ST.MARY'S UNIVERSITY

SCHOOL OF GRADUATE STUDIES

DETERMINANTS AND INTENSITY OF ADOPTION OF TEFF ROW PLANTING IN MINJAR SHENKORA WOREDA

BY

MESAFINT TEFERA

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A Thesis submitted to school of graduate Studies of St. Mary's University in Partial Fulfillment of the requirements for the Degree of Master of Science in Agricultural Economics.

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This thesis has been submitted to St. Mary's university, school of Graduate studies for examination with my approval as a university Advisor.

Maru Shete (PhD) _____

Advisor **Signature**

DEDICATION

This thesis manuscript is dedicated to my family and my wife Tigist Eshetu who have committed to unreserved moral support, patient, encouragement and responsibility for the betterment and success of my life.

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ACRONYMS

ACIPSU	Access to Technology Input Supply
ATA	Agricultural Transformation Agency
BoARD	Bureau of Agriculture and Rural Development
CREDITACC	Credit Access
CSA	Central Statistical Agency
EDUCAHH	Education Level
FARMEXP	Farmer Experience
FRECONEA	Frequency of Contact with Extension Agent(s)
EIAR	Ethiopia Institute of Agricultural Research
IAR	Institute of Agricultural Research
FGD	Focus Group Discussion
HHAGE	Household Head's age
HHH	Head of Household
LABORAVA	Available Labor
LANDHOLD	Land Holding
MDGs	Millennium Development Goals
MOA	Ministry of Agriculture
MOFED	Ministry of Finance and Economic Development
NOLTLU	Number of Livestock– (measured in TLU)
PAROFA	Participation in Off-Farm Activities
PERRPC	Perception on RP characteristics
SEXHH	Sex oh Household

SOCIALPART	Participation in Social organization
TOANIN	Total Annual Income
TRAIRPT	Training on Row Planting Technology
VIF	Variance Inflation Factor

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ABSTRACT

Teff yield is low in Ethiopia. Adoption of teff row planting is one of the farming practices believed to enhance teff yield in the country. However, there are several household, socio-economic, institutional and socio-pychological factors that limit adoption of teff row planting. This study deals with magnitude and determinants of adoption of teff row planting in Minjar shenkora woreda, Amhara region. A total of 115 farmers were selected with random sampling technique and interviewed in the study area to generate primary data for the study. Focus group discussion was used to generate qualitative data. Logit model for determinants of adoption of teff row planting and Tobit model for intensity of adoption of teff row planting were employed. Out of a total of 15 explanatory variables estimated using the logit model 6 variables were found to be significant to affect the adoption of teff row planting.The tobit model estimated that 7 variables were significant to affect the intesnity/magnitude of adoption of teff row planting. Age of the household, farmers experience, total annual income, access to credit, training and perception are those variables that positively and significantly influenced the likelihood of adoption of teff row planting among farmers. Whereas, education level, farming experience, training, access to technology input supply and perception towards row planting positively and significantly influenced the intensity of adoption of teff row planting. On the other hand, while landholding size negatively affected the intensity of adoption of teff row planting, age of household head and land holding size negatively and significantly influenced adoption of teff row planting. The findings of this study indicated that any effort in improving the adopting of teff row planting technology should recognize the correlates of adoption of teff row planting. Providing education, sufficient training and extension services to farmers, and improving access of farmers to credit and technology input supply, will improve the tendency of farmers to adopt teff row planting technology.

Keywords: Teff row planting technology, adopters and non-adopter, logit model, tobit model, Minjar shenkora, Ethiopia.

CHAPTER ONE: INTRODUCTION

1.1. Background of the Study

Agriculture is the backbone of Ethiopia's economy. It accounts for the lion's share of the total GDP, employment creation and foreign currency earnings. In 2013/14 fiscal year, the sector accounts for about 40.2 percent of national GDP, 80 percent of employment and 70 percent of export earnings (African economic outlook, 2015). Thus, the agricultural sector is crucial for the country's overall economic growth and poverty reduction endeavors.

Despite, agriculture is vital sector for economic growth in Ethiopia, yet production system is traditional, that resulted in low productivity. The sector mainly uses traditional farm implements and subsistence farming system (CSA, 2011). Besides, the majority of people who engaged in the agriculture sector are smallholder farmers who make their living from less than two hectares of land (ATA, 2015). Additionally, population growth led to a decline in the per capita land holding size. In return, this contributed to low productivity of the sector.

Despite the poor performance of the sector, agriculture is believed to be the leading sector that propels growth to the country's economy (CSA, 2011). In recent years, efforts have been made by the Ethiopian government to improve the productivity of the sector through promotion of improved agricultural technologies to farmers. According to ATA (2012), among the different technological packages, the majority of Ethiopian farmers have begun to practice row planting techniques for different types of grains such as teff (Eragrostis tef), wheat (Triticum), maize (Zea mays), barely (Hordeum vulgare) and sorghum (Sorghum bicolor).

Teff is one of the most important staple food crop of Ethiopians and which is believed to be originated, domesticated and diversified in the country. It is gluten free and high in iron and fiber (ATA, 2015). It is the major crops both in terms of agricultural area coverage and total production amount in the country. According to CSA (2013) during the meher season of 2012/2013 year, out of the total grain crop area, teff took 22.23 percent (about 2,730,272.95 hectares). However, in terms of production it took the second rank with 16.28 percent (37,652,411.66 quintals) next to maize 26.63 percent (61,583,175.95 quintals) out of the meher grain production of the same year. Furthermore, teff accounts 15 percent all calories consumed (MOA, 2011; cited in berhe, 2014),

and it is a daily food stable for about 60 percent of the total population, while teff straw is a high value for animal fed (ATA et al, 2013b).

However, until recently, the productivity of teff as per hectare is very low when it compare with other kinds of cereal crops. According to CSA (2013) during 2012/2013 meher season, teff accounts 13.79 quintal per hectare, while maize, rice, wheat, sorghum, and barley accounts 30.59 quintal per hectare, 21.10 quintal per hectare, 21.06 quintal per hectare, and 17.49 respectively. Different reasons a traditional cultivation method has contributed to teff's low productivity and quality.

Among the major bottlenecks that hampered teff crop's productivity, traditional way of planting operation contribute a lot. Hand broadcasting teff seeds is problematic to make sure a uniform spacing. Furthermore this practice hinders intercultural practices, and results sowing at high seed rates per hectare (ATA, 2013a). Beside the above mentioned reasons, there was a a limited international attention towards research on improved teff technologies mainly because of the teff crop having only local importance (Berhane et al. 2011; Fufa et al. 2011).

To address this challenge, In recent years, a joint effort have been made by the ATA and MoA to improve teff productivity and straw yield by introducing new technologies such as row planting, transplanting, reduced seed rates, improved seed adoption and improved fertilizer application (ATA et al, 2013b).

Moreover, in 2011 new concept known as TIRR (teff, improved seed, reduced seed rate, row planting) was introduced; This new innovative productivity enhancing package promote to reduce seeding rate by 90 percent to use only 3 - 5 kg teff seed per hectare and planting the seeds in rows with 20 cm spacing, which resulted 70 percent average yield increase over CSA national average (ATA, 2015).

Furthermore, several attempts are made to assist the agricultural technologies adoption process through extension program[1]. But ensuring farmers receive extension services and access to

[1]*The extension programme mainly focuses on assisting small-scale farmers to improve their productivity through disseminating research-generated information and technologies. It has been widely accepted by a large number of farmers across the country. It is obvious that, as the number of participating farmers in the extension programme increases, the demand for agricultural inputs also increases at a considerable rate. (http://www.ethioembassy.org.uk/fact%20file/a-z/agriculture.htm, accessed 12,19,2015)*

adequate information remains challenging (Ibid, 2015). But still row planting for teff production is not widely adopted.

The study area, Minjar shenkora woreda is one of the well-known teff producer in Ethiopia. According to the woreda level crop production ranking in Ethiopia done by IFPRI (2015), based on teff production in the years of 2009 – 2013, the study area (minjar shenkora woreda) ranked seventh.

This study was conducted on minjar shenkora woreda on magnitude and determinants of adoption of teff row planting (intensity of adoption of teff row planting, factors that limits row planting practice and some related issues).

1.2. Statement of the Problem

The adoption of more efficient farming practices and technologies that enhance agricultural productivity like row planting is seen as best crops production practice by different agricultural policy makers and extension personnel.

In an effort to improve teff productivity and production, after conducting a large scale trial and demonstrations of this new technology during the main planting season of 2011, the Ministry of Agriculture (MoA) through Regional Bureau of Agriculture (RBoA) had introduced teff row planting in 2012 all over the regions. It's true to the study area too.

However, since the introduction of the technology in the country, contrary of the efforts of the extension system, the introduced teff row planting technology are not widely accepted by farmers. According to Minjar Shenkora district Agricultural office report, teff row planting adoption is very low and recently it decreased a lot (MSDARDB, 2016). Out of total teff lands which were cultivated during 2015 main season (meher), 32.7 % or 5,391 hectares of land was covered using row planting technology. Whereas, last year report revealed that only 5.7 % or 763 hectares of teff land was covered with row planting method.

Number of studies has been undertaken to know more about row planting technology adoption in different parts of the world and very few in Ethiopia.

As far the knowledge of the researcher is concerned; only very limited researches on factors affecting farmers' adoption intensity of teff row planting technology were conducted in the country, and one was conducted in the study area in 2014, two years after row planting technology had been introduced for the first time.

The study conducted by Behailu (2014) on factors affecting adoption level of row planting technology and yield improvement on the production of eragrostis teff [ZUCC.]: the case of Minjar Shenkora Woreda, Amhara region of Ethiopia underline those factors such as, education level, age, gender, household size, land holding size, soil type, farmers level of training, access to extension services, the effectiveness of trainings, technological factors (Application simplicity of broadcast planting method, teff seeding time, teff seeding space and depth, application of packages with row planting and availability of row seeder machine Quality of teff straw) affected farmers adoption decision.

Unfortunately, Behailu used only simple descriptive statistics such as percentage, mean, frequency and cross tabulation for his analysis. But, descriptive statistics often fail to predict the combined effect of the explanatory variables on the dependent variable (Aldrich and Nelson, 1984). Thus, this gap is to be bridged by the help of selecting and using appropriate econometric models. So, in order to alleviate the problem of teff row planting adoption intensity, scientifically and statistically analyzed findings are very important rather than giving scattered and unreliable information.

The researcher believed that, by applying appropriate econometric models analyzing the factors affecting adoption and magnitude of adoption which could fill the knowledge gap and help the policy makers as well as the local government to prioritize the most pressing factors that limit the farmers not to adopt agricultural technologies, specifically teff row planting is very essential. Therefore, this study looked into the determinants of the magnitude of teff row planting adoption specifically i) To identify factors that affect adoption of teff row seeding technology; and ii) To assess factors that affect intensity of teff row seeding technology practice in Minjar Shenkora wereda, Amhara region.

1.3. Objectives of the Study

The general/overall objective of the study was to find out the determinants of the magnitude of row planting adoption in teff in minjar shenkora wereda. The specific objectives are:

1. To investigate the attitude and willingness of the farmers' adoption of row planting.
2. To assess the intensity of adoption of teff row planting and explore the main factors that limits row planting practice in the study area.

1.4. Research Questions

Based on the objectives listed above, the following research questions are prepared:

1. What is the attitude and willingness of farmers to adopt row planting?
2. What are the main factors that limit adoption of teff row planting practice in the study area?
3. What are the main factors that limit the magnitude of adoption of teff row planting practice in the study area?

1.5. Significance of the Study

By pointing out the factors that influence row planting technology adoption in teff, this study will add knowledge on which the determinant factors have the greatest influence on magnitude of teff row planting technology adoption. Since it is a new agricultural technology to the study area and the country as well, the study will provide an insight and valuable information for policy makers, research and rural development institutions and extension staffs that help them improve the magnitude of teff row planting technology adoption process. This study will attempt to reveal the fundamental factors which may account for the variations in the adoption intensity of row planting technology among the farmers in Minjar shenkora wereda. Therefore, once after this study conducted, all agricultural development actors including extension practitioners, agricultural researchers, rural development offices, agriculture research institutions, policymakers who work on formulation of agriculture policies, planner of minjar shenkora woreda as well as Amhara region and other development agents will be informed the main determining factors that affect the intensity of teff row planting adoption in order to tackle the challenges, and equip farmers with

appropriate solutions. In addition, the study can also serve as a supplementary source to conduct detailed studies by identifying some other research agenda.

1.6. The Scope and Limitation of the Study

This study was undertaken in Minjar shenkora Woreda, which is found in Amhara region. The adoption of new technology is influenced by many factors. A factor which is found to enhance adoption of a particular technology in one locality at one time might be found to hinder it or to be irrelevant for adoption of the same technology in another locality at the same or different time for the same or technology or the other way round. From these inconsistent results it is difficult to identify universally defined factors either impeding or enhancing adoption of technology. In addition to this, there are other limited factors like time, finance and human resources that restrict this study to the above-mentioned woreda.

1.7. Organization of the Thesis

The organization of the paper will be as follows. The first chapter is dedicated for brief introduction; the second chapter is review of literature on value chain analysis from different sources. The third chapter is methodology of the study, fourth chapter is discussion and analysis of results and fifth chapter is conclusion and recommendation.

CHAPTER TWO: LITERATURE REVIEW

2.1. Theoretical Review

2.1.1. Definition of Row Planting

Row planting as applied in conventional horizontal farming or gardening is a system of growing crops in linear pattern in at least one direction rather than planting without any distinct arrangement. According to ATA (2015), planting in row helps to reduce plant density and eases weeding, spraying and fertilizer application, making for fewer but stronger plants, producing more stems and grain. It can also help prevent plants from falling over, a common problem with teff. Another huge advantage for farmers is the reduced cost of seed due to the smaller volume required.

2.1.2. Definition and Concept of Adoption

Rogers (1983) defines the adoption process as the mental process through which individual passes from first hearing about an innovation or technology to final adoption. This indicates that adoption is not a sudden event but a process. Farmers do not accept innovations immediately; they need time to think over things before reaching a decision. In other words, Adoption is not the final event of change but rather a decision-making process. Individuals pass through various learning and experimenting stages from becoming aware of a problem and its potential solutions to finally adopting or rejecting the innovations under considerations.

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. Dasgupta (1989) noted that adoption, however, is not a permanent behavior. This implies that an individual may decide to discontinue the use of an innovation for a variety of personal, institutional, and social reasons one of which might be the availability of another practice that is better in satisfying farmers' needs.

Feder *et al*. (1985) classified adoption as an individual (farm level) adoption and aggregate adoption. Adoption at the individual farmers' level is defined as the degree of use of new technology in long run equilibrium when the farmer has full information about the new technology and it's potential. In the context of aggregate adoption behavior they defined diffusion process as the spread of new technology within a region. This implies that aggregate adoption is measured by

the aggregate level of specific new technology with a given geographical area or within the given population.

The increasing interest in innovation and adoption of new technologies is primarily because these innovative technologies improve the key economic factors of productivity and efficiency (Hategekimana and Trant, 2002). Moreover, technology is a means to improve the socio economic conditions of the society. It is in the diffusion state that new technologies produce impact on the economy (Feder, Just, Zilberman, 1985). Being the first to adopt a new, efficient technology means, being able to enjoy the gains before rivals. In other words, technical changes improves the productivity and the extent of this effect is very much a function of the diffusion process, which in turn depends upon the rate of adoption of innovative technologies. Therefore it is important for both the firms and policy makers to understand the rate of adoption of innovative technologies in order to evaluate the potential impact of technical change on the economy's overall productivity.

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

2.1.3. Overview of Agricultural Technology Adoption Pattern and Factors Affecting Adoption of Technologies

Agriculture is a way of life to many subsistence farmers and other farmers are in constant search of ways in which to improve upon their lives. In agriculture context, adoption is a decision made by an individual to start using new agricultural innovations with the aim to increase productivity. This might be a new crop variety or management practices adopted by an individual, family or corporation. Adoption of agricultural technologies is considered as one of the ways that offer opportunities for improved agricultural production and hence improved life (Niyegela, 2007).

The technology must be widely adopted in order to self-sustain. Within the rate of adoption, there is a point at which agricultural technology reaches critical mass. The categories of adopters are: innovators, early adopters, early majority, late majority, and laggard. Innovators (2.5%) – had larger farms, were more educated, more prosperous and more risk-oriented, early adopters (13.5%)

– younger, more educated, tended to be community leaders, less prosperous, early majority (34%) – more conservative but open to new ideas, active in community and influence to neighbours, late majority (34%) – older, less educated, fairly conservative and less socially active, laggards (16%) – very conservative, had small farms and capital, oldest and least educated. Level of adoption of technology manifests itself in different ways in various cultures and fields and is highly subject to the type of adopters and innovation-decision process (Rogers, 1983).

The factors affecting technology adoption in agricultural technologies are classified in farmer characteristics, farm structure, institutional characteristics and managerial structure (Blazy, 2008). Evidence from previous studies shows that, the critical role that underdeveloped input supply and marketing systems play on input choices and technology adoption in smallholder agriculture (Shiferaw et al., 2008). Access to credit service, extension visit and source of information could affect the adoption of new innovation by the farmers. The need to provide credit services to the farmers to empower them so as to acquire inputs which will enhance their adoption of new technologies (Okunlola, 2009). Farmers` participation in trainings and visits has made them to achieve relevant and timely information about agricultural production could motivate them to adopt agricultural technology (Kafle, 2011).

2.2. Approaches for Assessing Intensity of Technology Adoption

Technology adoption literature provides a variety of approaches to analysis of agricultural technology adoption decisions. The most common approach is the binary choice (logit and probit) models where farmers are categorized as being either adopters or non-adopters (Bett, 2004). In such cases, the dependent variable takes a value of one for adopters and zero for non-adopters (Fernandez-Cornejo et al., 1994; Burrows 1983 and Harper et al., 1990). The logit and probit models differ in the type of distribution followed by the error term. If the cumulative distribution of is logistic, we have the logit model but if it is normally distributed we have the probit model. The logit and probit models yield almost similar results, but the logit model is computationally easier than the probit model.

In situations where the dependent variable is discrete or continuous, it is desirable to quantify intensity of adoption either as a count of the number of components adopted (Ramirez and Shultz 2000) or the area of land allocated to the technology under study. One of the models used for

assessing intensity of technology adoption, when the dependent variable is continuous, is the tobit model. There are others available for the analysis of technology adoption intensity. But, the situations are a little bit different. For example, in situations where the intensity of adoption of a technology is measured as a count of technology components used by a farmer, the dependent variable takes discrete non-negative integer values. It is therefore desirable to use the count data regression models to assess the factors influencing intensity of adoption of such technologies (Greene, 2007).

2.3. Review of Empirical Studies on Adoption of Agricultural Technologies

Feder et al. (1985) summarized the vast amount of empirical literature on adoption and indicated that the constraints to adoption of a new technology may arise from many sources, such as lack of credit, inadequate farm size, unstable supply of complementary inputs, limited access to information, uncertainty and so on. Schultz (1995) suggested many testable hypotheses: that the probability of adoption of a new technology will depend on the difference in profitability between the new and old technologies, and the ability of the farmer to perceive the advantages and efficiently utilize the new technology.

2.3.1. Adoption of Improved Agriculture Technologies

A wide range of economic, social, physical, technical and institutional aspects of farming influences the adoption of agricultural production technologies. In a review of adoption of agroforestry technologies, Pattanayak et al (2002) established that there were five basic categories of determinants of adoption. These were farmer preferences, resource endowments, market incentives, biophysical factors and risk and uncertainty. Farmer preferences include risk tolerance, conservation attitude and intra-household homogeneity. But since these are difficult to model, proxies such as age, gender, education and social status are used instead. Resource endowments include assets which a household has such as land, labour, livestock and earnings. Market incentives relate to either lowering of costs or increase in benefits from adopting the technology. Economic determinants include issues such as prices, transport availability, availability of markets and potential losses or gains. Thus, the likelihood of a factor to increase the net benefits associated with the technology is likely to have a positive influence on adoption. Biophysical factors relates to the physical production process such as soil quality, slope of farmland and plot size. Lastly risk

and uncertainty reflect the unknowns in the market and institutional environment under which decisions are made. Fluctuation in rainfall pattern, commodity prices are some of the risks incurred.

Recent adoption studies in Europe, Asia and Africa have identified farm and technology specified factors, institutional, policy variables and environmental factors to explain the patterns and intensity of adoption. For example, Oladele (2005) highlights that some studies have shown strong and positive correlation between farming size and adoption while others have shown a positive and significant association between age, farming experience, training received, social-economic status, economic motivation, innovativeness, information source and adoption. Other studies have however shown household size not significantly related to adoption.

People and institutions both outside and inside Ethiopia have conducted empirical studies on the adoption and diffusion of agricultural innovations. But the studies were mainly different concerned with the types of technology adopted and thus, studies conducted in adoption of row planting particularly adoption of teff row planting are very limited. In general, the variables so far identified as having relationship with adoption are categorized as household, personal and demographic variables, socio-economic, economic and institutional.

Legesse (1998) studied adoption and diffusion of agricultural technologies in East and West Shewa zones using probit and Tobit models and found that location, oxen ownership, distance to market, credit, gender and degree of risk aversion had significant impact on the adoption decision of the new technologies. But education and the index of awareness had no effect on the adoption decision. He also found that the impact of increase in output price on the probability of adopting modern technology is very high.

The study conducted by Lelissa (1998) on determinants of fertilizer adoption, intensity and probability of its use in Ejere district, west Shoa zone of Ethiopia has also shown that agro-climatic conditions, access to credit, extension service, oxen ownership, age of the farmer, family size, farmers' level of education, distance to fertilizer distribution center and cropping pattern are the most important determinants of fertilizer adoption and intensity of its use.

Getahun Legesse (2013) in his study, which is conducted to understand the determinants of adoption and intensity of use of vetiver grass technology in Mettu district, the results of the

econometric tobit model indicate that, perception to characteristics of vetiver system, cultivated land holding of household head, farming experience of the household, level of aspiration, and training on vetiver system were among the main factors which have positive and significant influence on adoption and intensity of adoption of vetiver system technology package. The finding suggests that, the concerned bodies at zonal and woreda level should give attention mainly towards attitudinal change and give large portion on their training programs.

The logit model result of a study conducted by Belete Meseret (2015), to assess the factors affecting adoption of broad bed maker technology in east gojjam zone, Enebsie Sar Midir district underline those factors such as vertisol farm size, participation in training, access to credit and households' attitude affected farmers adoption decision positively and significantly. On the contrary, farm distance of plot from home was negatively and significantly affects BBM adoption.

2.3.2. Adoption of Row Planting

The objective of the row planting program is to increase farm production and productivity through creation of awareness and technology adoption. However, the adoption decision of farmers and intensity of use of improved technologies are determined by many factors. The factors documented in literature include farming household specific characteristics, available farm resources, and access to credit, information and market. For example, Ethiopian Development Research Institute (EDRI) conducted a rural survey in 2001/2002 covering 1920 households in four regions (Tigrai, Amhara, Oromia and Southern People and Nationalities) to evaluate the progress made in adoption and diffusion of agricultural technologies through Participatory Demonstration and Training Extension System (PADETES). The result of the analysis shows that:

- ✓ Farmers with larger land holding are more likely to adopt technologies as compared to those with small land holding.
- ✓ Older farmers have lower probability of adopting new technologies.
- ✓ Information (extension contact) is found to be crucial determinant for technology adoption.
- ✓ Literacy level, proximity to extension service center and availability of family labor has shown positive relationship with rate of technology adoption

Several studies have been done on adoption of row planting. For example Geremew et al. (2016) used bivariate probit model to assess factors determining and influencing smallholder farmer's

adoption and continuous application of teff row planting method in Wolaita zone and found sex of household head, number of adult equivalent, total land size owned, tropical livestock unit and number of trainings attended by farmers found to be positively and significantly influences the intensive use of teff row planting; Whereas, household head's farming experience, number of plots owned and better access to off-farm income negatively and significantly influences the continued use of the specified technology in the study area. The finding on access of trainings suggests that, in order to address the factors which affect the decision to use a technology continuously, strengthening the extension system is expected from the local government, and increasing the number of training and field visits should be given priority.

The binary logistic regression results of Worku and Yishak (2016) study indicate that sex of the household head, household size, and education status of the household heads, oxen ownership, and participation in agricultural training significantly affects the adoption of wheat row planting technology.

Tolesa Alemu (no date) also used logit model to assess the socio-economic and institutional factors limiting adoption of wheat row planting in Ethiopia and found that access to improved seed and agricultural extension services, educational level of household head, and livestock holding size were the factors that positively and significantly influenced the adoption of wheat row planting. The agricultural extension offices need to give due attention to household's access to improved wheat seed and extension services for improving or increasing adoption of wheat row planting. Successful adoption and scaling up of wheat row planting also needs improvement in household's educational status and livestock holding sizes.

The dependent double hurdle model results of Tadele (2016) study indicate that household being headed by illiterate head, family size (in man equivalent), farm size, annual off-farm income, distance to nearest market and training on row planting significantly influenced adoption and level of adoption of row planting. In addition to this, adoption of row planting is significantly affected by farming experience, number of information sources and distance to DA; whereas level of adoption of row planting by livestock (in TLU) and Number of oxen. This finding imply that row planting adoption and intensity of use of farmers should be improved by raising their education, optimally mobilizing their family members, raising their off farm income, raising farm household endowment and providing extension service.

2.4. Teff Crop

Teff is traditionally harvested grain in Ethiopia, where it was first domesticated between 4000–1000 BC (Rose, 2011). Teff flour is preferred in the production of injera a major staple food in Ethiopia (Gambao and Ekris, 2008). Teff is grown on a limited basis for livestock forage in other parts of Africa, India, Australia and South America. In the United States, small acreages of teff are grown for grain production and sold to Ethiopian restaurants throughout the country (Slavin, 2008). Teff grain is sold in some grocery stores as well (Zenk, 2005). A recent follow-up article has documented increased national interest in the crop is changed in a dynamic way (Zenk, 2008).

Ethiopia is the center of origin and diversity for teff that is highly adapted to diverse agro-ecological zones including conditions marginal to the production of most other crops (Stallknecht et al., 1993). It can grow from sea level up to 3000 meter above sea level. Teff is cultivated in high rainfall areas with long growing periods (Costanza et al., 1979). It can also be grown in low rainfall and drought prone areas characterized by protracted growing seasons and frequent terminal moisture stress; that tolerates reasonable levels of both drought and water logging better than most other cereals. Teff grows on various soil types ranging from very light sandy to very heavy clay soils and under mildly acidic to slightly alkaline soil conditions. The cultivation of teff in Ethiopia has partly been motivated by its relative merits over other cereals in the use of both the grain and straw (Miller, 2010).

The main use of teff is as a cereal grain used for human consumption in African countries because of the attractive nutritional profile of the grain with an excellent amino acid composition, and lysine levels higher than wheat and barley (Slavin, 2008). It contains no gluten and is high in dietary fiber, iron, phosphorus, copper, aluminum, barium, and thiamin. It has a sour taste and is similar to millet. In Ethiopia, where it is thought to have originated, to provides over two-third of the nutrition in the country (Gambao and Ekris, 2008). The economic importance of the crop is mainly as a human food (Roseberg et al., 2007). It has been also used for environmental purposes in erosion control in Africa. Teff provides a major source of human nutrition in the horn of Africa, but biotechnology has had little impact on its improvement to date (Zenk, 2008). Generally, teff has long history in Ethiopia which is mainly producing for human food and animal feed due to agro-ecological suitability and other factors to the nation.

2.4.1. Teff Crop Production in Ethiopia

Teff accounts for about a quarter of total cereal crop production in Ethiopia. According to USAID (2012) teff is currently the most expensive grain in Ethiopia because it requires labor-intensive harvesting and processing techniques, while producing the lowest yield per hectare of all cereal crops. Economic indicators unveil that teff is the most dominant cereal crop in Ethiopian agriculture. For instance, in 2010 cropping season, it was estimated that a total of 3.2 million tons of teff has been produced on 2.59 million hectare of land (CSA, 2010). This is equivalent to 20.50 and 28% of the total cereal crop production and acreage in the country respectively. This makes teff the leading crop among cereals and even among other annual crops.

Teff is Ethiopia‟s most important cereal crop, but the national average yield level is low. One of the presumed reasons is that current agronomic practices constraining teff productivity. By planting seed in rows at a low seed rate instead of the traditional practice of broadcasting seed at a high rate, yield is shown to improve significantly on-station. Field demonstrations of row planting of teff showed that yields increase on average by 70% compared to the national average (ATA, 2013). Consequently, these new production technologies are being promoted to Ethiopian teff farmers on a large scale.

In 2011/12 production season, it was estimated that teff made up of 20% of all the cultivated area in Ethiopia, covering about 2.7 million hectares and grown by 6.3 million farmers. The second most important crop was maize at 15% of all cultivated area. However, given the relatively low yields of teff; the total national production of teff is 3.5 million ton which was lower than maize with 6.1 million ton and sorghum with 3.9 million ton (CSA, 2012). On the consumption side, teff is more readily eaten by urban households than by rural households. Guush et al. (2011) show that, relying on national household consumption data that urban consumption per capita is as high as 61 Kilogram per year. This compares to 20 Kilogram per capita per year for rural areas. Teff is therefore an economically superior crop commodity that is relatively more consumed by the rich than by the poor. The lower consumption by the poor is also partly explained by the high prices of teff which are typically twice as high as the price of maize (Minten et al., 2012).

Teff is resistant to extreme weather conditions, as it is able to grow under both drought and waterlogged conditions (Minten et al., 2013). Combined with its low vulnerability to pest and

diseases, it is considered as a low risk crop (Fufa et al., 2011). In Ethiopia, teff is sown during the main summer rainy season between July and August, while harvesting is done in most cases in November and February. Seeds are broadcasted on a well ploughed soil and lightly covered with soil until germination. During the growing period, several weeding are often required (Assefa et al., 2011)

Teff has enormous potential for growth as it has been given very little attention in research, development and public support (CSA, 2013). Additionally, it has remained an important crop to Ethiopian farmers for several reasons, namely: the price for its grain and straw are higher than other major cereals; the crop performs better than other cereals under moisture stress and waterlogged conditions; its grain can be stored for a long period of time without being attacked by weevils. Increased productivity is believed to contribute about 6% of the growth while about 5% was attributed to expansion in area cultivated to teff. So a reasonable conclusion that can be inferred from the literature is that, the current or existing level of technology and factor endowment, there is a potential to boost agricultural output like teff production by improving the internal efficiency of the farmers through promoting new production innovation, education and providing credit facilities to the farmers, to mention few.

CHAPTER THREE: RESEARCH METHODOLOGY

This chapter discusses the research methodology used in the study including location and description of the study areas, data types and data sources, methods of sampling, methods of data collection and analysis.

3.1. Description of the Study Area

3.1.1. Geographical Location

Minjar Shenkora wereda is found in Amhara regional state, located farther to the southern part of North Shewa Zone. The wereda is located 260 km far from the administrative town of North Shewa Zone Debre Birhan and 130 km far from the capital city of Ethiopia, Addis Ababa. According to MSDARDB (2016) the wereda shares boundary with Hagere Mareyam and Berehet weredas in the north direction and the remaining boundary of Minjar Shenkora is shared with parts of Oromia region in the west, south and east directions. The geographical location of the study area extended from $8^0$42’46’’ N to $9^0$7’37’’ N latitude and from $39^0$12’57’’ E to $39^0$46’53’’E longitude. Minjar Shenkora district holds the total area of 1,595.83 square kilo meters or 159,682.9 hectares of land, out of this total area the share of cultivated agricultural land is 34.98% or 55,860.38 hectare, whereas the other 65.02 % of the area of Minjar Shenkora district is covered with non-agricultural land use activities. It hosts a topographic variation that extends from 1040 meter above sea level to 2380 meters above sea level. Consequently, due to this range of altitude the wereda is composed of three agro climatic regions- Kola, Woinadega and Dega.

Based on the 2007 national censes conducted by Central Statistical Agency of Ethiopia (CSA) Minjar Shenkora wereda has a total population of 128,879. Based on the 2007 population census result of CSA the study area has the total of 24,941 rural households, which is distributed among the 27 rural kebeles. According to recent population number projection made by Central Statistics Agency (CSA) (2012) the total population of Minjar Shenkora woreda is estimated to be 140,639. The population residing in the rural area is estimated to be 125,600, of which 65,571 are males and 60,029 are females. While, the urban population of the wereda is estimated to be 15,039 of which 7,402 are males and 7,637 are females. Based on the 2012 CSA projection report, the population density of Minjar Shenkora wereda is 93.1 persons per square kilometer.

3.2. Research Design

The purpose of a research can be exploratory, descriptive or casual/explanatory (Ghauri & Grønhaug, 2010). Casual research design was adopted as the optimal and most effective design approach to investigate the possible "cause-and effect" issues. According to the specification of causal research design (Ibid, 2010), the researcher tries to isolate the "cause" (independent variables) and examine whether it has any effects on dependent variable – row planting adoption.

Cross-section research design was used in this study. In this design data were collected at a single point in time. According to IDRC (2003), this type of research design is used in descriptive research design and in determination of relationship of variables. This research design was used because of the limited time and finance in field work and the fact that it was deemed to be adequate for addressing the study objectives.

3.3. Sources and Methods of Data Collection

The study used both primary and secondary data source. The primary data was collected from farmers and other informants through focused group discussion (FGD), semi-structured questionnaire and field observation to draw upon the information on how farmer view of technology, their experience, belief, and adoption of technology. Beside these, secondary data was collected from various secondary sources to complement the primary data. These sources reviewed different literatures, policy and strategy documents from relevant federal and regional government offices such as central statistics agency (CSA), zonal and woreda Agriculture and rural development bureaus, Ethiopian Agricultural Transformation Agency (ATA), and published and unpublished sources.

3.4. Sampling Frame

A total of 24,941 rural households were counted in Minjar Shenkora wereda according to CSA 2007. These households are the sample frame for this study. From these households, the study have selected sample representative teff growing households, so as to make generalization about the population.

3.4.1. Sampling Procedure and Sample Size Determination

In this study a two stage sampling techniques were employed. In the first stage, two kebeles were selected out of 27 kebeles of the wereda as study samples namely, Agirat and Bologiyorgis, with the total number of household of 693 and 1090 respectively. Selection was made through reviewing secondary data on the use of the introduction and application level of Row planting technology on Teff crop production. The application level of row planting method on Teff production in the two sample kebeles is very high compared to other kebeles in the study area. According to MSDARDB, both Agirat and Bologiyorgis hold the largest area of agricultural land of all 27 rural kebeles with in the district covered by Teff grain produced through row planting method accounting 123 hectares and 165 hectares respectively.

The second stage, the criterion to select sample households were farmers' adoption level of row planting technology by area of the land covered with teff through row planting method. With the support of DAs and kebeles' administrators, using the list of farmers' name with the area of farm land they covered with teff through row planting technology, farmers in the two sample kebeles were categorized in to Adopters and Non-adopters. For this study, farmers who had applied row planting on the production of teff on the area were leveled as adopters. Whereas, those who didn't applied this technology on the area less were leveled as non-adopters. Therefore sample households were classified and randomly selected from the available list.

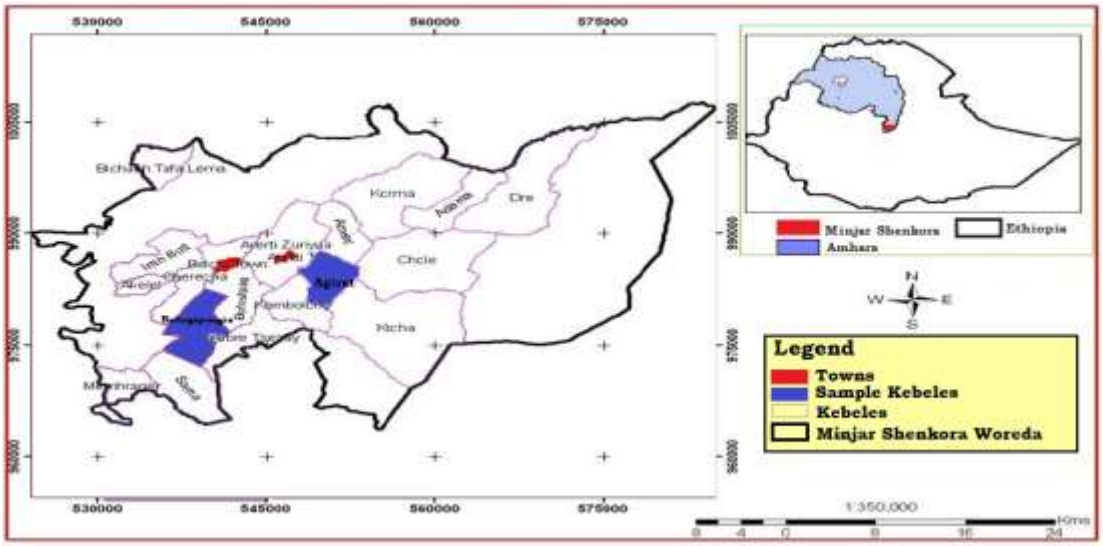

Figure 3.1 – Map of the Study Area

As it is indicated on the table below (Table 3.1), a total of 115 sample households from the two kebeles were selected of which 47 were adopters and 68 were non-adopters.

The following proportional allocation formula of Yamane (1967) was employed to select respondents from each sample kebeles and each farmer's category.

$$\boldsymbol{n = \frac{N}{1 + N(e)2}}$$

Where: N - The total household heads in the sample Kebele

n - Sample size of households in the study area.

e=error tolerated for the study (9%)

Table 3.1. Number of Sample Respondents in Each Kebele

No.	kebeles	Household heads			Sample taken		
		Adopters	Non-Adopters	Total	Adopters	Non-Adopters	Total
1	Agirat	370	323	693	24	21	45
2	Bologiyorgis	358	732	1090	23	47	70
3	Total	728	1055	1783	47	68	115

Source: kebeles' administrative offices (2016)

3.5. Analytical Techniques

Both Descriptive and econometric methods of data analysis were employed.

3.5.1. Descriptive and Inferential Statistics

Descriptive statistics were used for the description of different demographic, socioeconomic, institutional and situational characteristics of the sample respondents. These are mean, percentage, standard deviation and frequency. Moreover, the inferential statistics were used such as Chi-square test and F-test. Chi-square test was employed for dummy/categorized variables; while, F-test was used for continuous variables.

3.5.2. Econometrics Model

Descriptive statistics often fail to predict the combined effect of the explanatory variables on the dependent variable (Aldrich and Nelson, 1984). Thus, this gap is to be bridged by the help of selecting and using appropriate econometric models.

One objective, i.e., objective 2 of this study was achieved by employing econometric model to predict the influences of the explanatory variables on the dependent variables, which is to assess the intensity of adoption of teff row planting and explore the main factors that limits row planting practice in the study area.

The focus of the study with regard to this objective is to analyze the factors influencing the decisions of households to adopt teff row planting at higher rate.

Several models are available to analyze factors affecting technology adoption and utilization. The choice of one may depend up on several factors. Some of these alternative models are the discrete regression model in which the dependent variable assumes discrete values. But here, in our cases, the econometric models applied for analyzing determinants and magnitude of teff row planting adoption were both Logit and Tobit model.

The Logit regression model was used to establish relationship between the likelihood of adoption of teff row planting as production technology and the various factors affecting it. The Tobit regression model was used to establish the relationship between the magnitude or extent of adoption of teff row planting as production technology and the various factors affecting it. The decision of a farmer to use teff row planting is complex and can be modeled as consisting of two mutually exclusive processes. The first involves making the decision to adopt the technology as production technology in the first place, while the second involves deciding on the level i.e. the intensity or magnitude of use of that technology, given that adoption has taken place (Sall et al., 2002; Shiyani et al., 2002; Wabbi et al., 2006).

Model - 1: The Logit Model

Many models used in adoption studies fail to meet the statistical assumptions necessary to validate the conclusions based on the hypothesis tested (Feder et al., 1985). This calls for use of qualitative response models. The most commonly used are probit and logit. This is because; their probabilities

are bounded between 0 and 1. Also, they compel the disturbance terms to be homoscedastic because the forms of the probability functions depend on the distribution of the difference between the error terms associated with one particular choice and another.

Empirical evidence suggests that neither Logit nor Probit have superiority over the other. The choice becomes a matter of preference (Gujarati, 2004). Therefore, the logit model was used for this study because of its computational and mathematical conveniences.

Model Specification

Based on Gujirati (2004), the logit model can be specified as follows:

If Pi is the probability of adopting teff row planting and Xi is the factors influencing the adoption:

Pi = E (Y=1 /X_i =β_1 +$\beta_2 X_i$ ……..……..……(3.1)

Equation (3.1) can be represented as:

$$Pi = E(Y = 1/Xi) = \frac{1}{1+e^{-(\beta 1+\beta 2Xi)}}$$ ……..……..……(3.2)

If Z_i is equal to β_1 +$\beta_2 X_i$, equation (3.2) can be written as:

$$Pi = \frac{1}{1+e^{-Zi}} = \frac{e^{Z}}{1+e^{Z}}$$, and this represents logistic distribution function.……..…….. (3.3)

If Pi is the probability of adopting teff row planting then (1 – Pi) is the probability of not adopting the row planting which is:

$$1 - Pi = \frac{1}{1+e^{Zi}}$$…….....…..……(3.4)

Therefore, $\frac{Pi}{1-Pi} = \frac{1+e^{Zi}}{1+ei^{-Z}} = e^{Zi}$ is odds ratio in favor of adopting the practice. ……..(3.5)

Taking the natural logarithm of equation (3.5), gives

$$Li = \ln\left(\frac{Pi}{1-Pi}\right) = Zi = \beta 1 + \beta 2Xi$$ ……...…….……(3.6)

Farmers were categorized as adopters and non-adopters. Defining Y as adoption of the technology (teff row planting), and the adoption decision as a function of a set of farmers` characteristics and technology-specific attributes. Theoretically, the Logit model is expressed simply as:

$Y = B_0 + B_1X_1 + B_2X_2 + \ldots\ldots B_nX_n$ ……..……(3.7)

Where:

Y = Likelihood of Adoption, otherwise labeled as DADDTRP (Determinants of adoption of teff row planting technology).

B_0 = intercept;

B_1……..n = estimated parameters;

X_1……..n = Set of independent variables.

Model - 2: The Tobit Model

Tobit model is an extension of probit model and it is one of the approaches dealing with the problem of censored data (Johnston and Dandiro, 1997). Some authors call such model limited dependent variable model, because of the restrictions put on the values taken by the regressed (Gujarati, 1995). Tobit model is superior over the other adoption models like LRM, Logistic, and Probit, in that, those dichotomous regression models only attempts to explain the probability of adoption of agricultural technologies by the farm households rather than the intensity or extent of adoption. However, adoption of improved technology alone is not sufficient enough since improvement in production and productivity of farm households depends not only on adoption but also on the intensity of use of the technology.

The magnitude of use of teff row planting was analyzed by replacing the dependent dummy variable given in the first model equation with the magnitude of use of teff row planting. Teff row planted land is measured by its width in timad ($1/4^{th}$ hectare). It is measured in proportion (percentage share) with the total amount of land cultivated for teff crop to examine magnitude of teff row planting adoption.

Model Specification

Based on Greene (2012), Tobit model which helps to test the determinants of magnitude of adoption of teff row planting can mathematically be specified as follows:

$Y*i = xi\beta + \varepsilon i,$

$Yi = 0$ if $y*i \leq 0,$

$Yi = Y^{*}i$ if $Y*i > 0$..... (3.8)

Where:

$Y^{*}i$ = is the the observed dependent variable, intensity of adoption subjected to a set of constraints per household and conditional on being above certain limit, otherwise labeled as MADDTRP (Magnitude of adoption of the technology).

Yi = is adoption index for ith farmer

xi= Vector of factors affecting adoption and intensity of adoption,

β= Vector of unknown parameters, and

εi = is the error term which is normally distributed with mean 0 and variance σ2.

Before running the Tobit model all the hypothesized explanatory variables were checked for the existence of multi-collinearity and heteroscedasticity. There are two measures that are often suggested to test the existence of multi-collinearity.

Namely:

1) VIF (variance inflation factor) was used for testing the association between the hypothesized continuous variables, and the value of VIF can be computed using the formula,

$$\text{VIF}\ (X_i) = \frac{1}{1 - R_i^2}$$

Where, R_i^2 was the squared multiple correlation coefficient between X_i and the other explanatory variables (Maddala, 1992). Stata 13.0 was employed to compute the VIF values. To avoid the

problem of multi-collinearity, it is essential to exclude the variables with the high VIF value (10), which will happen when R^2 exceeds 0.9 (Gujarati, 1995).

2) Contingency Coefficients: These were also computed for dummy variables. In order to test multi-collinearity problem between discrete as well as dummy variables, contingency coefficient, which is X^2 (chi-square) based measure of association was computed. The values of contingency coefficient, ranges between 0 and 1, with zero indicating no association between the variables and values close to 1 indicating high degree of association. The association is said to be high when the value is greater than 0.75.

$$C.C = \sqrt{\frac{x^2}{n + x^2}}$$

Where: C.C = Contingence Coefficient, n= sample size, x^2=Chi-square value (Healy, 1984 as cited in Mesfin, 2005). In this study, both measures were used to test multi-collinearity problem.

3.5. Definition

Dependent Variable

This study applied both logit and Tobit models to enable comparison of the results. For the logit model, the dependent variable was defined as a binary variable representing the adoption status (Determinants of adoption of teff row planting technology (DADDTRP)) of the farmer. It entered the empirical logit model as 1 for an adopter and 0 otherwise. For the Tobit analysis, the dependent variable (Magnitude of adoption of the technology (MADDTRP)) was defined as the share of total teff farm area devoted to teff row planting by the farmer.

Independent Variables

The following explanatory variables are hypothesized to influence adoption and intensity of use of teff row planting in the study area.

Sex of the Household Head (SEXHH): It is nominal variable to be used as dummy (1 if male, 2 female). Sex difference is one of the factors expected to influence adoption of new technologies. Due to many socio-cultural values and norms, males have freedom of mobility and participation in

different meetings and consequently have greater access to information (Almaz, 2008). Therefore, it is hypothesized that male farmers are more likely to adopt row planting technology.

Household Head's age (HHAGE): It is measured in number of years. Age of a farmer can generate or erode confidence on technologies. In other words, with age a farmer can become more risk opposed to new technologies. However there are mixed results as to the direction of influence. It is hypothesized that younger farmers have more probability of adopting teff row planting.

Education Level (EDUCAHH): Level of education is assumed to increase farmers' ability to obtain, process, and use information relevant to the adoption of row planting. Education is therefore expected to increase the probability of adoption of row planting in teff production. It is also treated as a categorical variable and measured as: =1, if the farmer is Illiterate, = 2, if the farmer can read and write, = 3, if the farmer attends primary school, =4, if the farmer attends Secondary School, = 5, if the farmer attends Preparatory school, =6, certificate and above. Adoption is expected to correlate positively with education (Chianu and Tsujii, 2004). It is hypothesized that it will affect positively with the increase in education level of farmers.

Farmer Experience (FARMEXP): is measured in the number of years since a respondent started farming on his own. Experience of the farmer is likely to have a range of influences on adoption. Experience will improve farmers' interest of adopting row planting in teff production. A more experienced grower may have a lower level of uncertainty about the technology's performance (Abadi *et al*, 1999; Chilot *et al*, 1996). Farmers with higher experience appear to have often full information and better knowledge and will be able to evaluate the advantage of the technology. Hence, it is hypothesized to affect adoption and intensity positively.

Total Annual Income (TOANIN): Annual income refers to the total annual earnings of the family from sale of agricultural produce such as sale of crop, livestock and livestock product after meeting family requirements. This is believed to be the main source of capital for purchasing agricultural inputs. Thus, those households with a relatively higher level of farm income are likely to purchase labors or other essential agricultural inputs. According to Chiputwa et al. (2011) households with relatively higher income are expected to better adopt technology. It is hypothesized that it will affect positively with the increase in income level of farmers. It is measured in Birr.

Participation in Social Organization (SOCIALPART): membership and leadership in community organization assumes that farmers who have some position in rural kebeles and different cooperatives are more likely to be aware of new practices as they are easily exposed to information (Freeman *et al*, 1996; Chilot *et al*, 1996; van Den Ban and Hawkins, 1996; Asfew *et al*, 1997; Habtemariam, 2004). It is, therefore, hypothesized that those farmers who participated in some social organization as member or leader are more likely to adopt row planting. The variable will measured by allocating a score of 0 if a farmer did not participate, 1 if a farmer is member of one social organization, 2 if a farmer is committee member of one social organization and a score of 3 will be given if a farmer is leader of one social organization.

Land Holding (LANDHOLD): Land holding is an indicator of wealth and social status and had influence within community. This means that farmers who have relatively large size will be more initiated to adopt improved technologies (Almaz, 2008). Even if it is proposed as unpredictable in case of teff row planting adoption the point above takes superiority. So, as a continuous variable it is hypothesized to have positive relationship with adoption process.

Available Family Labor (HHLAVA): Family labor is measured in terms adult equivalent with the availability of active and productive family member in the household. Availability of labor force is likely to influence the gross margin of the adoption of the innovation. A farm with larger number of workers per hectare (unit) is more likely to be in a position to try and continue using a potentially profitable innovation. So, household's labor availability is expected to influence adoption and intensity of adoption positively.

Number of Livestock (NOLTLU): It is measured in Tropical Livestock Unit (TLU). Livestock ownership is hypothesized to be positively related to the adoption of technologies because it serves as proxy for wealth status (Habtemariam, 2004). It is thus assumed to be positively associated with adoption and intensity of a new technology.

Credit Access (CREDITACC): It is measured in terms of whether respondents have access to credit in terms of availability of credit sources and possibility of getting credit. Farmers who have access to credit may overcome their financial constraints and therefore buy inputs. Farmers without cash and no access to credit will find it very difficult to attain and adopt new technologies (Legesse, 1992; Teressa, 1997; Wolday, 1999; Mulugeta, 2000). It is a dummy variable, which

takes a value 1 if the farm households have used credit or 2, otherwise and expected that utilization of credit increase the probability of adoption and intensity of row planting method.

Participation in Off-Farm Activities (PAROFA): Additional income earned from agricultural activities outside the farm increases the farmers' financial capacity and increases the probability of investing on new technologies (Chilot et al, 1996; Freeman et al, 1996; Van Den Ban and Hawkins, 1996; Asfew et al, 1997; Habtemariam, 2004). It is therefore, expected to affect adoption positively. It is treated as a dummy variable taking 1 if a household head participated in off-farm income generating activities; 2 otherwise.

Access to Technology Input Supply (ACIPSU): This is a dummy variable, which takes a value of 1 if the farm household has access to technology input supply and 2 for not. As availability of planting technology at the sowing time increase, farmers' use of row planting would be enhanced. On the contrary, if planting technology is not adequate at the time of sowing, farmers use traditional broadcasting method. Therefore, in this study access to technology input supply is hypothesized to positively influence adoption of row planting.

Perception on RP Characteristics (PERRPC): To adopt new technology it is mandatory for the adopter to grasp and have positive attitude towards the technology. If not, the farmer will lag behind the technology adoption due to bad perception or lack of knowledge. Positive perception on characteristics of row planting technology can positively affect the adoption process of the farmer. (Düvel, 1991) associates perceptions with the way the attributes of innovations are perceived and he distinguishes between (a) awareness of relative advantages, (b) awareness or concern of disadvantages, (c) the overall prominence or relative advantage of innovation (practice), and (d) the compatibility with situational circumstances. This is determined by using the Likert scale with the items developed for the purpose of the study. To achieve this, a five point Likert scale containing items with response categories ranging: 1= for strongly agree, 2= for agree, 3= for no opinion, 4= for disagree and 5= for strongly disagree which is treated as a categorical variable. It is important to measure farmers‟ perception towards row planting in the sample households.

Training on Row Planting Technology (TRAIRPT): Exposure for training and adoption and intensity of use of row planting technology are expected to be positively correlated. Training is a tool for behavioral change and development of positive attitude towards technologies. It is dummy

variable with value of 1 if yes 2 otherwise. It is hypothesized that it will affect positively with the increase participation of farmers on training.

Frequency of Contact with Extension Agent(s) (FRECONEA): This refers to the frequency of contacts that the respondent made with extension agents. The variable is treated as a categorical variable, where a value of =1, for never contact throughout the year, =2, for farmers contacted 1 to 5 times a year, =3, farmers contacted monthly, =4, for farmers contacted weekly, and =5, for farmers contacted daily with extension agents. Empirical results revealed that frequency of contacts with extension agents has an influence on adoption of new technology (Hassen, 2014). Hence, it is hypothesized to affect adoption of row planting technology positively.

Table 3.2. – Summary of Variables and Hypothesis

Variables	Nature of the variable	Expected sign
Dependent variables		
Adoption of teff row planting ADTRP (y) – yes = 1, no= 0	Dummy	
Intensity/Magnitude/ of teff row planting (MADDTRP (y) – adoption index	Continuous	
Independent variabls		
1. Sex oh Household (SEXHH)	Dummy	+ve
2. Household Head's age (HHAGE)	Continuous	-ve
3. Education level (EDUCAHH)	Categorical	+ve
4. Farmer's Experience (FARMEXP)	Continuous	+ve
5. Total Annual Income (TOANIN) –	Continuous	+ve
6. Participation in Social organization (SOCIALPART)	Dummy	+ve
7. Land Holding size (LANDHOLD)	Continuous	+ve
8. Available Labor (HHLAVA)	Continuous	+ve
9. Number of Livestock units (NOLTLU) – (measured in TLU)	Continuous	+ve
10. Credit Access (CREDITACC)	Dummy	+ve
11. Participation in Off-Farm Activities (PAROFA)	Dummy	+ve
12. Access to technology input supply (ACIPSU)	Dummy	+ve
13. Perception of farmers on RP technology (PERRPC)	Dummy	+ve
14. Training on Row Planting Technology (TRAIRPT)	Dummy	+ve
15. Frequency of Contact with Extension Agent(s) (FRECONEA)	Categorical	+ve

3.6. Conceptual Framework of the Study

Agricultural technology adoption and diffusion patterns often vary from location to location. In general, the variations in adoption patterns proceed from the presence of disparity in agro ecology, institutional and social factors (CIMMIYT, 1993). Moreover, farmers' adoption behavior, especially in low-income countries, is influenced by a complex set of socio-economic, demographic, technical, institutional and biophysical factors (Legesse, 1998).

Adoption rates were also noted to vary between different group of farmers due to differences in access to resources (land, labor, and capital), credit, and information as well as differences in farmers' perceptions of risks and profits associated with new technology (Tesfaye et al. 2001).The direction and degree of impact of adoption determinants are not uniform; the impact varies depending on type of technology and the conditions of areas where the technology is to be introduced (Legesse, 2001).

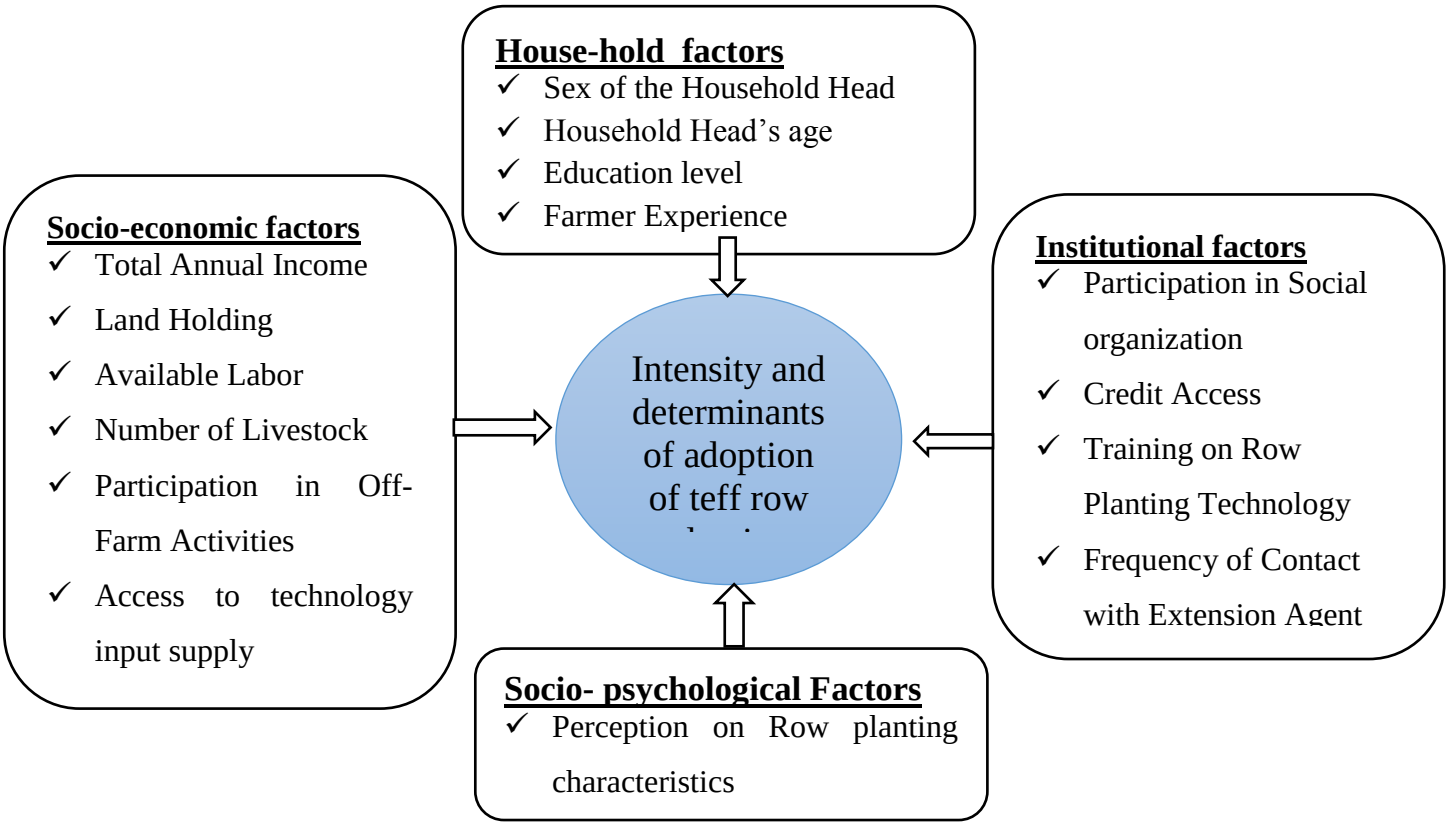

Figure 2.1: Conceptual framework of the study

Source: own formulation

CHAPTER FOUR: RESULTS AND DISCUSSION

This chapter provides clear insight about the study area and portrays the major findings of the research that answer the research questions, eventually extract overall evidences to address the objectives of the research.

4.1. Descriptive and Inferential Analysis Results of Variables

Descriptive statistics was run to observe the distribution of the independent variables. The Household, economic, institutional, and socio-psychological characteristics of the respondents and factors affecting adopters and non- adopters about teff row planting were analyzed.

4.1.1 Household Related Factors

Age of Sampled Household Head

Age plays an important role in household decision on adoption of different technologies including teff row planting method. From the total sample respondents (115), 59.1% were teff row planting adopters and 40.9% of the respondents were non-adopters. According to the result presented in Table 4.1 the mean age of the total respondents was 47.1% years with standard deviation of 8.3. The maximum age for the sample respondent was 70 years and the minimum was 25 years. The mean age and standard deviation of adopters was 44.8 and 9.2 respectively. Whereas the non-adopters mean age and standard deviation was 48.7 and 8.4 respectively. The t-test analysis result revealed that, age had statistically significant mean difference with both adoption categories with (t= 2.37, p= 0.0196**), indicating that significant relationship of age with teff row planting adoption at 5% significance level which is consistent with the hypothesized relationship with adoption. This implies that, the increase in age of sample respondents had negative influence with the adoption decision in the study area. This is due to the fact that; middle age farmers are ready to adopt new technologies than elder farmers. On the contrary, older people are conservative to change, and tends to be reluctant to the adoption of teff row planting method. Earlier study of Tadele (2016) supports this finding.

Sex of Household Head

Sex is another factor which limits the adoption of teff row planting method. Due to the prevailing socio-cultural values and norms males have freedom of mobility, participate in different meetings and trainings. Different studies have tried to capture the influence of sex on behavioral change and came with different feedbacks. They have identified male farmers are more responsive to agricultural innovations. Male headed households have better access to agricultural information than female headed households, which is attributed to negative influence of cultural norms and traditions. This study involved about 99 of male-headed household and only 16 of them were female headed (Table 4.2). According to the result, sex of household head was found to be significant at 1% probability level, with (chi2= 9.2175 and p= 0.002***). This implies that, male-headed households had a capability to participate freely in different social organization to have better exposure on the production of the selected variety than their counterparts. The result of this study confirms the finding of Geremew et al. (2016).

Education Level

The respondents who were selected are from different educational backgrounds. Therefore, the total sample households selected for the study are 31.3%, 33.9%, 27.8%, 4.4%, 0.9%, and 1.7% were illiterate, read and write, primary school, secondary school, preparatory school and certificate & above educational background respectively. The maximum and minimum education level of the total households included in this study was certificate & above and no educational background respectively for non-adopter category but for adopters secondary education was the maximum education level of the sample households (Table 4.2).

The chi2-analysis result indicated that, education level of sample households had no significant relationship with the adoption decision of households with chi2= 3.3973 and p-value=0.639 which is different with the positively hypothesized relationship with the adoption of teff row planting method. Consequently, the increase or decrease in education level has no significant relationship with the adoption and continuous use of row planting. On the contrary, Tolesa Alemu (no date) and Worku and Yishak (2016) reported that education has positive and significant relationship with the adoption of wheat row planting.

Experience of the Household Head

Farmers with higher experience appear to have often full information and better knowledge and supposed to evaluate the advantage of farm technologies. Hence it was hypothesized to affect adoption positively.

With respect to the respondents' farming experience, the most experienced farmers in the sample had experience of 45 years and the least experienced farmers had 3 year of experience in farming (Table 4.1). The average years of farming experience of household heads for non-adopters, and adopters were 26.6 and 26.2 years respectively.

The t-test analysis result revealed that, farming experience has significant relationship with the adoption decision of households at 1% probability level, with (t= -10.55, p= 0.0000***), which is similar with the positively hypothesized relationship with the adoption of teff row planting method. Thus, the increase or decrease in farming experience has significant relationship with the adoption of row planting. The result of this study agree's with the findings of Geremew et al. (2016).

4.1.2 Socioeconomic Factors

Land Holding

Land is often a good proxy for wealth. More land enables farmers to increase production, which provides more income that can be used to buy farm technologies including row planting machine and other farm inputs. The average farm size of the sample respondent was 8.6 timad (2.15 hectare) and 8.7 timad (2.17 hectare) for adopter and non-adopters respectively. Table 4.1 implies that, size of farm land had no significant influence on farmers decision with (t= 0.15, p= 0.8815NS). Therefore, the increase or decrease in farm size has significant relationship with the adoption and continuous use of row planting, which is consistent with the positive hypothesis. Similar to this result, Tadele (2016) reported that, farm size has positive and significant relationship with the adoption and intensity of adoption of teff row planting.

Available Family Labor

The availability of active working labor force in the household is considered as the number of individuals who resides in the respondent's house to perform production activities. Large available labor force is assumed as an indicator of performing more to the household tasks in the family. Based on this fact, availability of family labor is an input which is important for crop and other agricultural production to get the expected outcome on the expected way of production. It is also important to minimize time and cost of row planting method.

The total sample households had family labor is ranging from 2-6.8 adult equivalents. The total average labor availability in terms of man equivalent for sample household was 4.8 with standard deviation of 0.11 (The average number of available labor force in terms of man equivalent for adopters and non-adopters were 4.7 and 4.9 respectively (Table 4.1). Hence, the family labor in adult equivalent shows that, there is no significant mean difference between both adoption categories with the t-value=0.69 and p-value=0.4921NS (Table 4.1), which is different with the positively hypothesized relationship with the adoption of teff row planting method. The result of this study is incomplete agreement with the findings of Tadele (2016). In order to describe the labor availability of sample householdsthe Adult Equivalent Unit was used (Appendix 1).

Total Annual Income

The farm income refers to the total annual earnings of the household from sales of agricultural produce. This is believed to be the main source of cash for purchasing agricultural inputs and planting materials. Thus, those households with a relatively higher level of farm income are likely to have high purchase power and confidence on what they want to undertake on their farm land. In this study, the household farm cash income was estimated based on the sales of crops and livestock and livestock products as well as other income sources. Accordingly, the average annual incomes for sample households were 76486.96 Ethiopian birr per year. Whereas the mean farm income for adopters was 86991.49 birr and that of non-adopters mean on-farm income was 69226.47 birr per year. The test result (t=-3.71 and p=0.0003***) shown that, mean difference is significant between adopter categories in relation to farm income with 1% probability level. Similar to this result, research findings carried out by Tolesa Alemu (no date) and Worku and Yishak (2016) who all have reported positive influence of households' farm income on adoption of row planting.

Number of Livestock

Mixed farming characterizes the farming system of the study area. Both crop and livestock production activities were undertaken as major or secondary occupation in the study area. 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 agricultural technologies like row planting; because, livestock can provide cash through sales of products which enables farmers to purchase different agricultural technologies. The sample respondents rear livestock for various purposes including prestige, milk, meat, egg production etc. The farmyard manure collected from the livestock is also used as a source of organic manure. In order to describe the livestock holding sample households the Tropical Livestock Unit (TLU) conversion factor was used. (Appendix table 2). The average livestock ownership in TLU for adopter (6.3) and non-adopter (2.3) with standard deviation of 3.1 and 0 respectively. Table 4.1 result show that the mean difference is significant between adopter categories in relation to total livestock ownership in TLU at 5% significance level with (t= -2.43 and P = 0.0165**).

Participation in Off-Farm Activities

Off-farm activities are sources of additional income which may encourage or discourage investment in new technologies. In this study the main off-farm activities were casual labour, salary employment, carpentry and petty business. Table 4.2 shows that 36.2% and 48.5% of the sampled adopters and non-adopters involved in off-farm activities respectively. On the other hand, in both adoption categories the dominant number of the sampled households didn't participate in off-farm activitie. The test result also (chi2=1.7274 and p=0.189NS) shown that, the respondents participation in off-farm activities had no significant relationship with the adoption of teff row planting, which is inconsistent with the positively hypothesized relationship with adoption decision.

Access to Technology Input Supply

In order to apply row planting technology seeds should be sown proportionally with equal amount and recommended distance. Row seeder machine is very important input typically used in row planting. Especially, teff row planting requires accessory like row seeder machines, because of teff seed is very tiny.

According the result presented in Table 4.2, those farmers who used row seeder are 4.26%, 0% adopters and non-adopters respectively. However large amount of sample respondents were not used row seeder for their farm activities, (95.7%, 100% from adopters and non-adopters respectively). Only 2 sample respondants from adopers side have used row seeder in the study area. On this the focus group discussion also reveals that the farmers are facing shortage planting material like row seeder in the woreda and all over the market in the country as well.

The chi-square test (chi2= 2.9448 and P= 0.086*) shows a statistically significant associations with adoption decision at 10% level (table 4.2). This implies that, farmers having an access to use row seeder had more probable to improve their farm activities including teff row planting.

4.1.3 Institutional Factors

Participation in Social Organization

In the realm of the rural and agricultural development, the importance of social capital is perceived as a willingness and ability to work together. The very likely assumption on which the relationship between social capital and adoption anchored that neighboring agricultural households are, de facto, members of social structure who exchange information about improved agricultural practices. Rogers (1995) conclude that, "the heart of the diffusion process consists of interpersonal network exchanges between those individuals who have already adopted an innovation and those who are then influenced to do so".

In addition to membership, leadership in social organization was assumed more likely to be aware of new practices as they are easily exposed to information (Freeman et al, 1996; Chilot et al, 1996; van Den Ban and Hawkins, 1996; Asfew et al, 1997; Habtemariam, 2004).

Table 4.2 implies that, 44.7% of the adopter and 42.7% of the non-adopter sample respondents were not participated in social institutions like saving and credit group, Marketing cooperative, and Seed multiplication groups to share their own common values and experience. On the other hand, 38.3%, 12.8%, 4.3% of the adopter and 41.2%, 13.2%, 2.9% of the non-adopter respondents were only member, only committee member and leader of social organization respectively. The respondents` participation in social organization as a member, as committee member or a leader had no significant relationship with the adoption of teff row planting with (chi2=0.2267 and

p=0.973NS), which is inconsistent with the positively hypothesized relationship with adoption decision (Table 4.2).

Credit Access

Credit service is also another component of economic variables that influences adoption of technology in farming activities especially for the poor. According the result presented in Table 4, those farmers who used credit are 23.4%, 5.9% adopters and non-adopters respectively. However large amount of sample respondents were not use credit for their farm activities, (76.6%, 94.1% from adopters and non-adopters respectively).

The chi-square test (chi2= 7.5227 and P= 0.006***) shows that, farmers having an access to use credit service had significant relationship with the adoption of teff row planting at l% probability level, which is consistent with the positively hypothesized relationship with adoption decision (Table 4.2). Therefore, this implies that, respondents having an access to use credit had significant role on adopting teff row planting in the district.

Frequency of Contacts with Extension Agents

This refers to the number of contacts per year that the respondent made with extension agents. The effort to disseminate new agricultural technologies is within the field of communication between the change agent (extension agent) and the farmers at the grassroots level. Here, the frequency of contact between the extension agent and the farmers is hypothesized to be the potential force which accelerates the effective dissemination of adequate agricultural information to the farmers, thereby enhancing farmers' decision to adopt new crop technologies.

From the total sample households 55.3% and 27.9% of adopter and non-adopter households were visited monthly by the extension agents respectively. Whereas, 34.0% and 57.4% of adopter and non-adopter households were visited 1-5 times a year by the extension agents respectively.

The chi-square analysis shows that, there is a positive and statistically significant association with the adoption decision with (chi2=13.0969; p= 0.011**) at 5% level of significance which is similar with the hypothesized relationship with adoption of teff row planting (Table 4.2). This implies that, farmers with frequent contacts with extension agents increase the ability to get technical support to

understand technical issues of new innovation which is largely affecting adoption and production decision than the otherwise. The finding of this study confirms the finding of Tolesa (no date).

Training on Row Planting Technology

Training is an important input to improve farmers' performance. It equips farmers' with new knowledge and skills, which help them to perform new practices properly. Concerning farmers' participation in row planting training, 91.5% of adopter and 45.6% of non-adopter had participated in row planting; while 8.5% of adopter and 54.4% of non-adopter did not participate in training program related to row planting.

The chi-square analysis showed that (chi2= 25.5232, P= 0.000***) there exists a significant relationship with adoption of teff row planting at 1% probability level. The reason could be that, trained farmers could develop their knowledge to practice and make them confident to implement row planting. The result of this study is in agreement with previous findings of Geremew et al. (2016) and Tadele (2016).

4.1.4 Socio-psychological factors

Perception on Row Planting Characteristics

Farmers perception towards teff row planting is described and measured based on the agreement level of the respondents perceived during the data collection. Perception was measured using a scale with items developed for the purpose of this study. Responses of sample respondents on the perception related were analyzed using Likert type scale. According to the result of the questionnaire, most of the respondents perceived that teff row planting is high yielding method in comparison with the broadcasting method. Even if it is highly productive, some farmers are discouraged to adopt teff row planting because it demand more labor, time and cost. Some farmers also perceived that teff row planting is not good to produce quality straw and it is not suitable to have a better weeding.

The survey result indicated that, the majority of the sample households perceived that they have adopted the variety due to the yield advantage over the other as envisaged by 68.73% of the respondents. On the other hand, 93.1%, 89.6%, 81.8%, 79.2%, and 67.9% of the respondents

perceived that, even if it is high yielding planting method, it has some demerits such as demand more labor & time; not suitable in terms of weeding, it cost very high and, not good to produce quality straw respectively. According to the focus group discussant (FGD) elaboration, the respondents' perception towards row planting is negative due to different reasons.

The chi-square result indicates that except the cost parameter, in all parameters there is significant difference in the perception of respondents towards teff row planting at 1% level of significance. To conclude this, most of the sample households who were not adopting teff row planting were discouraged due to the above factors; therefore the extension and research system have to look in to these factors to give solution for the adoption of the teff row planting.

Table 4.1. Descriptive and Inferential Analysis Results of Continuous Explanatory Variables

Variables	Adopters				Non-adopters						t-value	P
	Mean	SD	Min	Max	Mean	SD	Min	Max	Total mean	SD		
HHAGE	44.81	9.18	28	70	48.74	8.43	25	62	47.1	0.83	2.37	0.0196**
FARMEXP	26.02	8.54	8	45	26.62	8.96	3	44	26.3	0.82	-10.55	0.0000***
LANDHOLD	8.55	4.58	3	30	8.68	4.18	2	20	8.6	0.40	0.15	0.8815NS
NOLTLU	6.25	3.11	1.4	16.4	5	2.30	0	11.23	5.5	0.25	-2.43	0.0165**
HHLAVA	4.74	.80	3	6.8	4.90	1.34	2	6.5	4.8	0.11	0.69	0.4921NS
TOANIN	8699 1.49	2952 3.52	400 00	150 000	6922 6.47	2177 1.33	110 00	1350 00	7648 6.96	247 9.87	-3.71	0.0003***

Source: Computed from survey data, 2017

Note: *** Significant at 1% level, ** Significant at 5%, and NS=Not Significant

Table 4.2. - Descriptive and inferential analysis results of dummy and categorical variables

		Adopters		Non-adopters		Chi2	P
Variables		No.	%	No.	%		
SEXHH	Male	46	97.87	53	77.94	9.2175	0.002***
	Female	1	2.13	15	22.06		
EDUCAHH	Illiterate	13	27.66	23	33.82	3.3973	0.639NS
	Read and write	17	36.17	22	32.35		
	primary school	14	29.79	18	26.47		
	secondary school	3	6.38	2	2.94		
	preparatory school	0	0	1	1.47		
	Certificate and above	0	0	2	2.94		
PAROFA	Yes	17	36.17	33	48.53	1.7274	0.189NS
	No	30	63.83	35	51.47		
CREDITACC	Yes	11	23.40	4	5.88	7.5227	0.006***
	No	36	76.60	64	94.12		
SOCIALPART	none member	21	44.68	29	42.65	0.2267	0.973NS
	only member	18	38.30	28	41.18		
	only committee member	6	12.77	9	13.24		
	leader of social org.	2	4.26	2	2.94		
FRECONEA	Never	2	4.26	1	1.47	13.0969	0.011**
	1-5 times in a year	16	34.04	39	57.35		
	Monthly	26	55.32	19	27.94		
	Weekly	1	2.13	0	0		
	Daily	0	0	0	0		
TRAIRPT	Yes	43	91.49	31	45.59	25.5232	0.000***
	No	4	8.51	37	54.41		
ACIPSU	Yes	2	4.26	0	0	2.9448	0.086*
	No	45	95.74	68	100		

Source: Computed from survey data, 2017

Note: *** Significant at 1% level, ** Significant at 5%, * Significant at 10% and NS=Not Significant

Table 4.3. Likert Scale Results on Respondents` Perception towards Teff Row Planting

No.	Perception		Parametres						
			It saves labour	It saves time	It saves cost	Better weeding	It increases teff yield per hectare	Enables to produce quality straw	It increases straw quantity
1	Strongly agree	N	0	0	1	7	25	7	2
		%	0	0	0.87	6.09	21.75	6.09	1.74
2	Agree	N	0	1	8	21	54	3	53
		%	0	0.87	6.96	18.27	46.98	2.61	46.11
3	Neutral	N	8	11	15	9	14	11	37
		%	6.96	9.57	13.05	7.83	12.18	9.57	32.19
4	Disagree	N	30	30	62	54	16	68	22
		%	26.1	26.1	53.94	46.98	13.92	59.16	19.14
5	Strongly disagree	N	77	73	29	24	6	26	1
		%	66.99	63.51	25.23	20.88	5.22	22.62	0.87
	Total	N	115	115	115	115	115	115	115
		%	100	100	100	100	100	100	100
6	chi2		24.4355	13.9809	7.4328	25.5161	32.1021	21.2464	13.2843
7	P-value		0.000***	0.003***	0.115NS	0.000***	0.000***	0.000***	0.010***

4.2. Determinants for the Adoption of Teff Row Planting and Magnitude of Adoption of the Technology

4.2.1. Logit Model Results

To identify determinant factors which influence the likelihood of adoption of teff row planting among farmers in the study area, the Logit model was estimated. Before running the model analyses the existence of a serious of multicollinearity among independent variables for all continuous and discrete variable were checked by Variance Inflation Factor (VIF) for continuous explanatory variables and contingency coefficients for dummy explanatory variables. The VIF values and Contingency coefficient displayed in (Appendix Tables 11) shown that all the continuous, dummy and discreet explanatory variables have no serious multicollinearity problem. The maximum likelihood estimates of the Logit model are presented in Table 4.4.

Table 4.4. Logit Model Estimates of Determinant Factors Influencing Farmers' Adoption of Teff Row Planting

Likelihood of adoption	Coef.	Std. Err.	z	P>|z|	[95% Conf. Interval]	
HHAGE	-.3461388	.1418098	-2.44	0.015**	-.6240809	-.0681968
SEXHH	-1.432409	1.282216	-1.12	0.264	-3.945506	1.080688
EDUCAHH	.5212257	.3727362	1.40	0.162	-.2093238	1.251775
FARMEXP	.3535299	.1519331	2.33	0.020**	.0557464	.6513134
LANDHOLD	-.075439	.1038394	-0.73	0.468	-.2789604	.1280825
NOLTLU	.1034368	.1572096	0.66	0.511	-.2046883	.4115619
HHLAVA	-.3416606	.4057013	-0.84	0.400	-1.13682	.4534992
TOANIN	.0000507	.0000163	3.11	0.02**	.0000187	.0000827
PAROFA	.4904276	.7058847	0.69	0.487	-.8930809	1.873936
CREDITACC	2.305492	1.128876	2.04	0.041**	.0929368	4.518048
FRECONEA	.0002062	.0019276	0.11	0.915	-.0035719	.0039842
TRAIRPT	2.417371	1.016302	2.38	0.017**	.4254561	4.409286
SOCIALPART	.111566	.4193495	0.27	0.790	-.7103439	.9334758
ACIPSU	0	(omitted)				
PERRPC	1.286732	.7235767	1.78	0.075*	-.1314522	2.704917
_cons	.2305437	3.636295	0.06	0.949	-6.896463	7.35755

Number of obs = 113, LR chi2(14) = 76.22, Prob > chi2= 0.0000***, Pseudo R2= 0.5017, Log likelihood = -37.858066 (***, represents 1%, **, 5% and *, 10% level of significance respectively)

Source: model output, 2017

Age of Sampled Household Head (HHAGE): - The results in Table 4.4 show that age has a negative relationship with the decision to adopt teff row planting at 5% level of significance. This imply that younger farmers are more willing to adopt teff row planting than older farmers. This can be attributed to the fact that younger farmers are more receptive towards newly introduced technologies than older farmers. Younger farmer are more risk takers than older farmers.

Farming Experience (FARMEXP): The coefficient of farming experience was found to be significant at 5% in influencing the decision to adopt teff row planting (Table 4.4.). This is expected because more experienced farmers may have better skills and access to new information about improved technologies. It could also imply that knowledge gained over time from working in uncertain production environment may help in evaluating information thereby influencing their adoption decision.

Total Annual Income (TOANIN): The results in Table 4.4 show that, total annual income has positive and significant influence on farmers` decision to adopt teff row planting at 5% level of significance. Increasing of capital to the farmer boosts adoption by enabling him/her to have the capacity to purchase technology and associated inputs which can be used in implementing the technology. Adoption of teff row planting needs capital which can be used in buying inputs like row seeding machine as well as hiring labour.

Access to Credit (CREDITACC): Table 4.4 also revealed that access to credit was found to be important in influencing the likelihood of adoption of teff row planting among farmers in the study area. The variable was found to be statistically significant ($\rho \leq 0.05$) and positively related with the likelihood of adoption. Most farmers fear trying improved technologies because they do not have the necessary financial resources to adopt the technologies (Ouma et al.,2006; Omolehin et al., 2007). This is partly explained by the fact that most agricultural technologies require complementary inputs such as fertilizers and pesticides. These complementary inputs are difficult to come by due to the cash-trapped nature of farmers. Access to credit helps farmers out of their predicaments thereby influencing them to adopt innovations.

Training on Row Planting Technology (TRAIRPT): Farmers can acquire new knowledge through participation in training to improve their production performance through the use of improved agricultural technology. The logit result (table 4.4) indicated that the probability of adoption of teff row planting was significantly and positively influenced by the participation in training at 5% level of significance. This implies that, participation in training is important to persuade farmers and to provide knowledge and skill on the practical application part of the newly introduced row planting technology.

Perception on Row Planting Characteristics (PERRPC): The result of logit model (table 4.4) showed that attitude towards teff row planting is positively and significantly influence farmers` adoption decision at less than 10% probability level. The above finding implies that those individuals who have unfavorable attitude towards teff row planting usually create resistance to accept new ideas and innovations thereby retard the processes of change towards which interventions in rural development are geared. This implies need to change misunderstand held by non adopters of teff row planting.

4.2.2. Tobit Model Results

This part presents the Tobit econometric model estimates of the determinants and magnitude of the adoption of teff row planting.

The factors considered are related with personal, socio-economic, institutional and Socio- psychological variables relevant to the magnitude of adoption of teff row planting. From the total of 15 explanatory variables hypothesized to influence adoption, seven variables were found to significantly influence magnitude of adoption of teff row planting (Table 4.5).

Table 4.5 Maximum Likelihood Estimates of the Tobit Model

Magnitude/Intensity of adoption	Coef.	Std. Err.	T	P>|t|	[95% Conf. Interval]	
HHAGE	-.0412685	.0133247	-3.10	0.003***	-.0677044	-.0148327
SEXHH	-.2013973	.2090348	-0.96	0.338	-.6161164	.2133219
EDUCAHH	.124363	.0537255	2.31	0.023**	.0177732	.2309529
FARMEXP	.0470623	.0143978	3.27	0.001***	.0184976	.0756271
LANDHOLD	-.0339127	.0118932	-2.85	0.005***	-.0575085	-.0103169
NOLTLU	.0140878	.0201684	0.70	0.486	-.0259257	.0541013
HHLAVA	-.05751	.0491437	-1.17	0.245	-.1550096	.0399897
TOANIN	2.14e-06	1.31e-06	1.64	0.104	-4.48e-07	4.73e-06
PAROFA	-.0519613	.1044152	-0.50	0.620	-.2591181	.1551956
CREDITACC	.1603002	.1204224	1.33	0.186	-.0786145	.3992149
FRECONEA	.0001558	.000274	0.57	0.571	-.0003879	.0006995
TRAIRPT	.4271159	.1725491	2.48	0.015**	.0847834	.7694483

SOCIALPART	-.0162029	.0554333	-0.29	0.771	-.1261809	.0937752
ACIPSU	1.085993	.2756119	3.94	0.000***	.5391867	1.632799
PERRPC	.2316168	.0918242	2.52	0.013**	.0494402	.4137933
_cons	-.2748598	.4456597	-0.62	0.539	-1.159036	.6093162
/sigma	.3370577	.036668			.2643094	.409806

Number of obs = 115, LR chi2(15) = 90.14, Prob > chi2=0.0000***, Pseudo R2= 0.5541, Log likelihood = -36.276924 (***, represents 1%, and **, 5% level of significance respectively)

Source: model output, 2017

Age of Household Head (HHAGE): Age of a household head is one of the determinants of technology adoption. It is also evident from Tobit model estimate result (table 4.5) that, age of household head had negative and significant influence on the extent of use teff row planting by the respondents ($\rho \leq 0.01$). This shows that the increase in age of household heads had negative influence on the magnitude of adoption of teff row planting in the study area. This is due to the fact that; middle age farmers are ready to adopt new technologies than elder farmers. Quite the reverse, older people are conservative to change and tend to be reluctant to the adoption of teff row planting. This result agrees with earlier study of Tadele (2016).

Farmer's Education Level (EDUCAHH): As expected, education had a positive and significant relationship with the magnitude of adoption of teff row planting at 5% level (Table 4.5). The Tobit analysis shows that, the magnitude of teff row planting adoption by farmers who were literate is likely to be greater than farmers who were illiterate. This suggests that being literate would improve access to information, capable to interpret the information, easily understand and analyze the situation better than illiterate farmers. So, farmer who are literate were likely to produce teff and use row planting properly with higher extent than those illiterate farmers. This result has supported by other previous studies such as Tadele (2016) and Tolesa (no date).

Farmer Experience (FARMEXP): The Tobit analysis (Table 4.5) shows that, farm experience had a general positive effect on the level of adoption of teff row planting. This literally means the more experienced a famer is, the more he/she is likely to adopt teff row planting with higher level; becuase more experienced grower may have a lower level of uncertainty about the technology's performance. Farmers with higher experience appear to have often full information and better

knowledge and will be able to evaluate the advantage dis-advantage of the technology. Other studies on adoption showed attainment of farm experience to be an important determinant of adoption (Abera, 2008).

Land Holding (LANDHOLD): Results in Table 4.5 show that farmers land holding sizes has a significant ($\rho \leq 0.01$) but negative influence in explaining the level of adoption of teff row planting. Land holding is failed to give the expected sign; the reason behind the result may be because of the large scale farmers face shortage of time and labor and on the contrary, teff crop has a limited period of time (not more than a week days) for plantation at the study area.

Training on Row Planting Technology (TRAIRPT): Training is one of the extension events where by farmers get practical skill and technical information for new technology. In addition to this, extension events like training result attitudinal change of household. Results of the study indicated that participation in training had positive and significant effect on magnitude of teff row planting adoption at 1% significant level (Table 4.5).

Access to Technology Input Supply (ACIPSU): Shortage of planting machinery especially implements used in making the seed to plant proportionally with equal amount and recommended distance in row was established to be one of the major constraints as far as teff row planting adoption was concerned. This was evident by having a highly significant and positive effect on magnitude of adoption teff row planting at 1% significant level (table 4.5). When suitable machinery technology like row seeder is not accessible, then labor constraint becomes more prevalence with consequent low adoption of the said teff row planting. Especially, because of teff seed is very tiny. Thus farmer' expressed interest in adopting the high yielding varieties coupled with acceptable processing characteristic if suitable harvesting and processing machines for labor saving were made easily accessible.

Perception on Row Planting Characteristics (PERRPC): perception is one of the determinants of technology adoption. It is also evident from Tobit model estimate result (table 4.5) that attitude towards teff row planting is positively and significantly affected the extent of uses of teff row planting at 5% significance level. This implies that those individuals who had bad perception towards teff row planting have lower level of adoption of teff row planting as it compared with those who have positive perception.

4.2.3. Effects of Changes in the Significant Explanatory Variables on Probability of Adoption and Magnitude of Adoption of Teff Row Planting

All variables that were found to influence the adoption and magnitude of use of teff row planting might not have similar contribution in influencing the decision of farm household. Hence, using a decomposition procedure suggested by McDonald and Moffitt (1980), the results of Tobit model was used to assess the effects of changes in the explanatory variables into adoption and magnitude of use and the result is presented in Table.

Table 4.6 Marginal Effects of Determinant Variables

Variables	Change in the probability of Adoption	Change in magnitude of Adoption
HHAGE	-.0423032	-.0108391
EDUCAHH	.127481	.0326637
FARMEXP	.0482423	.0123608
LANDHOLD	-.034763	-.0089071
TRAIRPT	.3780914	.1031877
ACIPSU	.7189077	.6826472
PERRPC	.2374238	.0608337

Source: model output, 2017

The results computed (table 4.6) indicate that the estimated increase in the probability of adoption and magnitude of use of teff row planting resulting from having access to technology input supply and access to training on row planting technology are 71.8% and 68.3% for input supply and 37.8% and 10.3% for training respectively (cetirus paribus) which were very large as compared to the changes resulting from other significant variables.

A change in perception towards row planting brings about 23.7% increases of probability of adoption and 6.1% of magnitude of use of teff row planting by the adopters (other factors kept constant) (table 4.6). This implies the need to give emphasis on awareness creation by strengthening institutional supports to improve farmers' perception to enhance adoption of teff row planting. Households headed by literate household heads have 12.7% higher probability and 3.3%

higher magnitude of adoption of teff row planting; whereas, an increase in farmers experience increases probability of adoption and magnitude of use of teff row planting by 4.8% and 1.2% respectively (cetirus paribus) (table 4.6).

The estimated influence of household head age is negative (in agreement with the hypothesis) and results in a reduction of probability of adoption and magnitude of use of teff row planting by about 4.2 % and 1.1 % respectively (other factors kept constant) (table 4.6). The same is true for land holding. The marginal effect result shows that, being the owner of large farm land decreases probability of adoption and magnitude of use of teff row planting by 3.4 % and 1.0% respectively (table 4.6).

CHAPTER FIVE: CONCLUSION AND RECOMMENDATIONS

5.1. Conclusion

The study was conducted in Minjar shenkora Woreda, with the objective of assessing the determinants and magnitude of teff row planting adoption. In the study area, teff is an important crop, which serves as a major source of income. Considering the contribution of teff production in the study area, the local government has introduced different agricultural technologies as a component of institutional support services. Row planting is one of the new agricultural technologies being introduced during recent times. Despite of such institutional support services, utilization of improved technologies remained low in Minjar Shenkora woreda. Hence, the aim of this study was to identify household, socio-economic, institutional, and socio-psychological factors in relation to adopting teff row planting.

In this study a two stage sampling techniques were employed. Purposive sampling design was used to identify the two kebeles in the woreda. Finally, random sampling technique was used to identify 115 households, 47 from the adopters and 68 from non-adopters side. Data for this study were collected by directly through structured interview.

In addition, secondary data were obtained from various relevant sources. Descriptive statistics were used to describe the household and farm characteristics. Mean, standard deviation, T-test and Chi-square test were employed to differentiate between two groups. According to descriptive analysis, some variations were observed between adopters and non-adopters in terms of household personal characteristics, socio-economical, institutional and socio-psychological factors.

The two groups differ to some extent in their age, sex, education level, farming experience, income generated from on-farm and off-farm, participation in Social organization, land holding, available labor, number of livestock, credit access, perception on RP characteristics, access to technology input supply, training on row planting, and frequency of contact with extension agent(s).

Results from the econometric Logit and Tobit models indicated that, six and seven of the fifthteen explanatory variables from Logit and Tobit models respectively, were significantly influencing teff row planting adoption. Namely: Age, farmers experience, total annual income, access to credit,

training and perception are those variables from logit estimation side where as education level, farming experience, training, access to input supply and perception towards row planting are those variables from tobit estimation side were positively and significantly influence at 1%, 5% and 10% level of significance. On the other hand, land holding variable from Tobit estimation side and age of household head variable from both sides have negative and significant influence at 1%, 5% and 10% level of significance on adoption of teff row planting. The remaining explanatory variables were not the correct predictors of adoption in the study area.

This study has identified key factors that affect teff row planting adoption process in the study area. Teff row planting adoption is influenced by several factors including household (personal), socio-economic, institutional and socio-psychological factors which reflect adverse effects on crop production of the society as a whole. The problems existed in households related to teff row planting adoption were found to be inter-related each other. This study therefore was conducted to assess the determinants and magnitude of teff row planting adoption. Based on the findings of this study, the study has made the following recommendations.

5.2. Recommendations

According to the findings of this study, adoption and variations in magnitude of adoption of teff row planting between households was found to be influenced by different factors. Most of the factors that were distinguished with this study were institutional and soci-economic variables that are related with support services that have huge role on farmers to adopt and reject as well as continuous use of teff row planting. Therefore, the concerned bodies at zonal and woreda level should give attention to make those services more accessible.

From the survey result obtained that, access to technology input supply positively influencing the adoption of teff row planting variety at 1% level of significance. The same is true for training. It is also important for getting technical support to manage newly introduced agricultural innovation on how to use it practically for increasing the production performance of the commodity in the real life situation. Therefore, strengthening farmer training centers and equipped farmers with row seeder machine is very important to adopt and expand the new innovation in a sustainable way. Additionally, distributing bicycle and improving educational performance of the extension agents is important to improve farmer` adoption of teff row planting in the area.

Credit access is significantly and positively influencing adoption of teff row planting at 5% level of significance. It is critically important for managing the crop according to precision demand required for it. Therefore, making credit easly accessable either in cash or in kind is very important. Because credit service enables the farmer to have enough cash to buy important inputs like row seeder machine and hire labors. This help to increase the production performance of the farmers.

The age of the farmer was significant on the likelihood and intensity of teff row planting adoption. Younger farmers adopted more teff row planting technology than older farmers suggesting that more attention should be given to younger farmers to enhance adoption of improved technologies and increase productivity. The same has to be done for those who are experienced in farming.

Above all, changing the perception of farmers towards teff row planting is crucial factor for improving the adoption and production performance of the farm households. It is necessary to encourage farmers to use teff row planting to bring advisable change in the agricultural production and development.

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APPENDICES

Appendix 1: Conversion Factor for Adult-Equivalent Unit (AE)

No.	Age group	Male	Female
1	<10	0.6	0.6
2	10-13	0.9	0.8
3	>13	1	0.75

Source: Storck, et al., 1991

Appendix 2: Conversion factor used to estimate TLU

Type of animal	TLU	Type of animal	TLU
1. Cows	1	2. Sheep	0.1
3. Oxen	1	4. Chicken	0.013
5. Heifers	0.75	6. Donkey	0.5
7. Calves	0.4	8. Horse	0.8
9. Bulls	1	10. Goats	0.1

Source: (Freeman *et a*l., 1996)

ANNEXS

Annex 1: Variance inflation factor and tolerance for the continuous variables

Variable	VIF	1/VIF
FARMEXP	4.79	0.203520
HHAGE	4.60	0.209357
NOLTLU	1.93	0.492724
HHLAVA	1.78	0.556815
LANDHOLD	1.46	0.574602
TOANIN	1.26	0.660112
Mean VIF	2.64	

Source: Own computational result, 2017

Annex 2: Contingency coefficient for dummy variables to test multi-collinearity

Variables	1	2	3	4	5	6	7	8
SEXHH	1							
EDUCAHH	0.2050	1						
PAROFA	0.2775	0.0463	1					
CREDITACC	0.1599	0.1702	0.1016	1				
FRECONEA	0.2576	0.2154	0.0409	0.0407	1			
TRAIRPT	0.0517	0.0237	0.0643	0.1488	0.3889	1		
SOCIALPART	0.0676	0.0692	0.0173	0.1085	0.1117	0.1524	1	
ACIPSU	0.0617	0.0858	0.0722	0.0539	0.0390	0.0948	0.0677	1

Source: Own computational result, 2017

Annex 3: Interview Schedules

Questionnaire for data collection

SAINT MARY UNIVERISTY

INSTITUTE OF AGRICULTURE AND DEVELOPMENT SYUDIES

DEPARTMENT OF AGRICULTURAL ECONOMICS

Magnitude and determinants of adoption of teff row planting in Minjar Shenkora Woreda

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Questionnaire Used for Collecting Data from Row planting method Adopter and Non adopter Farmers

Purpose: The objective of this questionnaire is to find out the determinants of the magnitude of teff row planting adoption in Minjar shenkora wereda. The information to be gathered through the questionnaire is basic to plan for an intervention that would enable and understand the gap of adoption. The study will also give information for those who want to conduct further study on the issue.

Instruction for Enumerators

1. Introduce yourself before starting interview and tell the purpose of the study.
2. Encircle all closed questions when answered by respondents and write additional answers in the space provided.

General information

- Date of interview _____
- Region _____
- Woreda _____
- Name of kebele _____
- Name of enumerator _____

- Signature of enumerator _____

1. Household characteristics

1.1. Name of the respondent: _____

1.2. Age of the respondent _____

1.3. Sex: 1= Male___ 2=Female___

1.4. Education level

No	Education level	Mark (√) in your level	Remarks
1.	Illiterate		
2.	Read and write		
3.	1-12 grade(specify)		
4.	Certificate and above (specify)		

1.5. How long have you been in farming (farming experience)? in years _____

1.6. Row planting experience of the household head in years_____

1.7. Household demographic characteristics. (Please put a right mark "√" in front of your choice)

Code of family member	Age	Sex: 1= Male; 2= Female	Remarks
1.			
2.			
3.			
4.			
5.			
6.			
7.			

2. Household Ownership

2.1. Land ownership in 2007/2008 E.C (total farm size owned (in hectare) _____

2.2. The land size allocated/covered by teff crop in 2007/2008 cropping season----------Timad

2.3. The land size allocated/covered by row planted teff in 2007/2008 cropping season ----------
Timad

Land allocation	Land size (in Timad)
	Using broadcasting technique
1. Coverage of teff crop	
2. Land covered by pulses	
3. Land covered by barley	
4. Land covered by wheat	
5. Vegetables and others	
6. Total	

2.4. Livestock ownership (At the end 2007/2008 E.C)

Type of animal	Number	Type of animal	Number
11. Cows		12. Sheep	
13. Oxen		14. Chicken	
15. Heifers		16. Donkey	
17. Calves		18. Horse	
19. Bulls		20. Goats	
21. Others		22. Total	

2.5. Household labor availability in (At the end 2008/2009E.c)

No	Age specify	Sex		*Activities participated in teff production
		Male	Female	

1.				
2.				
3.				
4.				
5.				
6.				
7.				

* Teff production activities includes: - 1) Land preparation 2) sowing 3) Weeding 4) Harvesting 5) Threshing 6) Transportation 7) Storage 8) Marketing 9) others (specify

3. Economic variables

3.1. In which income group do you locate yourself in the community? (0) High income group (1) Middle income group (2) Low income group

Annual income table

No.	Income group	Amount	Specify the amount
1.	High income group	≥ 100,000	
2.	Middle income group	20,000 – 100,000	
3.	Low income group	≤ 20,000	

3.2. Household's annual farm income from sale of crops /2007/2008E.C/

Types crop grown	Annual harvest	consumed	Gift	Sold		Total price
				Amount Quintals)	Unit price	
Teff crop						
pulses						
other cereals						

Vegetables and others						
Total						

3.3. Income from sale of livestock/2007/2008 E.C /

Type of animal	Number sold	Unit price	Total sale price	*Purpose
1. Cows				
2. Oxen				
3. Heifers				
4. Calves				
5. Bulls				
6. Goats				
7. Sheep				
8. Chicken				
9. Donkey				
10. Horse				
11. Others				
12. Total				

*Purpose includes 1) For purchasing farm inputs 2) For settling debts

3) For buying clothes for family 4) For buying food grains 5) Others (Specify) ----------

3.4. Income from sale of livestock products/2008/2009 E.C/

Type of animal	Amount collected per year (in liters/kilogram/number)	Consumed	Amount sold	Unit price	Total revenue	*Purpose

Milk (liters)						
Butter (Kg)						
Egg (Number)						

*Purpose includes 1) For purchasing farm inputs 2) For settling debts

3) For buying clothes for family 4) For buying food grains 5) Others (Specify) ----------

3.5. Did you face any labor shortage during the last crop season in row planting? _____

1=Yes 2=No

3.6. How did you solve the above problems?

1=through local organization (cooperation with the nearest farmers)

2=through hiring the daily labor

3=through family labor

4=others, specify_____

3.7. On an average how many days_____ and labors (man days)_____ needed to plant one Timad of teff land?

4. Income from participation in off-farm activities.

4.1. Do you have off-farm activities? _____

1=Yes 2=No

4.2. If yes, in which of the following activities? (Fill the following tables).

No	Types of activity	Members carried out the activity	No. of participant	Average income per year
1	Petty trade			
2	Selling local beverage			
3	Fuel wood and charcoal			

	selling			
4	Local mattress preparation			
5	Timber production			
6	Labor hire out			
7	Pottery			
8	Weaving			
9	Others (specify_____			

5. Credit accessibility

5.1. Have you obtained credit for teff production in 2007/2008 years? 1=Yes….. 2=No ….

5.2. If your answer for question number 5.1. is yes, from where do you get it ----------

5.3. How much did you get? _____ amount (in Birr) _____if no, why _____

5.4. For what purpose did you use the credit? (rank if you have multiple answers)

1) For purchasing fertilizer….. 2) For purchasing improved seeds….. 3) For purchasing chemicals……. 4) For purchasing of labor (ploughing, planting, weeding, harvesting)…….. 5) Other purpose (Specify) _____

Ranks_____

6. Extension services, Frequency of Contact with extension Agent(s), Training on Row Planting Technology

6.1. Do you get advisory services from extension agents? _____ 1=Yes 2=No…….

6.2. When does extension agent visit you? _____ A) During land preparation B) During Sowing C) During weeding…… D) When disease/ pest occur…… E) during harvesting F) others (Specify) _____

6.3. What are your other sources of information and how often you use/ have contact with them?

No	Source of information	How often you contact them					Means of information
		Never	Once in a	Monthly	weekly(4)	Daily(5)	

		(1)	year (2)	(3)			exchange
1.	Researcher						
2.	Contact Farmer						
3.	Fellow Farmer						
4.	PA leader						
5.	NGOs						
6.	Cooperative						
7.	Neighbor/Friends						
8.	Agri. experts						
9.	Mass media						
*Means of information exchange: 1) Demonstration 2) Field day/visit 3) Training 4) Written materials (leaflets, manuals, and so on) 5) Others (Specify) ----------							

6.4. When have you first heard about row planting? _____E.C.

6.5. From who/ which source? _____ categories from the above table (value from 1 - 9)

6.6. Have you participated in field day/ visit in the last five years? _____ 1) Yes 2) No

6.7. If yes, how many times? _____, and Who arranged for you? 1. OoARD 2. Research org. 3. NGO 4. Others (Specify) _____

6.8. What benefit did you get from the field day? (rank if you have multiple answers)

I. Production increment

II. Getting suitable planting techniques

III. Getting comparative advantage of planting techniques

IV. Others specify _____

6.9. Have you ever received training in teff row planting in the last five years? _____ 1) Yes 2) No

6.10. If yes, how many times _____, and who arranged for you? _____

1. OoARD 2. Research org. 3. NGO 4. Others _____

6.11. Do you have demonstration site in your kebele? _____ 1) Yes 2)No

6.12. If the answer `yes` for question number 6.11 is `yes` in what way do you benefit from it? (rank if you have multiple answers)

I. Training about new technologies

II. Advice and crop and livestock production

III. Counseling

IV. Information access

V. Others specify _____

7. Membership of farmer's association

7.1. In which of the following organization are you member and leader? Please tick

Organization)	Membership (1) 1=member 2= non-member	Committee member (2) 1= yes, 2= No	Leader (3) 1 = yes, 2 = No
Seed multiplication group			
PA leader			
Saving and credit group			
Marketing cooperative			
Other/specify			

8. Access and utilization of inputs for teff production (2007/08 E.C. production season)

8.1. What type of mechanization did you use to plant teff in rows? _____

1=row seeder machine

2=water plastic

3=hand

4=if other, _____

8.2. Have you ever used row seeder machine _____

1=Yes 2=No

8.3. Did you use row seeder machine during the last cropping season?

1=Yes 2=No

8.4. if not, why you didn't use (Multiple response allowed)?

1=High cost of technology

2=Unavailability of the technology

3= No information about the technology

4=Assumed to be not profitable

5=Shortage of cash

6=Lack of credit

7=No willingness to use

8=others, specify_____

8.5. Under what arrangements is the row seeder utilized? _____

(1 = sole owner, 2 = shared owner, 3 = rented in, 4 = borrowed)

8.6. If 2 above, how many others are the row seeder shared with? _____

8.7. If 3 above, at what price is the row seeder rented in (ETB)? _____

9. Perception towards characteristics of row planting

9.1. What type of planting method do you prefer to use for teff production? _____

1=Broadcasting method----------

2=Row planting method----------

3=Transplanting method----------

9.2. Indicate your level of agreement or disagreement for the issues raised in the following table

Parameters	**Perception** Strongly agree - 1 Agree - 2 Neutral - 3 Disagree - 4 Strongly disagree - 5		
	Broadcasting method	Row planting method	Transplanting method

I.	It saves labour			
II.	It saves time			
III.	It saves cost			
IV.	Better weeding			
V.	It increases teff yield per hectare			
VI.	Enables to produce quality straw			
VII.	It increases straw quantity			
VIII.	If others specify and put your level of agreement			

9.3. What is your perception towards the adoption of teff row planting in your locality?

_____

_____

_____

10. Intensity of adoption of row planting technology

10.1. In the last three years production season did you use row planting? _____

1) Yes 2) No

10.2. if your answer is yes specify the number and fill the table below (teff land coverage timad)

No.	2004/05 E.C.	2005/06 E.C.	2006/07 E.C.
1.			

10.3. If you apply row planting for teff crop why did you apply it (Multiple answer allowed)? _____

1= willingly

2= imposition from government

3=through safety net program

4=pressure from colleague

5=fear of penalty from authority

6=other specify _____

10.4. How do you perceive the effectiveness of row planting method of seeding on the improvement of teff crop production? _____

1=Excellent

2=very good

3=good

4=poor

4= Very poor

if other, specify _____

10.5. Do you plan to use teff row planting method in 2009/10 E.C.? (1 = yes, 2 = no) _____

10.6. What was the most important factor in your decision to use teff row planting?

_____

10.7. What factor would most facilitate increased and sustained use of teff row planting method (Rank them)?

1=Income

2=Labour

3=credit access

4=training on row planting

5= mechanization (technology) input

6=others specify _____

Thank you!

Checklist used for conducting focused group discussion.

As you probably know, agriculture office is trying to popularize an improved technology, which should significantly increase yields. The office is also providing best practices from other areas who adopt row planting of tef. Even Agricultural agents are also supporting the farmers in different dimensions. However,

- Most of the farmers are not adopting row planting .why?
- Why are so few farmers adopting the row planting?
- Is the row planting make profitable to farmers?
- Do the farmers experienced difficulty in practicing row planting?
- What are the general impressions about the row planting?
- Which method of sowing did you use in tef production and why?
- What are the advantages of using broadcasting method?

Thank you!

ዳታ መሰብሰቢያ መጠይቅ

ቅድስተ ማርያም ዩንቨርስቲ

የግብርናና ልማት ጥናት ኢንስቲቲዩት

አግሪካልቸራል ኢኮኖሚክስ ዲፓርትመንት

Magnitude and determinants of adoption of teff row planting in Minjar Shenkora Woreda

ይህ መጠይቅ በመስመር መዝራት ዙሪያ የገበሬውን ሁኔታ ለማወቅ ታስቦ መረጃ ለመሰብሰብ የተዘጋጀ ነው።።

አላማ፡ የዚህ መጠይቅ አላማ በምንጃር ሸንኮራ ወረዳ የሚገኙ አርሶ አደሮች የጤፍ መስምር መዝራት ዘዴን የሚጠቀሙበት ደረጃና እንዲጠቀሙ ወይም እንዳይጠቀሙ የሚያደርጋቸውን ምክንያት ለማወቅ መረጃ መሰብሰብ በማስፈለጉ ነው።። በዚህ መጠይቅ መረጃ መሰብሰቡ የቴክኖሎጂው ተጠቃሚነት ላይ ያሉ ክፍተቶችን በመረዳት መስተካከል የሚችሉ ጉዳዮችን በቀላሉ ማስተካከል እንዲችሉ ለማድረግ ሲሆን ለተጨማሪ ጥናት የሚያግዙ መረጃዎችንም ለሌሎች አጥኚዎች ለመስጠት ነው።።

ዳታ ሰብሳቢው ሊያደርጋቸው የሚገቡ ነገሮች

3. መረጃ ሰብሳቢው በቅድሚያ ራሱን ያስተዋውቃል፤ ቀጥሎ ስለ ጥናቱ አላማ ይገልፃል
4. መልሱን በሚሰጡበት ወቅት ማብራሪያ ለሚያስፈልጋቸው ከነኑ በተዘጋጀው ክፍት ቦታ ላይ የሚሞሉ ሲሆን ማብራሪያ ለማይሹት በማከበብ ወይም የራይት ምልክት በማድረግ ይመልሱ

ጠቅለል ያሉ መረጃዎች

- መጠይቁ የተከናወነበት እለት _____
- ክልል _____
- ወረዳ _____
- ቀበሌ _____
- መረጃውን የሞላው/ዳታ ሰብሳቢው ስም _____
- የዳታ ሰብሳቢው ፊርማ _____

II. የተጠያቂው መረጃ /Household characteristics

1.8. የመላሹ ስም: _____

1.9. እድሜ _____

1.10. ፆታ: ወንድ__ ሴት__

1.11. የትምህርት ደረጃ

No	የትምህርት ደረጃ	የራይት ምልክት (√) ያድርጉ	አስተያየት ካለ
ነ.	ያልተማረ		
2.	መፃፍና ማንበብ የሚችል		
3.	ከነ-12 ክፍል (ክፍሉን ከጎን ይግለፁት)		
4	ሰርተፍኬትና ከዚያ በላይ (ከጎን ይግለፁት)		

1.12. በግብርና ላይ ከተሰማሩ ምን ያህል አመት ሆነዎት?_____

1.13. በመስመር መዝራት ከጀመሩ ምን ያህል አመት ሆነዎት?_____

1.14. የቤተሰብ አባላትን የተመለከተ መረጃ (በምርጫዎ አቅጣጫ የራይት ምልክት (√) ያድርጉ)

ኮድ	እድሜ	ፆታ: 1= ወንድ; 2= ሴት	አስተያየት ካለ
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			

3. የንብረት ሁኔታ/Household Ownership

3.1. ምን ያህል ሄክታር መሬት አለዎት በ2007/2008 ዓ.ም የምርት ዘመን _____

3.2. ካለዎት መሬት ውስጥ ምን ያህሉን ጤፍ ዘሩት _____

3.3. ጤፍ ከተዘራው መሬት ውስጥ ምን ያህሉ በመስመር ተዘራ _____

ለሰብል የዋለ መሬት	የመሬት ስፋት በጥማድ
	በብተና ዘዴ የተዘራ
በጤፍ የተሸፈነ	
በጥራጥሬ(Pulses) የተሸፈነ	
በጉበስ የተሸፈነ መሬት	
በስንዴ የተሸፈነ መሬት	
በአትክልት፣ ፍራፍሬና በሌሎች ሰብሎች የተሸፈነ	
ጠቅላላ	

3.4. የቤት እንስሳ ብዛት (በ2007/2008 ዓ.ም ላይ)

የቤት እንስሳው አይነት	ብዛት	የቤት እንስሳው አይነት	ብዛት
23. ላሞች		24. በጎች	
25. የእርሻ በሬዎች		26. ዶርዎች	
27. ወይፈን		28. አህያ	
29. ጥጃ		30. ፈረስ/በቅሎ	
31. ኮርማ		32. ፍየሎች	
33. ሌሎች		34. ጠቅላላ	

3.5. በ2007/2008 ዓ.ም ለስራ ዝግጁ የነበሩ የቤተሰብ አባላት ብዛት(ሰንጠረዡ ላይ ይሙሉ)

No	እድሜያቸው ከዚህ በታች ይጠቀስ	ፆታ		*በጤፍ ምርት ላይ በየትኛው ጊዜ ተሳታፊ ሆኑ(ከታች ከተዘረዘሩት ውስጥ እየመረጡ ቁጥሩን ያስቀምጡ)
		ወንድ	ሴት	
1.				
2.				
3.				

4.				
5.				
6.				
7.				

የጤፍ ምርት ሂደት፡ 1)ማሳን ለዘር ማዘጋጀት 2)መዝራት 3)ማረም 4)ማጨድ 5)መውቃት 6)ማጓጓዝ 7)መደበር፣ንተራ ማስገባት 8)ገበያ ወስዶ መሸጥ 9)ሌላ ካለ.....

4. የኢኮኖሚ ሁኔታ

4.1. በገቢዎ መጠን ከየትኛው ጎራ ይመደባሉ? (0) ከፍተኛ ገቢ (1) መካከለኛ ገቢ (2) ዝቅተኛ ገቢ

አመታዊ ገቢ መጠን

No.	የገቢ ምድብ	መጠን በብር	የእርስዎን አመታዊ ገቢ ከዚህ በታች ያስፍሩ
4.	ከፍተኛ ገቢ	≥ 100,000	
5.	መካከለኛ ገቢ	20,000 – 100,000	
6.	ዝቅተኛ ገቢ	≤ 20,000	

4.2. በግብርና ምርት ያስገባው ገቢ መጠን /በ2007/2008 ዓ.ም/ በኩንታል

የምርት አይነት	በአመቱ የተመረተ	ቤተሰቡ የተመገበው	ለሌላ ሰው የተሰጠ	የተሸጠ		ጠቅላላ ዋጋ
				ብዛት	የአንዱ ዋጋ	
ጤፍ						
ጥራጥሬ						
ሌሎች የብራንዳ እህል						
አትክልት፣ ፍራፍሬና ሌሎች						
ጠቅላላ						

4.3. የቤት እንስሳ በመሸጥ የተገኘ ገቢ/2007/2008 ዓ.ም /

የቤት እንስሳው አይነት	የተሸጠ ብዛት	የአንዱ ዋጋ	ጠቅላላ ዋጋ	*አላማ/ገንዘቡ የዋለበት/ ከታች ከሰፈሩት ዝርዝሮች መርጠው ቁጥሩን ብቻ ያስቀምጡ
13. ላሞች				
14. የእርሻ በሬ				

15. ወይፈን				
16. ጥጃ				
17. ኮርማ በሬ				
18. ፍየሎች				
19. በጎች				
20. ዶሮዎች				
21. አህያ				
22. ፈረስ/በቅሎ				
23. ሌሎች				
24. ጠቅላላ				
*ገንዘቡ የዋለበት አላማ 1) የግብርና ግብዓቶችን ለመግዛት 2) ብድር ለመክፈል 3) ለቤተሰብ አባላት አልባስና ቁሳቁስ ለመግዛት 4) የምግብ ወጪን ለመሸፈን 5) ሌላ ካለ እዚህ ይጥቀሱ ----------				

4.4. የእንስሳት ተዋፅኦዎችን በመሸጥ የተገኘ ገቢ የ/2007/2008 ዓ.ም/

የእንስሳ ተዋፅኦው አይነት	በአመት የተገኘ ምርት	ለቤት ፍጆታ የዋለ	የተሸጠ ብዛት	የአንዱ ዋጋ	ጠቅላላ ገቢ	**አላማ/ገንዘቡ የዋለበት/ ከታች ከሰፈሩት ዝርዝሮች መርጠው ቁጥሩን ብቻ ያስቀምጡ
ወተት (በሊትር)						
ቅቤ(በኪሎ)						
እንቁላል (በቁጥር)						
*ገንዘቡ የዋለበት አላማ 1) የግብርና ግብዓቶችን ለመግዛት 2) ብድር ለመክፈል 3) ለቤተሰብ አባላት አልባስና ቁሳቁስ ለመግዛት 4) የምግብ ወጪን ለመሸፈን 5) ሌላ ካለ እዚህ ይጥቀሱ ----------						

4.5. በመስመር መዝራት ያመረታችሁበት ጊዜ ላይ የሰው ሀይል/ሰራተኛ እጥረት ገጥሟችኋል? _____

1=አዎ 2=አይ

4.6. ችግሩን እንዴት ቀረፋችሁት?

1=ከሌሎች ጎረቤቶች እርዳታ/ወንፈል

2=ስራተኛ በመቅጠር

3=የቤተሰብ አባላትን በመጠቀም

4=ሌላ ካለ_____

4.7. አንድ ጥማድ የጤፍ መሬትን በመስመር ለመዝራት በአማካይ ምን ያህል ቀናት _____ የሰው ሀይል _____ ይፈጃል?

5. ከግብርና ውጭ ሌላ ገቢ የሚያገኙበት መንገድ

5.1. ከግብርና ውጭ ገቢ ለማግኘት የቤተሰቡ አባላት የሚሰሩት ስራ አለ? _____

1= የለም 2=አለ

5.2. ካለ፣ ቀጥሎ በሰንተረዡ ከተዘረዘሩት ውስጥ የትኛውን እንደሆነ ይምረጡ?

ተ.ቁ	የስራው አይነት	የቤተሰብ አባላት የሚሰሩት ስራ	ስራው ላይ የሚሳተፉ የቤተሰብ አባላት ብዛት	አማካይ አመታዊ ገቢ
1	ንግድ			
2	ጠላና አረቄ አይነት መጠጦችን ማዘጋጀትና መሸጥ			
3	ማገዶ ሽያች			
4	ፍራሽ መስራት			
5	ባህርዛፍና የቤት መስሪያ ዛፍ መሸጥ			
6	የቀን ስራ			
7	ሸክላ ስራ			
8	ሽመና			
9	ሌላ ካለ(_____			

6. የብድር አገልግሎት

6.1. ባለፉት ሶስት አመታት ውስጥ ጤፍ ለምርት ገንዘብ ተበድረው ያውቃሉ? አዎ____ አይ___

6.2. መልስዎ አዎ ከሆነ ምን ያህል ብር ተበደሩ _____ ከየት ተበደሩ _____ ካልተበደሩስ ለምን _____

6.3. ብድሩን ምን ላይ አዋሉት? (ምርጫዎትን ካከበቡ በኋላ በዳሹ ቦታ ላይ ደረጃ ይስጡት)

2) ማዳበሪያ ለመግዛት 2) ምርጥ ዘር ለመግዛት 3)ተባይ ማጥፊያ ኬሚካል መግዣ 4) የቀን ሰራተኛ መቅጠሪያ (ለእርሻ, ለዘር , ለአረም, ለአጨዳ) 5) ሌላ ካለ (_____

ደረጃቸው _____

7. የኤክስቴንሽን አገልግሎት፣ ከኤክስቴንሽን ባለሙያዎች ጋር የሚገናኙበት ጊዜ/ብዛት፣ በመስመር መዝራት ላይ የተደረገ ስልጠና

7.1. ከኢክስቴንሽን ባለሙያዎች የምክር አገልግሎት አግኝታችኋል? _____ 1=አዎ 2=አይ

7.2. መቼ መቼ ነው የኢክስቴንሽን ባለሙያዎቹ እየመጡ የሚጎበኟችሁ? _____ A) በእርሻና መሬት ማለስለስ ወቅት B) በዘር ወቅት C) በአረም ወቅት D) ተባይ ወይም የሰብል በሽታ ሲከሰት E) በአጨዳ ወቅት F) ሌላ ካለ _____

7.3. ሌላ የግብርና መረጃ የሚሰጧችሁ አካላት ካሉስ በየስንት ጊዜው መረጃ ይሰጥዋችኋል/ ያገኝዋችኋል?

No	የመረጃ ምንጮች	በየስንት ጊዜው ትገናኛላችሁ					*መረጃ የምትቀባበሉበት መንገድ(ከታች ከተዘረዘሩት ውስጥ ምረጡ)
		በጭራሽ አንገናኝም(1)	በአመት አንድ ጊዜ (2)	በየወሩ (3)	በሳምንቱ (4)	በየቀኑ (5)	
1.	ተመራማሪ						
2.	Contact Farmer						
3.	Fellow Farmer						
4.	የጎጥ መሪ						
5.	መንግስታዊ ያልሆኑ ድርጅቶች/NGOs						
6.	ህብረት ስራ ማህበር						
7.	ጎረቤት/ጓደኛ						
8.	የግብርና ባለሙያ						
9.	ሚዲያ						

*መረጃ የምትቀባበሉበት መንገድ: 1) ሰርቶ ማሳያ 2) የመስክ ምልከታ 3) ስልጠና 4) በፅሁፍ (በራሪ ወረቀት፣ ማንዋሎች፣ እና ሌሎች የፅሁፍ ማሰራጫ መንገዶች) 5) ከተጠቀሱት ውጪ ካለ----------

7.4. በመስመር ስለመዝራት ለመጀመሪያ ጊዜ የሰሙት መቼ ነው? _____ዓ.ም.

7.5. ከማን ሊሰሙ ቻሉ/የመረጃ ምንጩ ማን ነው? _____

7.6. ባለፉት 5 አመታት ውስጥ በመስክ ምልከታ ላይ ተካፍለው ያውቃሉ? _____ 1) አዎ 2) አይ

7.7. አዎ ካሉ፣ ምን ያህል ጊዜ? _____,እና እንዲካፈሉ ማን ጋበዝዎት/ የመስክ ምልከታውን ማን አዘጋጀው? 1. የወረዳው የግብርና ቢሮ 2.የምርምር ተቋም 3. መ/ያ/ድ (NGO) 4. ሌላ ካለ _____

7.8. ከመስክ ምልከታው ምን አይነት ጥቅም አገኙ? (መልስዎትን በደረጃ ያስቀምጡ)

V. የምርት ጭማሪ

VI. ተስማሚ የአዘራር ዘዴ አወቁ

VII. በአዘራር ዘዴዎች መካከል ያለውን አሰራርና የጥቅም ልዩነት አወቁ

VIII. ሌላ ካለ _____

7.9. ባለፉት አምስት አመታት ውስጥ በጤፍ የመስመር መዝራት ዘዴ ዙሪያ ስልጠና አግኝተዋል? _____ 1) አዎ 0) አይ

7.10. አዎ ካሉ፣ ምን ያህል ጊዜ_____፣ እና ማን ጋበዘዎት/ ማን ስልጠናውን አዘጋጀው? _____ 1. የወረዳው የግብርና ቢሮ 2.የምርምር ተቋም 3. መ/ያ/ድ (NGO) 4. ሌላ ካለ _____

7.11. በእርስዎ ቀበሌ ውስጥ የሰርቶ ማሳያ አለ? _____ 1) አዎ 2)የለም

7.12. አለ ካሉ፣ በምን መልኩ ይጠቅመኛል ብለው ያስባሉ? (መልስዎን በደረጃ ያስቀምጡ)

VI. በአዳዲስ የግብርና ዘዴዎች ዙሪያ ስልጠና ይሰጠኛል

VII. በሰብል ምርትና በእንስሳት እርባታ ዙሪያ የማማከር አገልግሎት ይሰጡኛል

VIII. ካውንስሊንግ

IX. የመረጃ ምንጭ ይሆናሉ

X. ሌላ ካለ _____

8. የገበሬ ማህበር አባልነት

8.1. በየትኛው ድርጅት ውስጥ አባልና መሪ ነዎት? ምልክት ያድርጉበት

ድርጅት	አባልነት (1) አባል ከሆኑ=1 አባል ካልሆኑ=2	የኮሚቴ አባል ነዎት (2) 1= አዎ, 2= አይ	አመራር ነዎት (3) 1 = አዎ, 2 = አይ
ዘር ማራባት ቡድን/Seed multiplication group			
የነጥ መሪ/PA leader			
የብድርና ቁጠባ ቡድን			
የግብይት ህብረት ስራ ማህበር			
ሌላ ካለ_____			

9. ለጤፍ ምርት የሚያገለግሉ የግብርና ግብዓቶች ተጠቃሚነት (2007/08 ዓ.ም ምርት ዘመን)

9.1. ጤፍን በመስመር ለመዝራት የምትተቀሙት ቁሳቁስ? _____

1=መስመር መዝሪያ ማሽን

2=የውሃ ፕላስቲክ

3=በእጅ

4=ሌላ ካለ፣ _____

8.8. የመስመር መዝሪያ ማሽን ተጠቅመው ያውቃሉ _____

1=አዎ 2=አይ

8.9. ባለፈው የምርት ዘመን የመስምር መዝሪያ ማሽን ተተቅመው ነበር?

1=አዎ 2=አይ

8.10. ካልተጠቀሙ ምክንያትዎ ምንድን ነው?

1=ማሽኑ ውድ ስለሆነ ነው/ከፍተኛ ወጪ ስለሚያስወጣ

2=ማሽኑ በአካባቢዎ ባለመኖሩ

3= ማሽኑ ስለመኖሩ ስለማያውቁ

4=አዋጪ አይደለም ብለው ስለሚያስቡ

5=የገንዘብ እጥረት ስለገጠምዎት

6=የብድር እጥረት ስለገጠምዎት

7=ለመጠቀም ፈቃደኛ ስላልሆኑ

8=ሌላ ካለ_____

8.11. ከተጠቀሙ የመስመር መዝሪያ ማሽኑን ከየት አገኙ? _____

(1 = በግልዎ ገዝተው፣ 2 = ከሰዎች ጋር በጋራ ገዝተው፣ 3 = ከሌሎች ተከራይተው፣ 4 = ከሌሎች ተውሰው)

8.12. ከሰዎች ጋር በጋራ ገዝተው ከሆነ ሰዎቹ ስንት ናቸው? _____

8.13. ተከራይተው ከሆነ፣ በስንት ብር ተከታዩት? _____

10. በመስመር መዝራት ዘዴ ላይ ያለ አመለካከት

10.1. ጤፍ ለማምረት የትኛውን አይነት የመዝራት ዘዴ መጠቀም ይመርጣሉ? _____

1=የብተና ዘዴ----------

2=በመስመር የመዝራት ዘዴ----------

3=ከአንድ አካባቢ ነቅሎ ሌላ ቦታ በመውሰድ መትከል ዘዴ/Transplanting method----------

10.2. ቀጥለው የተዘረዘሩት ነጥቦች ላይ ምን ያህል የሚስማሙ ወይም የማይስማሙ መሆኑን ይጠቁሙ

መስፈርቶች	**አመለካከት(ቁጥሩን ከታች ይሙሉ)** በሚገባ እስማማለሁ - 1 እስማማለሁ - 2 ገለልተኛ - 3 አልስማማም - 4 በፍፁም አልስማማም - 5		
	የብተና ዘዴ	በመስመር የመዝራት ዘዴ	አፈላሾ /Transplanting method

IX.	የሰው ሀይል ይቆጥባል/ብዙ ሰራተኛ አይፈልግም			
X.	ነጊዜ ይቆጥባል/ ብዙ ጊዜ አይፈጅም			
XI.	ወጪ ይቆጥባል			
XII.	ለአረም አያስቸግርም			
XIII.	በሄክታር የሚሰጠው የጤፍ ምርት ከፍተኛ ነው			
XIV.	ጥሩ ጭድ ይወጣዋል			
XV.	ብዙ ጭድ ያስገኛል			
XVI.	ሌላ ካለ እዚህ ካሰፈሩ በኋላ የስምምነት ደረጃዎንም ይጠቁሙ			

10.3. በአጠቃላይ ጤፍን በመስምር መዝራት ላይ የሚሰማዎትን ይግለፁ?_____
_____
_____

11. ገበሬው የመስመር መዝራትን የተቀበለበት መጠን/ ደረጃ

11.1. ባለፉት ሶስት አመታት በመስመር መዝራትን ተጠቅመዋል? _____

1) አዎ 2) አይ

11.2. ከተጠቀሙ ከታች ያለውን ሰንጠረዥ ይሙሉ?

	2004/05 ዓ.ም	2005/06 ዓ.ም	2006/07 ዓ.ም
ስንት ጥማድ የጤፍ መሬት በመስመር ዘሩ?			

11.3. ጤፍ ለመዝራት በመስመር መዝራትን ከተጠቀሙ እንዴት ሊጠቀሙት ቻሉ?_____

1= በፍቃደኝነት

2= ከመንግስት/የወረዳ ግብርና ቢሮ ተፅዕኖ ምክንያት

3=በሴፍትኔት ፕሮግራም አማካኝነት ተገፋፍተው

4=በጎረቤት/ጓደኛ ተገፋፍተው

5=በአካባቢ ባለስልጣን/መሪዎች ቅጣት እንዳይጣልብዎ ሰግተው

6=ሌላ ካለ ይጥቀሱ _____

11.4. በመስመር መዝራት በጤፍ ምርት ላይ የሚበረክተውን አስተዋፅኦ እንዴት ይገልፁታል?_____

1=በጣም ጥሩ

2=ጥሩ

3=ዝቅተኛ

4=ሌላ ካለ _____

11.5. በሚቀጥለው አመት (2009/10 ዓ.ም) በመስምር ለመዝራት አቅደዋል? (1 = አዎ, 2 = አይ) _____

11.6. አዎ ካሉ የትኛውን ሰብል በመስመር ይዘራሉ? _____

11.7. በመስመር ለመዝራት ሲያስቡ ተግዳሮት የሆነብዎ ነገር ምንድን ነው? _____

11.8. ከሚከተሉት ውስጥ ቀጣይነት ላለውና በተነቃቃ ሁኔታ ሰዎች በመስመር የመዝራት ዘዴን እንዲጠቀሙ የሚያደርጋቸው የቱ ነው?

1=የገቢ መጠን

2=የሰው ሀይል ብዛት

3=የብድር አገልግሎት

4=በመስመር መዝራት ዙሪያ የሚሰጥ ስልጠና

5= የመስመር መዝሪያ ማሽን መኖሩ

6=ሌላ ካለ _____

አመሰግናለሁ!