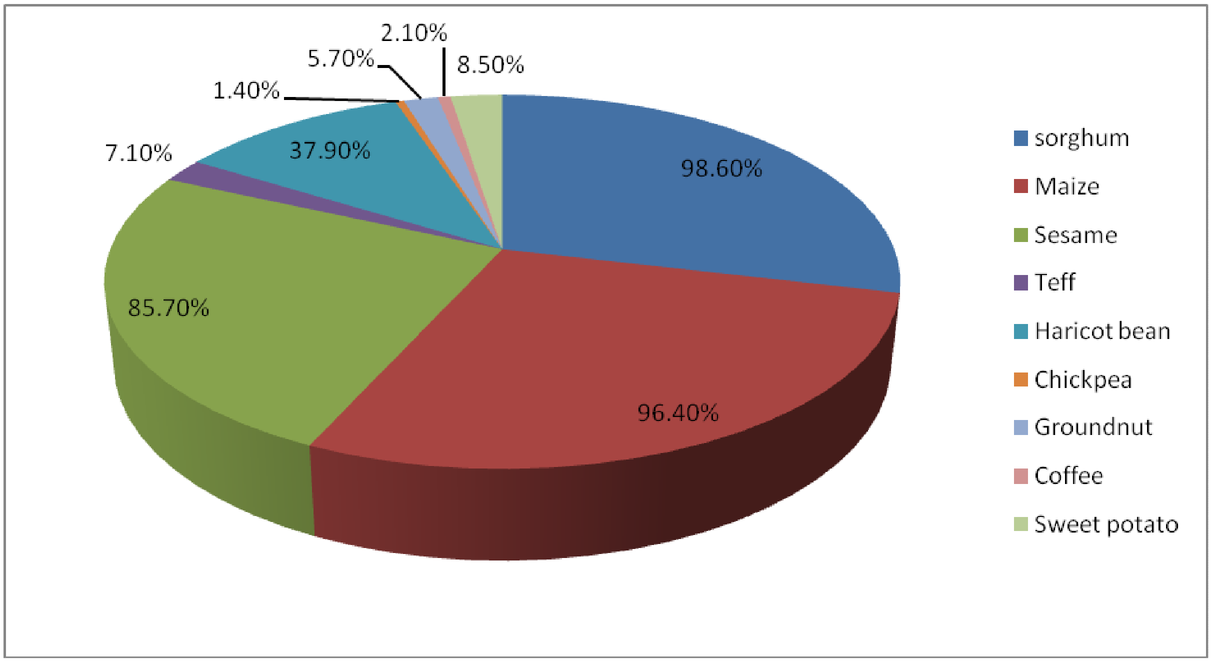


Figure 3. Proportion of sample households who grown different crops

4.2.2. Land use and cropping pattern

The average size of land sampled household allocated for maize, sorghum, sesame and other crop are summarized in the Table12. Majority of the land were allocated for sorghum and maize production by sampled households in the study area. This was mainly because of the fact that sorghum and maize are the staple crops mainly produced for home consumption purpose. The average land allocated to sesame was 0.19 and 0.60 ha for adopters and non-adopters farmers, respectively. However, the mean difference statistically is not significant between the two groups. Area allocated to sorghum by the non-adopters exceeds the area allocated for sorghum by adopters.

In the study area more than ,85.5 % of the sample households reported that sesame is intercropped with maize and sorghum but the remaining ,14.5 % of sample household report that sesame planted as sole crop during survey time. However, farmers believe that sole cropping of sesame could be more profitable than intercropping but due to risks of drought in the area, they prefer intercropping them.

Table 12. Average land allocation pattern for sample households in 2009/10 (in hectare)

Description	overall	Adopter	Non-adopter	Test value t
Average Land allocated for maize	0.62	0.65	0.57	1.63
Average Land allocated for sesame	0.19	0.24	0.12	1.574
Average Land allocated for sorghum	0.79	0.74	0.82	0.992
Average Land allocated for other crops	0.44	0.43	0.44	0.25

Source: own survey 2010

4.2.3. Production status and major constraints in sesame production

The study area, Meisso district, being part of the central rift valley, is one of the potential improved sesame producing area in West Hararghe Zone of Oromiya Regional State. The high market demand provided better opportunity to farmers to grow different oil crops specifically sesame crop. Among the oil crops grown in the area, sesame is the most important crop mainly produced for the market. Sesame covers about 220.9 ha of crop land in Meisso woreda in year 2009/10 (Meisso District Office of Pastoral and Rural Development, 2009).

In current study area, the average area of cropland planted to sesame is about was 0.19 ha. An increase in average yield of sesame may be due to frequent expansion of areas of production. Improved sesame yield per hectare of sample households was 6.2 quintal. Comparatively speaking, this figure is higher than the national productivity reported by CSA (2007) which is 4.5 qt/ha. However, it is relatively low when compared with achievements at research station which is 7-18 qt/ha indicating possibility for further improvement. Sesame crop are the most important crop due its high market value and it is livelihood of grower households as an important income source. The average gross income from improved onion production of the sample adopter households from one season harvest during 2009/10 production year was 6200.00 ET birr.

In the study area, oil crops production in general and sesame production in particular is predominantly rain fed due to underdeveloped irrigation infrastructure. The respondents were asked whether they have their own oxen, as these animals are the most important production factors in agriculture, on the one hand, and they are status indicators among smallholder subsistence farmers, on the other hand. More than 49.1% of the total amount of sesame farmers reported that they have their own oxen, which they use for the cultivation of land.

Sample respondent farmers mentioned several factors constraining improving production, productivity, and income from sesame. The production constraints are timely access to inputs like improved sesame seeds, and fertilizers, recurrent drought, lack of information on quality standards, pest infestation and poor extension service were the major production related factors mentioned by sample respondents. On the other hand, low selling price of products which is a resultant factor of other several associated problems was mentioned as one of the serious marketing related problem.

Shortage of improved sesame seed and unavailability of inorganic fertilizers was one of the major production problems in the study area. According to the respondents, there is no certified seed and fertilizer source in the area and as a result of this; there is a very serious problem of obtaining quality seed and fertilizer. The major seed sources for farmers in the area were others farmers, WOoPRD, NGOs and IPMS Project as was mentioned by 46.7 %, 16.7 %, 10%, 11.6% and 15.0 % of respondents respectively.

Recurrent drought was also one of the major production problems in the woreda and this was reported by 85 % of the respondents. Due this problem the productivity of sesame is gradually declining from year to year in the area. Although early mature sesame varieties have been recommended, awareness, availability of such seed is problematic. This therefore suggests that a need exists for interventions that would enable these farmers to use mechanisms that would improve production and productivity.

Poor extension service was another major problem mentioned by sample respondents. In line with this, the results of this study indicated only about 57.9 % of the sample households had contact with public extension agents. The remaining sample respondents did not get any extension advice during the survey period. However, for some of the sample households particularly those who are members of the cooperative, there is a possibility to get extension advice from other organizations. During the survey year, 22.5% of the respondents have participated training and other extension support from NGOs. Care Ethiopia, IRC and mercy Corpos were some of the NGOs providing support to sesame producer farmers.

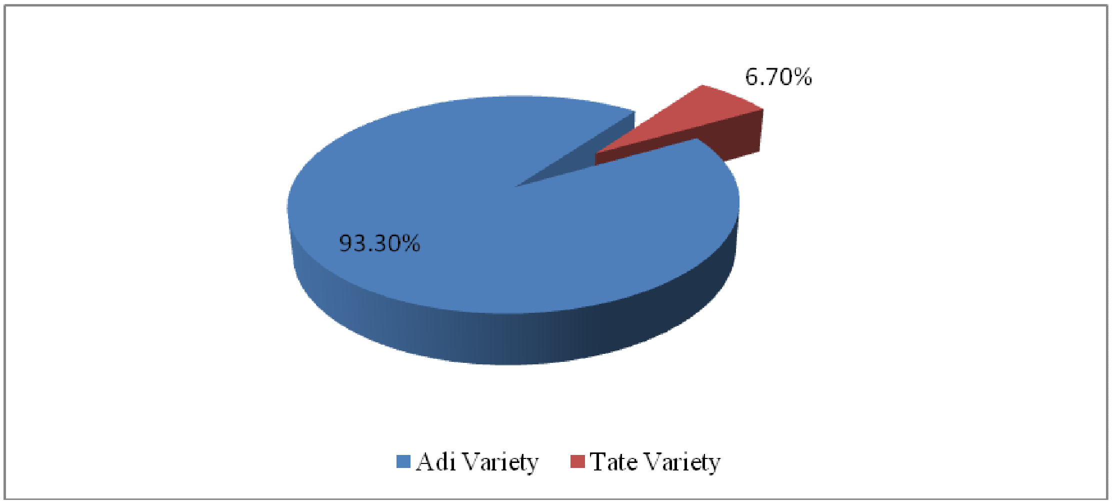
The other category of problems facing sesame growers were related to marketing. Improvement in production alone is not sufficient to achieve better income unless the marketing aspect is well improved. In line with this, respondent farmers mentioned lack of reliable sources of price information, exploitation by middle men and traders due to their poor bargaining power and the resulting low selling price as the major marketing problems. The major sources of price information for farmers were middle men, neighbor farmers and traders as reported by 88.3 %, 56.7 % and 40.6 % of the sample respondents respectively. According to respondents, middlemen and traders are not the reliable sources of price information as they always try to reap more benefit at the expense of their earnings.

4.2.4 Sesame production practices

4.2.4.1. Improved Sesame varieties grown

Farmers grow an assortment of sesame varieties. Both local landraces often referred to as local varieties and improved varieties are grown to meet farmers' multiple objectives. About 57.1% of the respondents predominantly grow local varieties, whilst only 42.9% dominantly grow improved sesame varieties, often in addition to the local varieties. *Adi* and *Tate* are the two improved sesame varieties are currently grown by farmers. *Adi* is the most frequent variety in terms of the number of farmers growing it. As highlighted in the Table14 the majority (93.3%) of improved sesame grower sample households produced *adi variety* for its early maturity, relatively higher in terms of its yield advantage, and better market price than others.

The other improved variety is currently being produced by farmers in the study area, are *Tate* variety and it is only, and 6.7 % of adopters' farmers produce this variety. The reason for only a few adopters farmers produce it, they perceived that the color of variety has less demanded in the local market and also not suitable for the intercropping with sorghum. Hence, understanding farmers' varietals preference criteria and perception is an important issue in technology generation and dissemination process. This suggests the need to give emphasis to participatory research which considers farmers' technology preference criteria, needs and priorities.



Source: own survey, 2010

Figure 4. Proportion of adopters' farmers by type improved sesame varieties growers

4.2.4.2. Seeding rate

Farmers' adoption of the recommended seeding depends among several things on the appropriateness of the research recommended seed rate, timely availability of quality seeds and other household related socio-economic problems. Farmers in the study area were found to use varying seed rates ranging from 4.5 to 8 kg per ha, the maximum being greater than of the recommended rate (5. kg/ha) rate by the research system. On average sample adopter households, used 6.25 kg of improved sesame seed per ha with a standard deviation of 1.24 kg. There was significant variation among the sample grower households in amount of seed used where the minimum was 4.5 kg while the maximum is 8.0 kg per ha.

Such excessive use of seed had increased farmers production expense thereby increasing seed purchase cost. Average seed cost per ha per a production season in 2009/10 production year was 78.125 birr. Seed purchase price for the year ranges from 10-15 birr/kg. The average cost of seed used was found to be higher than the cost that would have been incurred when the recommended rate used.

The main reasons for using such high seeding rate according to 53.3 % of sample households were poor quality of seed and at the same time the need to have denser plant population in order to get better yield. Farmers also questioned the adequacy of the recommended seeding rate by the research system which is 5 kg per ha. They claimed that whatever the quality of the seed may be, the recommended rate is not sufficient under their physical and management condition. Seed quality problem was due to shortage of certified seed available to growers. The majority of the sample farmers (46.1%) obtained sesame seed from individual famers while 16 % purchased from local market.

4.2.4.3. Fertilizer, Pesticide, and Herbicide application

Sesame producing households did not apply any commercial fertilizer on their sesame fields and also other crop land. Respondent farmers provided different reasons for not using inorganic fertilizers for sesame production. The majority (92.1%) of the respondents perceived that their soils are reasonably fertile and application of fertilizers doesn't increase the yield. In their view, fertilizer research recommended rate is not needed. This has an implication for research indicating the need to revisit the previous research recommendation by conducting further site specific fertilizer trials. It is also true for agro chemicals (pesticides and herbicides) and manures. Almost all of the sample farmers reported that they did not use agrochemical for sesame production due to unavailability of the chemical in the area. However, all of the sample farmers in the study woreda expressed their interest to use herbicides and pesticides for the sesame field if they have access to it.

4.2.4.4. Frequency of ploughing

Plowing is one of the major sesame crop production activities and it is done with a pair of oxen. The average plowing frequency was three times for one production season. Land preparation starts in March and planting is done from July to August based on the early start of rainfall for land preparation. With regard, to the number of ploughing, research recommended 2-3 times ploughing in a production season. Unlike seed rate, there was no much variation among farmers in frequency of ploughing used. Moreover, the frequency of ploughing used by sample grower farmers was almost similar to the research recommendation, which is 2-3 times in a production season. According to the survey result, majority of sample farmers (89 %) perform three times ploughing while the rest 11 % perform two times ploughing in a production season for improved sesame. Majority of the farmers used drilling method of sowing.

4.2.4.5. Weeding frequency

Weed infestation is one of the major constraints to crop production in the study areas. All of the sample respondents reported to have used hand weeding; they did not use herbicides to control weeds infestation due to unavailability of herbicides in the area. Sample farmers prioritized weeding as the primary farm activity requiring huge amount of labor if a farmer wants to harvest better yield of sesame from a given cropland. More than 90% of the sample farmers in the study area reported weeding 2 to 5 sesame crop per production year. The first weeding usually is done in the first week of August and the second and three weeding are done starting from August 20 to September 15. If weeding is missed during these critical periods, a significant portion of yield could be reduced. Hence, producers at these periods badly need and use family labors.

4.2.4.6 Harvesting and threshing

The crop is ready for the harvesting when one-third to two third of the leaves, stems and pods turn into yellow. Harvesting usually done by hand using sickles, bundled and stalked vertically for the pods to dry. Threshing is carried out on a clean and flat area by beating the dried plant with sticks. When farmers think about the harvesting of sesame, they face two important constraints that determine output.

4.2.3. Crop incomes and sources

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The amount of household income obtained from sale of crops, after the household consumption requirement, is met could be used for the purchase of agricultural input and a household with relatively higher farm income was expected to better adopt improved sesame varieties. The survey result has shown that, on average sample households earned about birr 2103.2 from crop sales. Adopters obtained large revenue from crop sales (Birr 2421.9) compared to non adopters (Birr 1864.2), with mean difference significant at 5% (Table 13).

Table 13.Incomes sources of sample households from sales crops

Sources	Overall (average)	Adopter (average)	Non-adopter (average)	Test value χ^2/t)
Sorghum	518	592.2	460.1	0.950
Maize	274	359.2	205.2	1.742*
Sesame	1394	1575	1259.02	2.107**
Haricot bean	102	98.1	105.2	-0.2
Total	2103.2	2421.9	1864.2	2.250**

**,*Significant level at 5% and 10% level respectively
Source: own survey 2010

4.2.4 Non-adopters reasons for not using improved sesame varieties

The survey result has revealed that among the total sample households, 42.9 % of the sample farmers adopted improved sesame varieties in the study year. The remaining 57.1% of sample farmers not adopted. The non-adopters of improved sesame varieties were asked why they did not use improved sesame varieties. The major reasons given by respondents were, 52.5 % absence of unavailability of improved sesame seed in the area, 21.3% low market demand, 3.8% absence of fertilizers recommended for improved sesame in the district and 22.5% lack of information(awareness)about the benefit and recommendation package of improved sesame varieties (Table 14).

Table 14.Distribution sample household's reasons for not using improved sesame varieties

Reasons	Respondents (N)	Percent (%)
Unavailability of improved sesame seed	42	52.5
Lack of awareness on benefit of improved sesame seed	18	22.5
Low market demand	17	21.3
Fertilizer is not available on time	3	3.8
	80	100

Source: own survey results 2010

4.3. Profitability of Improved Sesame Technology

Partial budgeting analysis was used to determine the level of profitability of improved sesame technology over the local varieties. It was carried out according to CIMMYT (1988) methodology. Obviously the yields of both sesame crop would be realized in a one year period, and therefore, the plan is designed to show only a per annum profile of the cost and returns that vary for the improved sesame varieties and local sesame cultivars.

The partial budgets omit the fixed costs such as land because it is unchanging across practices. and also the cost of fertilizers, herbicides, pesticides were not incorporated in the partial budgeting analysis because all the farmers in the Meisso Woreda had not been used fertilizer, pesticide and herbicide for all crops production in general and sesame crop production particular. Therefore, partial budget analysis focus only on the variables cost that varied across the practices. This variable cost includes cost of seed and labor for land preparation, weeding, harvesting and threshing. All benefits and costs should be calculated using farm-gate prices. That is, the actual price which the farmer pays for the inputs or receives for his products.

Respondents were asked to quantify the amount of labor they put on major activities of improved and local sesame production on a hectare of land. Average working hours for all activities was 7.7 hours per day. The farm gate prices used for partial budgeting analysis were, 12.5 and 8.5 birr per kilogram for the improved sesame and local sesame seed respectively at time of planting.

4.3.1. Partial budget analysis results and its implications

The improved sesame profitability level through partial budgeting analysis is presented in Table17.The total variable cost (TVC) incurred by improved sesame varieties adopters and non adopters were birr 2958.12/ha and birr 1605/ha, respectively. The net income from improved sesame production per hectare was birr 3241.88/ha, while net income per hectare of local sesame cultivars was birr 2175/ha. Therefore, the marginal benefit of improved sesame varieties compared to the local sesame was 1067 birr/ha.

According to marginal rate of return analysis, improved sesame raised the farmers' net benefit by 78 % with additional cost of 1353 birr per hectare over the local sesame cultivars. This means for each 1 birr invested in improved sesame varieties, farmers could get additional 0.78 birr more than what they could get by investing on local sesame cultivar (Table17). This implies that adopters of improved sesame varieties get higher marginal benefit as compared to non-adopters of improved sesame varieties who grow local sesame. In other word it may indicate that the new technology is "better" than the traditional variety in term of generating additional income.

Table 15 .Results of partial budget analysis for the improved sesame varieties and local ones

Items	Types of sesame technology	
	Adopters (improved sesame)	Non Adopters (Local)
Average yield (qt ha^{-1})	6.2	4.2
Price of sesame(birr/qt)	1000	900
Gross benefit (birr ha^{-1}))	6200	3780
Cost of seed (birr $ha^{-1)}$	78.12	45
Cost of plowing (birr ha^{-1})	600	480
Cost of weeding (birr ha^{-1})	1400	800
Cost of harvesting (birr ha^{-1})	640	160
Cost of thrashing (birr $ha^{-1))}$	240	120
Total cost that vary (birrha^{-1})	2958.12	1605
Net benefit (birr ha^{-1})	3241.88	2175
Marginal benefit (MB))		
Compared with local (birr ha^{-1}))	1066.88	
Marginal cost (MC)	1353.12	
Compared to local (birr ha^{-1})		
MRR (%)	78.84	
Compared with local one		

Source: own survey result data 2010.

4.3.2. Sensitivity analysis

In order to capture the effect of the likely changes of price on marginal benefits, rerunning the marginal analysis with alternative prices is very important (CIMMYT, 1988).The subsequent Marginal benefit is sensitive to the input and output price for year in the future. Hence, it was assumed that the sensitivity analysis is undertaken by moving the prevailing average input price upwards by 15% and the output price downwards by 10% relative to the standard (average) market price under the assumption of market is deregulated both for input and output price and poor infrastructure development. The base for two the scenarios, 15% increase input price and 10% decrease of output price is considering the past price trends history analysis of input and out put price in the study area.Table16. Shows the effect of increasing input price by 15% on net benefits and marginal benefit of improved sesame varieties are presented.

.Table 16. Sensitivity analysis the net income of improved and local sesame with regard the input price increase by 15%

Items	Types of sesame technology	
	Adopters (improved sesame)	Non Adopters (Local)
Gross benefit (birr ha^{-1}))	6200	3780
Total cost that vary (birrha^{-1})	3401.8	1845
Net benefit (birr ha^{-1})	2798.2	1935
Marginal benefit (MB))		
Compared with local (birr ha^{-1}))	863	
Marginal cost (MC)	1556	
Compared to local (birr ha^{-1})		
MRR (%)	55	
Compared with local one		

Source: own computation

Assuming a 15% increase input cost of sesame, the net benefit of the improved and local sesame variety severely decline. Even thought, the net benefit of the both decline the net benefit of adopters of improved sesame (2798.2Birr per ha) was found higher as compared to the local (1935Birr per ha) Thus, the sensitivity analysis shows that by 15% the input cost sesame decline the farmers' MRR declined from 78 to 55 percent.

Table 17 Sensitivity analysis the net income of improved and local sesame with regard the output price decrease by 10%

Items	Types of sesame technology	
	Adopters (improved sesame)	Non Adopters (Local)
Gross benefit (birr ha^{-1}))	5580	3402
Total cost that vary (birrha^{-1})	2958.12	1605
Net benefit (birr ha^{-1})	2622	1797
Marginal benefit (MB))		
Compared with local (birr ha^{-1}))	825	
Marginal cost (MC)	1353	
Compared to local (birr ha^{-1})		
MRR (%)	61	
Compared with local one		

Source: own survey result data 2010

Assuming a 10% decreased in the output price of sesame, the net benefit of the improved and local variety decreased and the marginal benefits obtained from improved sesame decreased from Birr 1066 to 825 per hectare Similarly, a decrease in the output prices of the improved and local sesame by 10% resulted in the severe decline of the net benefits of the improved and local sesame (Table 17). Even though, the net benefits of the both varieties declined the net benefits of the adopters of improved sesame (5580 Birr per hectare) was found to be higher as compared to the net benefits of non-adopters, *i.e*. local sesame (3402 Birr per hectare).

4.4. Perceptions about Relative Advantages of Sesame Technology Attributes

In order to get insight on farmers' decisions of new technology use, looking at their perceptions about each attributes of a given technology is of paramount importance. Hence, knowledge of respondent farmers' evaluative criteria as regard to technology attributes is needed. Through literature review and a participatory process, eight most commonly used attributes by farmers while assessing the desirable qualities of improved sesame variety or seeds in general were identified. These include: yield, drought resistance, seed color, and pod per plants, shattering resistance, disease resistance, marketability and maturity.

Three descriptions, i.e., superior, same and inferior were used to facilitate the comparison by farmers of the recommended improved sesame variety against their local seed(s). Table18 displays the results of the assessment of the perceived improved sesame variety by both user and non-user group.

The results show that more than fifty percent of the sample households perceived that the traits early maturity, seed color, drought resistance, disease resistance, marketability, number of pod per plants and yield of the improved sesame variety are superior to the local ones. However, shattering resistance of the improved sesame variety was perceived as inferior to the local ones. About 61.4% of the total sample households and 71.6% of the adopters perceived the improved variety as earlier in maturity compared to the local one. The chi square test results supported that there a statistically significant perception difference between adopters and non-adopters, implying the association between perception and variety adoption.

The attribute “drought tolerance” is highly associated with the earliness in maturity because those which mature earlier have the possibility to escape drought especially under moisture stress conditions and limits the effects of drought on crop yield, and thus enhances productivity. About, 57.9 % of the total sample households perceived improved sesame variety to be superior to the one with respect to drought tolerance. It is observed that less than fifty percent from both adopters and non-adopters farmer had the perceived that improved variety is inferior to the local with this trait. Again there is a statistical significant difference between adopters and non adopters with respect to the perception of drought resistance at less 5 percent of probability level. Also, 62.1 % of respondents consider the improved sesame Variety Superior to the local ones in terms of yields. More than 50.7% of sample household perceived the attributes of pod per plant of improved sesame superior as compare to the local. The chi square test results for two attributes show that the difference in perception was significant at 1 percent probability level.

Similarly, 57.1 % of the respondents had the perception that the color of this variety is superior in market demand as compared to the color of the local ones. They have strongly underlined that it is very demanded in the domestic and international markets. However, 37.1% of the sample households perceived the improved sesame color it to be inferior in relation to their local ones. This again shows the possible association between perception and the use of the technology.

The perception of farmers with regard to the attributes of shattering, marketability and disease resistance of the variety indicates that 19.4, 76.4 and 57.1 % of the sample households had the perceived improved varieties as superior in comparison to the local cultivars in terms of shattering resistance, marketability and disease resistances, However, 22.9, 17.9 and 35.7 % of sample households perceived as inferior with respect to these attributes. In the comparison between adopters and non adopters with respect to three attributes, chi-square test result shows that there are no statistically significant differences in perception.

The overall survey results show that farmers' perception of advantages of improved sesame varieties attributes shows a high degree of variation. This may be due to differential access to information and differences in information processing capacity may lead to variations in perceptions .This has the potential to affect the eventual adoption of these technologies.

Table18.Farmers'perceptions on improved sesame varieties attributes as compared to the local

Technology Attributes	Description	Farmers Category						
		Adopters		Non Adopters		Total		X^2- value
		N	%	N	%	N	%	
Yield	Superior	48	80	39	48.8	87	62.1	
	Same	8	13.3	25	31.3	31	23.6	14.3*
	Inferior	4	6.71	16	20	20	14.3	
Maturity	Superior	43	71.7	43	53.8	86	61.4	
	Same	8	13.3	25	31.3	33	23.6	6.46**
	Inferior	9	15	12	15	21	15	
Pod per plant	Superior	30	50	41	51.3	71	50.7	
	Same	0	0	11	13.8	11	7.9	10.12*
	Inferior	30	50	28	35	58	41.4	
Drought resistance	Superior	43	71.1	38	47.5	81	57.9	
	Same	4	6.7	4	5	8	5.7	9.9*
	Inferior	13	21.7	38	47.5	51	36.4	
Disease resistance	Superior	38	63.3	42	52.5	80	57.1	1.2
	Same	2	3.3	8	10	10	7.1	
	Inferior	20	33.3	30	37.5	50	35.7	
Marketability	Superior	47	78.3	60	75.3	107	76.4	1.28
	Same	3	5	5	6.3	8	5.7	
	Inferior	10	16.7	15	18.8	25	17.9	
	Inferior	15	25	17	21.3	32	22.9	
Shattering resistance	Superior	26	43.3	35	43.8	61	43.6	1.1
	Same	17	28.3	30	37.5	47	33.6	
	Inferior	17	28.3	15	18.8	32	22.9	
Color	Superior	40	66.7	40	50	80	57.1	
	Same	1	1.7	7	8.8	8	6.1	5.5***
	Inferior	19	31.7	33	41.3	52	37.1	

**, * significant at 5 and 10 % level respectively
Source: own survey 2010

4.5. Farmer- to- Farmer Knowledge/technology Sharing

Farmers demand reliable information that enables them to make informed decision regarding technology adoption to improve production and productivity. With regard to improved sesame production, the producers may need information about the existence of new varieties, their potential economic benefit and methods of applying them and attributes of the recommended varieties like the maturity period. Early maturing sesame varieties are important in the context of the study area as this help reduce drought risk while also significantly increasing the yield level. The development of these varieties is worthless if farmers do not discover the desirable qualities and use the varieties. Therefore, Adoption and diffusion of improved technologies would be successful with an appropriate mechanism of disseminating the information about the technologies.

In Ethiopia, including study area, different formal institutions supply information that can reach the farmer in several ways (e.g. pamphlets, field days, demonstrations, DAs, and association with other farmers). However, the relevance, accessibility and credibility of this information may affect farmers' decision to adopt improved technology. According to Feder et al (1986), often smallholder farm households consider other farmers the most important and reliable source of agriculture information. Therefore, this section summaries the role of farmer to farmer information/knowledge sharing in term of providing relevant and reliable information to rapid and wide spread adoption of new technologies.

4.5.1. Mechanisms of information /knowledge sharing

This sub section reports on the finding of the exploration of farmer-to-farmer knowledge sharing mechanisms. As displayed in Table19, majority of the sample farmers shared the knowledge on improved sesame technology during khat chewing sessions/breaks and/or while working together in the field. Meeting and discussion at market and religious place, and discussion at cooperative meetings are the other important venues and mechanisms for information sharing.

Table 19.Distribution of Sample respondents by methods in knowledge sharing

Knowledge sharing methods	Frequency						Score	Rank
	Mostly		Some time		None			
	No	%	No	%	No	%		
At chat chewing place	80	61	19	15	41	29.3	319	1
Farmers at work	70	50	29	20.7	41	29.3	309	2
Cooperative meeting	45	35	57	44	38	27.1	287	4
Interpersonal discussion	66	51	27	21	47	33.5	299	3
During seed giving out	9	7	24	18	107	76.4	158	5

Source: Own survey, 2010.

4.5.2. Contribution of farmer-to farmer knowledge/seed sharing to adoption

Decision-making is the most crucial undertaken by the farmers to adopt improved technology. The basic input required to make decision is information/knowledge (Burger *et al.,* 1996).The effectiveness of the decision made depends among others on the quality of the information. Here knowledge/information defined as the data for decision making or a resource that must be acquired and used in order to make informed decision.

The contribution of farmer to farmer seed/ or knowledge exchange for the adoption and diffusion of improved sesame varieties are discussed in the following subsection. Their contributions are discussed as source of improved seed and providing quality attributes (relevant, correctness, right frequently) information/ knowledge on the technological package for the adoption decision of the households.

4.5.2.1 As source of improved seed

Two recognized seed system exist in the study area- formal and informal. Formal seed sources involve agricultural development offices, IPMS project and NGOs as major agent. However, these formal seed systems in Meisso are still not well established, and hence, as discussed earlier, among major constraints in improved sesame varieties adoption. Existing limited private seed suppliers focus on cereals like sorghum; and extension technical assistance and input supply specifically targeted the same crop, cereals.

Often, gaps exist in the technology development and adoption chain, between technology developers, adopters, and even between technology leaders and followers. Where a technology has to be adapted to farmers' circumstances and local conditions, there is narrower gap with the farmer-to-farmer technology transfer process. This is because farmers are involved in testing, watching and circulating information and therefore a greater chance of adoption is ensured.

In the effort to bridge the gap between technology generation and adoption, several institutions like research centers ,woreda office of pastoralists and rural development , NGOs and IPMS project were involved in the distribution of short seasoned improved sesame varieties namely, Adi (83-100 maturity days) and Tate (110 -130 maturity days) to the few innovative farmers. On-farm result demonstration method is commonly used to show and convince farmers about the advantages of improved sesame varieties, particularly Tate and Adi. It was assumed that gradually the number of farmers growing the varieties and sharing knowledge and exchanging seeds via sale or gift increased significantly.

The current analysis shows the farmer- to- farmer seed exchange has contributed to the adoption and wider varieties diffusion. This conclusion is justified by the fact that a number of innovative (model /early adopting) farmers shared their knowledge and also gave out some seeds to other fellow farmers (Figure-4) via sale or as a gift to about 47% of the varieties user farmers at the time of the survey. The others 16.7%, 10%, 11.6% and 15% of sesame grower farmers obtained improved sesame varieties directly from local market, office of Agricultural development, NGOs and, IPMS Project through, purchased gift and loan mechanism during survey time. This implies that farmer to farmer seed exchange mechanisms are mostly based on traditional social networks and family relations and can be very effective in the diffusion of technology in the study area.

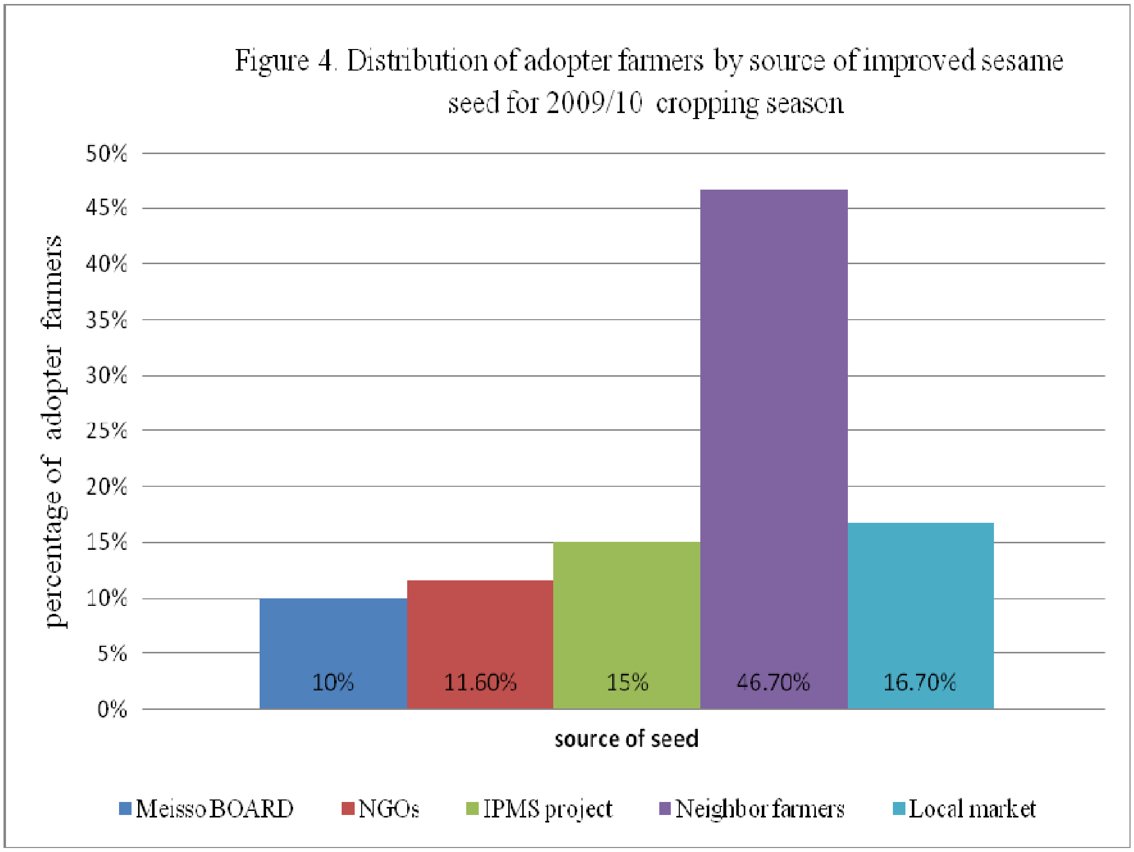

Figure 4. Distribution of adopter farmers by source of improved sesame seed for 2009/10 cropping season

Source: Own survey, 2010

4.5.2.2. Role of farmers Knowledge sharing on adoption decision

Role of farmers to farmer knowledge sharing on adoption decision of improved sesame varieties are assessed in term of the frequency of access to knowledge/information, and perceived relevance and credibility / trustworthiness of the information/ knowledge receive from different sources.

4.5.2.2.1. Knowledge/information sources

Information sources were analyzed to assess the strengths and weaknesses of information source. The Information/ knowledge about innovations which come from relevant source will have differential impact on individual farmer's adoption. This information may come from farmers own experience and/ or external sources of formal institutions. In this study, pamphlets, field days, participation on training, mass media and researchers were considered as the external sources of information for sample households' farmers. Whereas farmers experience visits, farmers to farmer's knowledge sharing network and relatives were informal source of mechanisms. Distribution of respondents on the basis of improved sesame technology information source is described in Table 20.

Table 20.Information source to the respondents in terms of their frequency of use

Information Source	Frequency of access							
	Always		Sometimes		Never		Score	Rank
	N	%	N	%	N	%		
Participation on extension events	45	32.1	30	21.4	65	46.4	260	5
Radio programmes	30	21.6	70	50	40	28.5	270	4
Farmers to farmers	80	57.1	60	42.8	0	0	360	1
Researchers	4	2.8	3	2.1	133	95	155	6
Development agent	40	28.57	80	57.1	20	14.28	300	3
Farmers experience visit	70	50	60	42.8	10	7.1	340	2

Source: Own survey, 2010

There are six main information sources in the area. As explicitly indicated in the Table 20, among the six identified information source, farmer to farmer' knowledge sharing and farmers experience sharing visit which organized by different institutions were perceived as most frequent information sources for sample farmers in the area in their rank order of first and second. Development Agents and rural radio programmes were the third and fourth major sources of knowledge for sample respondents on sesame production managements. As showed in Table 20, the least used information sources were researchers and Participation on formal extension events like training, demonstration and field day which organized by different formal institution found in the area. This is probably because they never had access to them.

Regards to the contribution of farmer to farmer knowledge sharing in the adoption of the improved sesame technology, among the total adopters, 35 (68.2%) of the farmers reported that they used only knowledge/information obtained from fellow farmers. This implies that farmer to farmers sharing information source has a positive effect on farmer decision to adopt improved sesame varieties.

4.5.2.2.2. Perceived importance of information sources

All the identified information sources were not equally important for the sample household, because all of these actors may not give timely related to sesame technology production information. Under this subsection, importance of information sources as perceived by farmers to obtain information on sesame technology was explored and ranked based on their score. Distribution of household respondents based relative importance information source is presented in Table 21.

Table 21.Frequency distribution of knowledge sources in terms of their importance

Source	Importance of knowledge/information sources							
	Very important		Important		Low		score	Rank
	N	%	N	%	N	%		
Participation on Extension events	50	35.7	20	14.3	70	50	260	5
Radio programmes	60	42.9	70	50	10	7.1	330	4
Farmers knowledge sharing network	100	71.4	30	21.4	10	7.1	370	1
Researchers	5	3.5	2	1.4	133	95	155	6
Development agent	40	28.5	80	57.1	20	14.2	300	3
Farmers experience visit	70	50	60	42.8	10	7.1	340	2

Source: Own survey, 2010

As the observation summarized in Table 21 suggests, farmers to farmers' knowledge sharing and farmers experience sharing visits are the most important sources of improved sesame technology. Farmer to farmers knowledge sharing was used most frequently, and that the source could be trusted, reliable, and accessible with minimum transaction costs. The survey result clearly indicates the importance of the relationship among neighbors as source of agricultural information and farmer- to- farmer experience sharing visit is another equally important improved sesame technology information source in the study area. DA and Rural radio programs are the next important improved sesame technology information sources in their order of importance. Further, the respondents perceived that participation on events organized by extension and research were the least important as sources of information on sesame production practices (Table 20). Agricultural extension often focus on progressive farmers rather than poor farmers; and low level of literacy among the producers and inaccessibility of on-farm research trails/ demonstration might also be the reasons for the limited role of extension and research as sources of information in sesame production.

The finding reported here implies that information received from other farmers including through experience sharing visits has more influenced the farmers to adopt the technology. This finding is consistency with other empirical research evidence (Feder, 1985). The latter found that even in areas were social organization and infrastructure exists, farmers prefer their fellow farmers as their primary information source and Feder and Slade (1985) study India shows farmers without access to formal extension service use farmer-to-farmer communication; and most farmers in India preferred fellow farmers as their major source of information despite the existence of Training and Visit Extension System at the time of the study.

According to the result of Deriebe(2007), women farmers in the Dale Woreda put high preference on Neighbors/ friends as first choice followed by other farmers and Das as a third; while the study result of Bekele (2008) in Metu showed that maize package farmers preferred WARDO, neighbors and Das and Kebele Administration as the important sources of information. Thus, the result of this study showed similarity with Deribe's (2007) outcome while there is a slight difference with Bekele's (2008) result whereby WARDO was ranked first.

4.5.2.2.3. Trustworthiness of sources

As Table22 indicates, the information from farmers to farmers' knowledge sharing network, farmers experience sharing visit, development agents, and from rural radio programs, respectively, is the first, second, third and fourth in trustworthiness. The respondent farmers' perceived knowledge obtained from fellow farmers as the most trusted. This is probably because of a strong social capital that exists among neighboring farm households than between farmers and outsiders.

Hence, strengthening farmer-to-farmer knowledge/information sharing mechanisms deserve due attention in extension as it has a profound influence on individuals in the process of adoption and diffusion of agricultural technologies. This finding is agreements with other empirical research evidence (Dessalegn,2008) found that Neighbors, relatives and friends are the crucial networks to influence adoption and diffusion of technologies are because most people trust their social networks than outsiders (they consider DAs or experts as outsiders) who share the same goals and operate the same context. This is also in line with the findings of Bandiera and Rasul (2003) in Mozambique where farmers were more likely to adopt if other people in their network also adopted.

Table 22.Sampled households Perceived trust of information sources of sesame technology

Actors	Perceived trust of knowledge source							
	Highly trusted		Moderate		low		score	Rank
	N	%	N	%	N	%		
Participation extension events	32	22.9	48	34.3	60	42.8	252	5
Farmers experience visit	65	46.4	52	37.1	23	16.4	322	2
Farmers to farmers knowledge Sharing network	120	85.7	20	14.3	0	0	400	1
Researchers/on-farm trial	20	14.3	2	1.4	118	84.3	182	6
Development agent	50	35.7	57	40.7	33	23.5	297	3
Radio programmes	60	42.3	28	20	52	37.1	288	4

Source: Own survey, 2010

4.6. Analysis of the Determinants of Adoption of Improved Sesame Varieties

In this sub-section, the results of the logistic regression model is presented and discussed. It is well known that technology adoption decision of farm households are influenced by different socioeconomic, technical and institutional factors. Different variables are important across different space and over time in explaining adoption of technologies by farmers. Many factors are hypothesized to influence the adoption of improved sesame varieties based on theoretical models and empirical evidence. For the study area, the selection of explanatory variables was done after t test and chi square test to identify variables which are significantly different between improved sesame varieties users and non-users. Accordingly, a total of eighteen (12 discrete and 6 continuous) variables were selected and used for developing and estimating logit regression model (Table 23).

Table 23: Descriptions of variables included in the logit regression model

Variables	Type	Description
H_EDUC	Binary	Farmer educational status, 1 if literate ,0 otherwise
H_SEX	Binary	Sex of households heads, 1 if male, 0 otherwise
EXP	Continuous	Experience of HHs in sesame production(year)
SOCI	Binary	Member of organization, yes=1; otherwise 0
FAMILY	Continuous	Total family size of HHs in man equivalent (ME)
TTLU	Continuous	Total livestock owned by household heads(TLU)
INCOME	Continuous	Total farm income owned by household head(Birr)
LANDSZ	Continuous	Total land holding owned by household head (He)
RADIO	Binary	Radio ownership by HHs, 1 if owned, 0 otherwise
INPUT	Binary	Access to input supply by HHs, 1 if accessed, 0 otherwise
FFKN	Binary	Farmers to farmer information sharing, 1 if shared,0otherwise
DOM	Binary	Hosting on-farm demonstration, 1 if hosted, 0 otherwise
EXPSH	Binary	Experience sharing visit of HHs, 1 if visited,0 otherwise
TRAINI	Binary	Participation of HHs on crop training,1 if partipated,0 otherwise
CREDIT	Binary	Received to formal credit service, 1 if received,0 otherwise
DISTKM	Continuous	Residence distance from near market center (km)
FRECY	Continuous	Frequency of day contact with DAs in last cropping season
PERCEP	Binary	Perception of household head on the attributes of sesame varieties,1 if superior than local, 0 otherwise

Source: own survey, 2009

Prior to running the logistic regression model, the explanatory variables were checked for existence of multicollinearity and the degree of association. Accordingly, a technique of Variance Inflation Factor (VIF) was employed to detect the problem of multicollinearity among the continuous variables. Similarly, contingency coefficients were used to check the degree of association among the dummy variables. It was concluded that there were no multicollinearity and association problems between a set of continuous and discrete variables, as the respective coefficients were very low (less than 10 for continuous variables and less than 0.75 for dummy variables) (Appendix Table 3 and 4).

4.6.1 Descriptive statistics of variables included in the model

Descriptive statistics of both dependent variable and independent variables (mean and standard deviation) in the model are presented in the following table (Table 24).

Table 23.Description and means of variables in the binary logit model

Variables	Mean	Standard Deviations
ADOP	0.43	0.49
H_EDUC	0.53	0.5
H_SEX	0.8	0.2
EXP	25.4	9.4
SOCI	0.47	0.5
FAMILY	3.7	1.44
TTLU	11.48	3.75
INCOME	7905	3466
LANDSZ	2.13	0.84
RADIO	0.51	0.5
INPUT	0.31	0.46
FFKN	0.36	0.48
DOM	0.20	0.40
EXPSH	0.49	0.52
TRAINI	0.33	.47
CREDIT	0.32	0.50
DISTKM	12.6	8.03
FRECY	13.5	4.7
PERCEP	0.67	0.47

Source: own survey, 2010 Note: See Table 22 for variables description.

4.6.2 Econometric results and discussion

The results of maximum likelihood estimation of the parameters are as displayed in Table 25. The various goodness of fits measures were employed to check and validate that the model fits the data well. The chi-square goodness-of-fit test statistics of the model show that the model fits the data with significance at 1% level. This shows that the independent variables are relevant in explaining the farmers' decision to adopt improved sesame varieties.

Another measure of goodness of fit of the model is based on a scheme that classifies the predicted value of events as one if the estimated probability of an event is equal or greater than 0.5 and 0, otherwise. The results show that about 93.1% of the adopters and 92.68 % of non-adopters were correctly by the model. Generally the model correctly predicted 92.86% of the overall sample cases. Thus, the model predicted both adopters and non-adopters of improved sesame varieties accurately.

Out of 18 explanatory variables included in the model, 9 were found to be significant in influencing farmers' decision to adopt or not to adopt improved sesame varieties at 1, 5 and 10 % significant levels. The variables include educational level, sex, family labor supply in man equivalent, sesame crop production experience, total livestock in tropical livestock unit, perception on sesame varieties attributes, farmers to farmers knowledge sharing, farm annual income, and market distance from farmers residence in km (Table 25).

Table 24.Maximum likelihood estimate of logit model results for determinants of adoption

Variables	Coefficients.	Std. Err.	Odds Ratio	t- ratio
EDUC	2.891	0.905	18.013	3.20***
SEX	3.526	1.213	33.992	2.91**
SEXP	0.103	0.051	1.1091	2.00**
FAMLOB	0.585	0.326	1.795	1.79*
TTLU	0.248	0.128	1.282	1.94*
RADIO	-0.075	0.909	0.927	-0.08
INPUT	0.560	0.890	1.752	0.63
LANDSZ	0.429	0.498	1.5361	0.86
SOCI	-0.373	0.819	0.688	-0.46
FFKNW	2.382	1.034	10.833	2.30**
DOMNS	0.558	1.186	1.7481	0.47
EXPSH	0.269	0.784	1.309	0.34
TRAINI	-1.341	1.064	0.261	-1.26
CREDIT	-0.603	0.854	0.547	-0.71
FAINCOME	0.0003	0.00012	1.0003	2.40**
DIST_KM	-0.121	0.059	0.885	-2.03**
EXTCON	0.223	0.276	1.250	0.81
PERCEP	2.027	0.899	7.592	2.25**
CONS	-16.819	4.189		-4.01***

Number of observation	140
LR $chi^2(18)$	125.05***
Prob > chi2	0.000
Log likelihood	-33.7748
Over all model prediction (%)	92.86
Over all prediction of Adopters	93.10
Over all prediction non adopters	92.68

***, **and * significant 1%, 5% and 10% level, respectively

Source: model results (2010)

The 9 explanatory variables which have been found to significantly influence the decision by the sample farm households with regard to whether or not to adopt improved sesame varieties are interpreted and discusses below.

Sex of household head (SEX): As expected, sex of household head, i.e., being male-headed household has a positive and significant relationship (at 5% level) with the probability of adoption of improved sesame varieties. The odds-ratio in favor of adopting improved sesame varieties, other factors being kept constant, increases by a factor of 34 with the change in sex of the head from female to male. The positive sign implies that male-headed households tend to adopt the varieties more than their female counterparts. This may be due to relatively better access of male-headed households to information and agricultural resources than females' household heads. The result is in line with the finding of similar studies (Mulugeta *et al.*, 2001; Techane, 2002).

Family labor supply (FAMLOB): As expected, family labor supply has also a positive and significant relationship (at 5 % level) with probability of adoption of improved sesame varieties. The odds-ratio in favor of adopting improved sesame varieties, other factors kept constant increases by a factor of 1.8 as family labor supply increases by one man equivalent for an average farmer. The positive relationship implies that the households with large family labor supply are more likely to adopt improved sesame varieties than households with small family labor supply. This may be due to large family may provide labor for planting new sesame in drilling and weeding. The model result confirms that. The result is agreed with the priori expectation and the findings of Lelissa (1998) and Techane (2002).

Level of education of household heads (EDUC): As expected, education level of household head has a positive and significant relationship (at 1% level) with the probability of adoption of improved sesame varieties. The odds-ratio in favor of adopting improved sesame varieties, other factors kept constant increases by a factor of 18.1 for the farmer whom assumed household heads become literate than that who did not. This implies that the educated farmers are more likely to adopt improved sesame varieties than those who are not educated. This may be due to relatively educated farmers have more access to information and they become aware to new technology, and this awareness enhances the adoption of technologies. This result is consistent with finding of Asfaw et al. (1997), Bekele et al. (2000) and Tesfaye and Alemu (2001).

Sesame production experience of the HH head (SEEXP): As expected, sesame crop production experience has a positive and significant relationship (at 10 % level) with probability of adoption of improved sesame varieties. The odds-ratio of 1.1 for sesame crop production experience implies that other things being kept constant, the odds-ratio in favor of adopting improved sesame varieties increases by a factor of 1.1 as a farmer' sesame crop production experience increases by one year. This implies that farmers who have longer years of experience in sesame crop production have adopted improved sesame varieties than those who have the lower years of experience in sesame crop production. This may be due to relatively farmers who have longer years of experience may develop the confidence in handling the risk, skills in technology application. Many studies supported this argument. For instance, Legesse (1992), Kidane (2001) and Melaku (2005) have reported farming experience positive and significant relation with adoption. In contrary, Ebrahim (2006) found that farming experience is to have negative relationship with over all dairy adoption. However, Chilot (1994) and Rahmeto (2007) reported that farming experience has no statistically significant relationship with adoption.

Distance to market center (MKT_DIS): As expected, distance to market center has also a negative and significant relationship (at 10 % level) with probability of adoption of improved sesame varieties .The odds-ratio of 0.9 for market distance implies that other things being kept constant, the odds-ratio in favor of adopting improved sesame varieties decreases by a factor of 0.88 as the market distance increase by one kilometer. The implication is that the longer the distance between farmers' residence and the market center, the lower will be the probability of improved sesame varieties adoption. This may be due to relatively Proximity to market also reduces marketing costs. This result is consistent with other studies by Berhanu (2001); Tesfaye *et al*, (2001) and Kebede (2006).

Farmers' perception of improved sesame varieties attributes (PERC): It is the sum of eight perception variables (yield, disease resistance, marketability, drought resistance, and pod per plant, maturity, color and shattering resistance).It is equally important in considering the determinants of adoption decision. As prior expected, this explanatory variable has a positive and significant relationship (at 10% level) with probability of adoption of improved sesame varieties. The odds-ratio in favor of adopting improved sesame varieties, other factors kept constant increases by a factor of 26.5 for the farmer whom assumed household heads become perceived the attributes of improved sesame varieties superior to the local cultivars than that that did not. Earlier adoption studies omitted farmers' perception of technology attributes and there might have biased the results of factors conditioning adoption decisions against this variable. But nowadays adoption studies (Wubeneh, 2003) considering farmers' perception of technology attributes have found that these attributes condition the adoption choices of farmers. Farmers have subjective preferences for technology characteristics (Adesina and Zinnah, 1993) and this could play major roles in adoption.

Farmers to farmers' knowledge sharing (PFFK): As expected, farmer to farmers knowledge sharing has a positive and significant relationship (at 5 % level) with probability of adoption of improved sesame varieties. The odds-ratio in favor of adopting improved sesame varieties, other factors kept constant increases by a factor of 10.8 for the farmer whom assumed household heads become participated in farmers to farmers' knowledge sharing network than that who did not. The positive relationship indicates that, the odds ratio in favor of the probability of being adopters' increases with an increase in farmers to farmers knowledge sharing. This may be due to the interpersonal communication with others farmers and neighbors improve farmers' innovativeness' and motivates them to adopt improved sesame varieties. This study is in consistent with the study of Nathaniels (2005) which indicates that, farmers to farmer extension in Benin that farmer's shared knowledge seed along kinship, with friends and neighbors than formal extension organization.

Total farm income (FAINCOME): Household's total farm income has a positive and significant relationship (at 10 % level) with probability of adoption of improved sesame varieties. The odds ratio1.0 implies that, other things being constant, the odds ratio in favor of being adopter's increases by a factor of 1.0003 as farm income increase by one unit of Ethiopia birr. This implies that a farmer who has better income will be more likely to adopt improved sesame varieties. This may be due to the resource demanding nature of sesame production activity particularly when the production purpose is beyond the home consumption and for the commercial purpose. Regarding the influence of farm income on adoption, many other studies have also found similar results. For instance, Kidane (2001); Degnet et al. (2001) and Getahun (2004) reported positive influence of household's farm income on adoption of improved technologies.

Livestock holding TTLU): As expected, the variable has a positive and significant relationship (at 10 % level) with probability of adoption of improved sesame varieties. The odds-ratio in favor of adopting improved sesame varieties, other factors kept constant increases by a factor of 1.3 as livestock increases by one TLU. This implies that a farmer who has more number livestock will be more likely to adopt improved sesame varieties This may be due to relatively having more livestock offer a means for a better propensity to buy improved sesame seed and also farmers who have large number of livestock might consider their asset base as a mechanism of insuring any risk associated with the adoption of improved sesame varieties. The same results were reported by Tesfaye *et al.* (2001) and Haji (2003). This implies that livestock holding has an influence on the adoption of new technology in different areas.

4.6.3. Relative importance of significant explanatory variables

All dummy and continuous variables do not have the same level of impact on farmers' decision to adopt improved wheat varieties.The relative importance of the dummy explanatory variables can be seen by examining the changes in probabilities that would result from changes in values of these variables. To rank these factors "typical farmer" is defined by the most frequent values of the dummy variables included in the model. Accordingly, a typical farmer is male (80%), who perceived the attributes of improved sesame varieties to be superior (67.14%) who is literate (52.8%) and who participated farmer to farmer knowldge sharing (64.5%). Thus, the probability that the typical farmer will show interest to adopt improved sesame varieties was computed to be 0.731. The effects of significant dummy variables were calculated by changing their values keeping all the continuous variables at their mean values and the dummy variables at their most frequent values (Table 26).The predicted probabilities show how the likelihood of adoption was affected by changes in the significant dummy variables.

Accordingly, the probability of adoption of improved sesame varieties increased by 0.3939 (or 53.89 %) for those farmers who are typical but who participated on farmers to farmers knowledge sharing. Similarly, the probability of adoption of farmers with a typical but have illiterate is decreased by 0.0824 (11.285%).

The probability of adoption of improved sesame varities decreased by 0.0782 (10.7 %) for those farmers are typical but who percived attributes of imroved sesame varieties inferior to the local one. Moreover, the probability decreased by 0.1524 (20.86 %) for farmers who were typical but who female headed. As a result, one can note the existence of variability among the significant discrete variables in their effect towards the probability of improved sesame varieties adoption.

Table 25.Change in the probability of adoption of typical farmers with regard to dummy variables

Variables	Probability	Change in probability	Percentage (%) change
Typical farmer	0.7310		
Typical farmer but illiterate	0.6486	0.0824	11.285
Typical farmer but participated on farmers to farmers knowledge sharing	0.3371	0.3939	53.89
Typical farmers but female household headed	0.5786	0.1524	20.86
Typical farmers but who perceived attributes inferior	0.6528	0.0782	10.7

Source: own survey result data 2010

The relative importance of the quantitative variables in the adoption decision of improved sesame varieties can be seen by examining variable elasticity, defined as the percentage change in probability of adoption due to change in the value of these variables. The values were calculated for a ‘typical farmer’ and (Table26) depicts the sensitivity of adoption to change in the values of quantitative variables.

For instance, a decrease in distance to the nearest market center by 10% would increase the probability of adoption of improved sesame varieties by 9.989% . By contrast, an increase of liverstock holding by 10% will increase the probability of adoption of improved sesame varieties by25.66%. Similarly an increase in farm income by 10% will increase the probability of adoption of improved sesame varieties by 20.13%. Likewise, an increase in family size man equvalent and sesame crop production experience by 10% will increase the probability of adoption of improved sesame varieties by 16.5 and 21.6% respectively. The sensitivity analysis revealed that the relative importance of the quantitative variables in the adoption of improved sesame varieties is not the same.

Table 26.Change in the probability of adoption of typical farmer with regard to continuous variables

Variables	Probability	Change of probability	Percent change of probability
Average farmer	0.7310		
10% decrease in the distance from market center	0.6579	0.0730	9.989
10% increase in sesame production experienece	0.5725	0.1584	21.67
10% increase in livestock holding	0.5434	0.1875	25.66
10% increase in farm income	0.5838	0.1471	20.13
10% increase in family labor supply	0.6103	0.1206	16.5

Source: own survey result data 2010

5. SUMMARY, CONCLUSION AND POLICY IMPLICATIONS

5.1 Summaryof the Key Finding and Conclusion

In order to increase productivity and production of sesame crop, the research centers in the country have released many improved varieties. Since the establishment of Ethiopia Institute of Agricultural Research (EIAR), particularly during the period 1980 – 2005, about ten improved sesame varieties were developed and recommended for the suitable agro ecology (Hailu, 2005). Besides the technology generation, efforts were also made to promote these technologies in potential areas. Meisso district is among the area where the improved sesame varieties were introduced to improve the income and food security status of farmers.

This study was conducted in order to assess relative financial profitability, perceptions about attributes of sesame varieties, contribution of farmer- to- farmer knowledge sharing to adoption decision and to identify factors that influence adoption of improved sesame varieties and to quantify the relative importance of the various factors.

To address the objective of the study, a three-stage sampling procedure was employed to select the district, 4 peasant associations(PAs) and then a total of 140 sample farm household heads using probability proportion to size random sampling method. The primary data necessary for quantitative study were collected using pre-tested semi structured interview schedule from 140 sample household respondents which are the units of observation of the study. Qualitative data were collected through field visit, personal observations, focused group discussion, informal interview of key informants and *kebele* administration leaders. Secondary data were also collected from the various sources to supplement the data obtained from the survey.

Different analytical techniques were applied to analyze the collected data. Percentage frequency, chi-square and ranking was used to identify Source of information, perceived importance and perceived trust worth of sesame technological package information in the study area and assess farmers' perception about improved sesame varieties attributes. On top of that mean, standard deviation and t-test were also used to compare between the independent variables and farmers' adoption decisions of improved sesame varieties. Binary logit model was employed to identify the determinants of adoption. Partial budgeting analysis was also conducted to assess the financial benefit of improved sesame varieties over the local cultivars.

The results of the survery show that the net income from improved sesame production per hectare was birr 3241.88, while it was birr 2175 for the local sesame cultivars. Therefore, the marginal benefit of improved sesame varieties compared to the local sesame was 1066. 88/ha .This implies that adopters of improved sesame varieties had earned more income than those sesame producing households using local one.

The study reveals that, more than fifty percent of the sample households perceived that the traits early maturity, drought resistance, disease resistance, marketability and yield of the improved sesame variety are superior to the local ones. Where as, shattering resistance of the improved sesame varieties were perceived as inferior to the local variety by most of the sample farm households.

In the study area, majority of sesame growing farmers perceived that knowledge obtained from farmers through farmers to farmers knowledge sharing is highly trusted, relevant and more accessible .This is probably that, most people trust their social networks than outsiders (they consider DAs or experts as outsiders) who share the same goals and operate in the same context. Therefore farmers to farmers' knowledge sharing networks may exert powerful influence on individuals in the process of adoption and diffusion of agricultural technologies.

Descriptive statistical analysis results show that adopters of improved sesame varieties were better educated, male headed households, have more access to farmers to farmer's knowledge sharing network and perceived the attributes of improved sesame varieties more advantagous than the non-adopters of improved sesame varieties and have more access to extension services and more involved in local administration than non-adopters. Moreover, they have more family labor force, livestock ownership, sesame crop production experience, earned farm income and more near to the market center than non adopters.

The logit analysis of the determinants of adoption of improved sesame varieties result indicated that, the probability of adoption of improved sesame varieties is significantly and positively influenced by perception of technology attributes, educational level, sex of household heads, labor force, total livestock ownership, total farm income and farmer to farmer knowledge sharing network ,while distance from near market influence the probability of adoption significantly but negatively .The relative importance of each significant variable on the adoption of improved sesame varieties was quantified using sensitivity analysis. Accordingly, favorable perception about the superior attributes of improved sesame varieties, and increase in liverstock holding,total farm income, labor force, exprience in producing sesame crop, participation in farmer to farmer knowldge sharing, literatcy and sex of household heads were found to increase the probability of adoption of improved sesame varieties. Similarly, a decrease in distance to the nearest market center by would increase the probability of adoption of improved sesame varieties.

In conclusion, from this study one can understand that improved sesame varieties were more profitable than the use of traditional varieties. Hence, adopters have benefited substantially from the use of improved sesame varieties. Farmers' perception of improved sesame varieties attributes is found to be pertinent in gauging the probability of adoption. In addition to this, a farmer to farmers knowledge sharing has contributed to the adoption of improved sesame varieties by facilitating farmers' access to information and improved seed. As demonstrated by the econometric analysis, family labor availability, livestock ownership, sesame crop production experience, education level, sex of households, distance from market center, farmers to farmers knowledge sharing network, perception of farmers on attributes of improved sesame varieties and household total annual farm income were found to be important determinants of the adoption of the improved sesame varieties.

5.2. Policy Implications

On the basis of the results of this study, the following policy implications are suggested as to be considered in the future intervention strategies which are aimed at promotion of sesame production technologies.

In this study, the results of partial budgeting analysis on the net benefit of adoption of improved sesame over the local sesame cultivars showed that improved sesame varieties increased the farmer net benefit .Hence, extension orginazation,NGOs and private sectors dissemination should make the necessary effort to ensure that the benefit of improved sesame varieties is spread to more farmers in the region.

Farmers to farmers knowledge sharing were found to have a positive and statistically significant influence on adoption of improved sesame varieties. Therefore, farmers to farmers' knowledge sharing networks should be strengthening for a wide dissemination and adoption of the varieties.

Sex of the household head was found to be positively and significantly, influencing adoption decision improved sesame varieties. This implies male-headed households were more adopted improved sesame varieties than female-headed households, because female-headed households have less access to improved technologies, land and information than male-headed household that helps for the adoption of improved sesame varieties. Thus, Extension organization, NGOs and private sectors should be empower women farmers through access to financial capital, training. Most

The study revealed that famers'perception on the sesame technology attributes superiority has significantly and positively affected adoption of improved sesame varieties.Therefore, research approaches that incorporate farmers' preferences for various characteristics of sesame in breeding programs and extension strategies that are geared towards providing accurate information for efficient revision of farmer perceptions are needed to raise the adoption rate.

Distance from market center obvisouly increases transportation and other transaction costs related to the sale of farm output and acquization of critical inpurs that would reduce farmers incentives to engaged in agricultural production activities using improve techologies .While the present effort of the goverment to extend the construction of wether road in rural areas is encouraging, improving the existing market center in the locality(which is informal and poor developed) should be given proper attention to enhance the adoption improved sesame technology.

Education was found to be positively and significantly influencing farmer's adoption decision of improved sesame varieties. The diffusion of the technology could, thus, be facilitated through educated farmers to be used as contact farmers, besides improving farmers' level of education.

Farmers experience in sesame crop production was found to be positively and significantly influence adoption decision of improved sesame varieties. Thus, it is important for research, extension organization and NGOs to target experienced farmers during on farm research and improved sesame technology promotion as they can easily understand about the technology which, in turn helps for convincing the other to adopt the technology.

Though the improved sesame crop fetch high market price, the yield of this crop in the *woreda* was found 6.2qt/ha, which is very low compared to the yields 7.2 qt/ha in other areas of the country. The low productivity of crop may strongly associate with the recurrent drought and other factors. Hence, adaptive research special drought resistant varieties, demonstration trials, the irrigation schemes which have already developed by Oromiya resource offices in the Woreda must be strengthening to boost production and productivity.

An appropriate and effectives extension services can encourage farmers to use improved sesame varieties to boost their production and productivity. However, the study result indicated that extension services less impact on farmer's adoption decision of improved sesame varieties. This may be due to less attention given to extension of sesame crop rather than cereals crop by extension organization, NGOs and private sectors. Therefore, Policy makers and other development partners involved in agricultural development have to give more attention to the provision of more effective agricultural services. Furthermore, concerted effort should be done to update the theoretical and practical knowledge of the extension personnel through in service training.

Since more than 46.7% of improved sesame varieties adopters initially obtained seed from others farmers in the form of seed exchange, gift and loan and the formal input supply in the area are very few in numbers. Hence, farmers to farmer's seed exchange need to be encouraged in order to sustainable the informal seed system in the area.

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7. APPENDICES

Appendix Table 1.Conversion Factors Used to Estimate Man-Equivalent (ME)

S/N	Age group	Male	Female
1.	< 10	0.00	0.00
2.	10-14	0.35	0.35
3.	15-50	1.00	0.80
4.	> 50	0.55	0.50

Source: Storck *et al*. (1991)

Appendix Table 2.Conversion Factors Used to Estimate Tropical Livestock Unit (TLU)

S/N	Animals	Live weight (kg)	TLU
1.	Cow	250	1.0
2.	Heifer	125	0.5
3.	Oxen/Young bull	250	1.0
4.	Calves	50	0.2
5.	Sheep and goat	22	0.1
6.	Horse and mule	200	0.8
7.	Donkey	90	0.4

Source: Varviko (1991)

Appendix Table 3. Variable Inflation Factor for the continuous explanatory variables

Variables	Tolerance ($Ri^{2)}$	Variance Inflation Factors (VIF)
SESA-EXP	0.756	1.324
H_FAMILY	0. 769	1.301
T-TLU	0.837	1.195
H_INCOME	0.899	1.113
H_EXT	0.964	1.038
MKT- DIST	0.915	1.093
H_LAND	0.742	1.348

Source: own survey result data 2010

Appendix Table 4.Value of Contingent coefficient for dummy explanatory variables

Variables	1	2	3	4	5	6	7	8	9	10	11
EDU	1										
SEX	0.27	1									
RDIO	0.19	.216	1								
SOC	0.04	0.22	.184	1							
PTRAIN	0.25	0.23	.170	.246	1						
PDEMO	0.18	0.16	.203	.135	.438	1					
PFFKN	0.20	.224	.235	.117	.410	.429	1				
INPU	0.03	.015	.056	.008	.004	.130	.200	1			
FEXPSH	0.20	0.148	0.20	0.07	0.41	0.339	0.227	0.06	1		
CRIEDT	0.20	.118	.122	.117	.308	.175	.194	.067	.200	1	
PERCE	0.10	0.046	0.05	0.05	0.08	0.212	0.036	0.10	0.07	0.2	1

Source: own survey result data 2010