Adoption and Cost Benefit Analysis of Sesame Technology in Drought Prone Areas of Ethiopia: Implication for Sustainable Commercialization

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Abstract
This article documents the determinants of household-level of adoption and cost benefit analysis based on the data collected in 2014 G.C from 140 randomly -selected households in drought prone areas of Ethiopia namely from West Herreghe Zone, Meisso district. Data for the study was obtained from formal household questionnaire survey, key informant discussion and direct observation of farmers fields. .In addition, secondary data were collected from relevant sources such as different research institute, zonal and wereda bureau of agriculture . In order to describe and compare different categories of the sample units with respect to the desired characteristics mean, standard deviation and percentage were used. Furthermore, chi-square test and an independent sample t-test were used to identify variables that vary significantly between adopters and non-adopter.Logistic regression (binary logit) analysis was used to identify the relative importance of the various factors associated with adoption of improved sesame technologies. The economic analysis using the partial budgeting method and price sensitivity analysis were also used to ascertain the profitability of the adopted improved sesame technologies. The result of the study indicated that about 42.9% of the sample respondents were adopters of the improved sesame technologies ,while 57.1 % non- adopters. Results of the logistic regression analysis indicate that among 18, identified explanatory variables 9, of them significantly influenced adoption of improved sesame technologies. Education,sex, family labor supply, livestock onwership,total farm income earned ,perception on varieties attributes, farmer to farmers knowledge sharing and years experience in sesame crop production are associated singificantly and positively with adoption of improved sesame technologies.whereas,distance from market center is associated significantly but negatively. The partial budget results also indicate that improved sesame technology was highly profitable compared to local cultivars .The overall finding of the study underlined the high importance of institutional support in the areas of extension service to insist farmer-to-farmer knowledge sharing, credit and market to enhance adoption of improved sesame technology. There is also need to consider farmers' views during the new technology development, evaluation and dissemination process. Moreover, due attention and policy consideration has to be given by government to those significant variables which have a potential impact in determining farmer's adoption decision in the study area.
Keywords: Logistic regression (binary logit) analysis, seseame tecchnology adoption, Cost Benefit Analysis Sensitivity , Ethiopia

1. Introduction

Achieving national food security and diversifying export earning agricultural commodity is one of the major challenge currently facing developing countries like Ethiopia. Oils crop in general and sesame productions in particular play a great role in improving household's food security. It also is one of Ethiopia's fastest growing and important sectors, both in terms of its foreign exchange earnings and as a main source of income for over three million Ethiopians. It is the second largest source of foreign exchange earnings after coffee [1]. Hence, an oils crop plays a vital role in Ethiopian economy.

Among the oils crops, sesame is one of the biggest export earner for Ethiopia .Due it is organic seed (with out use of inorganic fertilizer and pesticides), the demand of Ethiopian sesame is growing in the world market. For instance, the Ethiopian white sesame seed is used as a reference for grading in international markets. This may be the reason why Ethiopian government indicates the oils seeds specifically sesame as high priority export crop. In the last few years, sesame production has demonstrated highly significant growth. In 1997 the total area under sesame production was about 64,000 ha. In nearly ten years' time (up to 2007), the total area of sesame production has increased by more than 200% to about 211,000 ha. Similarly, the quantity of sesame produced during the same period, which is mainly intended for export, has also increased from 42,000 tones in 1997 to about 149,000 tones CSA, 2007, which is again an increment of over 250% [2].

However, despite the country has high potential to increase production and rapidly demand growth in the international market of Ethiopian sesame, the productivity of the crop is low as compared to its potential yield. Some of the contributing factors to the low productivity level are low yield potential of seed cultivars, low quality of seeds, erratic rainfall, and susceptibility of seeds to biotic and a biotic stress, low adoption of improved technologies mainly seed and recommended management practices [3]. Farmers in the districts of West Hararghe in general and the study area, in particular are among those who are suffering from the problem of low yield.

In order to increase productivity and production, the research centers in the Ethiopia have released many improved sesame technology. Since the establishment of Ethiopia Institute of Agricultural Research (EIAR) particularly during the period 1980–2005/06, about ten improved sesame varieties were developed and recommended for the suitable agro ecology [4] . Besides the technology generation, efforts were also made to promote this technology in potential production areas in the country. A Meisso district is among the area where this improved sesame varieties were introduced to improve the income and food security status of farmers. This has been done through on farm demonstration and seed dissemination through the collaborative efforts of various institutions such as Melka Werer research center, IPMS project, woreda Office of pastoralist and Rural Development and some NGOs. The produced seeds were also popularized to the farming community through farmer-to-farmer seed exchange system.

In spite of such intervention made so far, information with regard to adoption of improved sesame technology on locally specific factors influencing adoption, and the financial profitability of improved sesame technologies being promoted in the woreda was not systematically studied and documented in the study area. Hence, this study was aimed at assessing financial benefits and factors that influence the adoption of sesame varieties and farmers' perception about improved sesame varieties attributes.

The overall objective of the paper is to assess the cost benefit, level of adoption and its determinants among the farm households in drought prone areas of Ethiopia. The specific objectives are to:-

- assess the relative financial profitability of improved sesame technology adoption
- document the perception of farmers about improved sesame technology attributes
- determine the relative importance of the various factors associated with adoption of sesame technology

2. RESEARCH METHODOLOGY

2.1. Description of the Study Area

The study was undertaken in Meisso Wereda of West Hararghe Zone of Oromiya National Regional State (Figure2). Meisso is located at a distance of 300 kms away from Addis Ababa along the main road to Dire Dawa. It is situated between latitude of 40^0 9"30 E and 8^0 48 12" N and 9^0 19"52" N (IPMS report, 2006). The woreda has shares boundaries with East Doba, north of Chiro & Guba Koricha, northeast of Anchar woredas; and northwest of Somali and south and southwest of Afar Regions. The woreda has a total land area of 196,026 hectares. The altitude of the woreda ranges from 900 to 3106 m.a.s.l. and the wide range of the area has gentle slope and sloppy at the border. The most common and dominating soil type is vertisols. The annual temperature varies between 24 °C to 28 °C .The mean annual rainfall ranges from 400 to 900 mm with an average of about 700 mm and it is erratic in nature. A small rain occurs between March and April, while the main rainy season occurs between July and September .The woreda has a total of 45 kebeles. Of the total kebeles, 34 belong to agro-pastoral and 11 pure pastoralists [5]. The location of Meisso woreda is shown in Figure 2.

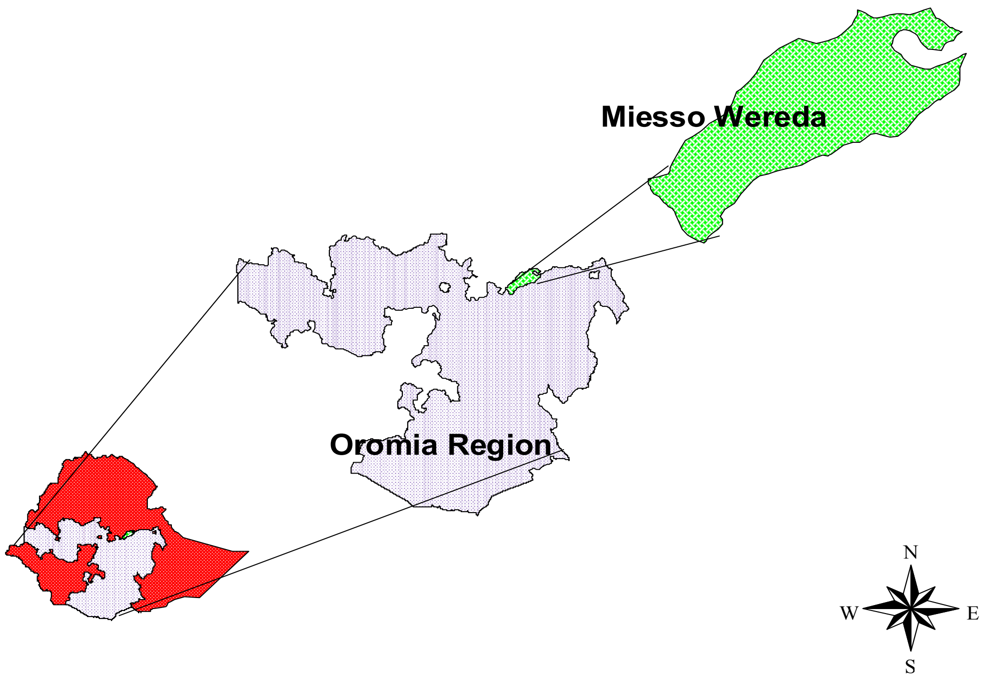

Figure 1.Map of Meisso district

2.2. Sampling Procedure

A three- stage sampling technique was used to select sample respondents. In the first stage, Meisso Woreda was purposively selected for this study because of the fact that improved sesame technology is widely popularized by various governmental and non governmental organizations in the area. The study covered four randomly sampled PAs namely; Ittisa Roro, Hunde Misoma, Oda roba and Harmero deyima from the wereda. The target population of this study consisted of smallholder farmers.

The second stage was the selection of PAs using a simple random selection method, while the second involved the selection of farm households to be interviewed. Lists of a total of 45 PAs in Meisso Woreda were obtained from the WoAPD. Among a total PAs found in the woreda, 11 PAs belong to pure pastoralist farming system while the remaining 34 PAs are agro pastoral production system. The latter farming system where sesame crop is extensively produced by the farmers and improved sesame technologies have been widely popularized by research centers, WoAPD and others organizations. Four PAs were selected, using simple random sampling technique from the 34 agro-pastoral PAs. The list of sesame producing households in the selected PAs were obtained from the concerned office and 140 sample farm households were randomly selected based on probability proportional to size of sesame producing households in each selected PAs(Table2)

Table 1. Sampled PAs and number of households selected from each sampled PAs

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

Source: WOoPRD, 2013

2.3. Data and Data Collection Methods

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

Primary data were collected using quantitative approach by means of household survey using a set of pre-tested questionnaires. The household survey was carried out from December to January, 2014. The qualitative method of data collection was also employed. It consisted of in depth open- ended interviews, direct observations and written documents. The interview method was mainly emphasized. Group discussion and individual interviews were held to have reactions of the farmers concerning their detail experiences and their perceptions of the technology and their experience in sesame knowledge sharing. Discussions were also conducted with experts of Meisso Woreda Pastoralist and Rural Development Office and key informants.

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

2.4. Method of Data Analysis

2.4.1. Descriptive statistics

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

2.4.2. Improved sesame varieties adoption analysis

2.4.2.1. Selection of appropriate econometric model

The logit and probit are the two most commonly used models for assessing the effects of various factors on the probability of adoption of a given technology. These models can also provide the predicted probability of adoption. The logit model follows a logistic distribution function, whereas the probit model follows a normal distribution function. Yet both models usually yield more or less similar results. The choice between the two models is thus a matter of convenience to the analyst. However, often logit model is preferred as it simplifies the estimation and interpretation of parameters [6]. Hence, the current analysis opted for the logit model and employed in modeling demographic, socio-economic, institutional and psychological (perceptions) factors influencing the probability of adoption of improved sesame varieties by farm households in the research area.

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

Following Maddala [7] and Gujarati [8] the logistic distribution function for the adoption of improved sesame varieties can be specified as:

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

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

e^{zi} = stands for the irrational number e to the power of Z_i.

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

$Z_i = B_0+B_1X_1+B_2X_2+\ldots+B_nX_n$...(2)

Where, X_1, X_2, X_n = explanatory variables. B_0- is the intercept, $B_1, B_2 \ldots B_n$ are the logit parameters (slopes) of the equation in the model. The slopes tell how the log-odds ratio in favor of adoption of improved sesame varieties changes as an independent variable changes. The unobservable stimulus index Z_i assumes any values and is actually a linear function of factors influencing adoption decision of improved sesame varieties. It is easy to verify that Z_i ranges from $-\infty$ to ∞, P_i ranges between 0 and 1 and that P_i is non-linear related to the explanatory variables, thus satisfying two requirements:

- As X_i increases P_i increases but never steps outside the 0 and 1 interval; and
- The relationship between P_i and X_i is non-linear, i.e., one which approaches zero at slower and slower rates as X_i gets small and approaches one at slower and slower rate as X_i gets very large. But it seems that in satisfying these requirements, an estimation problem has been created because P_i is not only non-linear in X_i but also in the B's as well, as can be seen clearly below.

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

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

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

Therefore, the odds ratio can be written as:

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

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

$$L_i = L_n\left(\frac{P_i}{1-P_i}\right)= L_n\left(e^{B_0+\sum_{i=1}^{n}B_iX_i}\right) = Z_i = B_0+\sum_{i=1}^{n}B_iX_i \quad \ldots\ldots (6)$$

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

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

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

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

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

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

Test for Multicollinearity

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

In this study a Variance Inflation Factors (VIF (X_i)) technique was employed to detect the problem of multicollinearity for continuous variables [8]. Each selected continuous explanatory variable (X_i) is regressed on all the other continuous explanatory variables, the coefficients of determination (R_i^2) being constructed in each case. If an appropriate linear relationship exists among the explanatory variables, then this should show up as a 'large' value for R_i^2 in at least one of the test regressions. A popular measure of multicollinearity associated with the VIF (X_i) is defined as:

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

Where, R^2_i is the coefficient of multiple determinations when the variable X_i is regressed on the other explanatory variables. A rise in the value of R_i^2 that is an increase in the degree of multicollinearity, does indeed lead to an increase in the variances and the standard errors of the OLS estimators. A VIF value greater than 10

(this will happen if R_i^2 exceeds 0.90) is used as a signal for the strong multicollinearity (Gujarati, 1995).
Similarly, there may be also interaction between two qualitative variables, which can lead to the problem of multicollinearity or association. To detect this problem, coefficients of contingency were computed from the survey data. According to Healy (1984), contingency coefficient is a chi-square based measure of association where a value 0.75 or above indicates a stronger relationship. Accordingly, there was no strong association between the dummy variables included in the model. The VIF and contingency coefficients are presented in appendix tables 3 and 4, respectively. The contingency coefficient is computed as follows:

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

Where, C = Coefficient of contingency, n = total sample size and χ^2 = a chi- square value which is estimated as using the following formula.

2.4.2.2. Definition of variables and working hypotheses

Adoption literatures provide a long list of factors that may influence the adoption of agricultural technologies. Generally, farmers' decision to use improved agricultural technologies in a given period of time are hypothesized to be influenced by a combined effect of various factors such as household characteristics, socioeconomic and physical environments in which farmers operate. Based on the previous study done on the adoption of improved crop technologies and the experience of the farming system of the study area, the following listed explanatory variables in the table were selected for this study.

Definition variables	Nature and units of measurement of variables	Expected Sign
Dependent variable		
Adoption of improved sesame technology	Dummy (0=No, 1=Yes)	
Independent variables		
Gender of the household head	dummy ,0,female,1,male	Positive(+)
Education of the household head ((H_EDUC)	dummy ,0,ilterate,1,male	Positive(+)
Sesame production experience of the HHs	number of years on farm	Positive(+)
Participation in local administration (PARTNADMN)	dummy ,0,No,1,Yes	Positive(+)
Family labor supply (FAMLOB)	Number (ME)	Positive (+)
Total farm size (H_CULL)	Cultivated area in ha	Positive(+)
Number of livestock owned	TLU	Negative(-)
Total annual income(TINCOM)	In Ethiopian birr	Positive(+)
Timely availability of input (H_INPUT)	dummy ,0,No,1,Yes	Positive(+)
Distance to nearest all weather road	Kilometers (km)	Negative (-)
Credit use	Dummy(0=No, 1=yes)	Positive(+)
Perception of household head on the relative attributes of sesame varieties (H_PERAT):	(0= not superior, 1= superior to local	Positive(+)
participation on crop production training	dummy (0= No, 1=Yes)	+
participation on crop demonstration	dummy (0= No, 1=Yes)	+
Participation on Farmer to farmer knowledge sharing (FFKNWSH)	dummy (0= No, 1=Yes)	+
Participations on experience sharing filed visits (H_FFEXP)	dummy (0= No, 1=Yes)	+
Frequency of Extension contact in a given production year (H_FREQUNCY	Total number of days per year	+
Radio ownership (RADIO):	dummy (0= No, 1=Yes)	+

2.4.3. Partial budgeting analysis

Partial budgeting analysis was used to determine the level of profitability of improved sesame technology over the local varieties. The success of partial budgeting depends on prediction accuracy, which depends on the accuracy of the information and estimates it contains. Partial budget crystallizes ultimately into the statement of costs and returns based on input and output data.

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

$$NB = GB - TC \quad \ldots\ldots 11)$$

$$MB = NBIV - NBLV \quad \ldots\ldots 12)$$

$$MC = TCIV - TCLV \quad \ldots\ldots 13)$$

$$MRR = \frac{MB}{MC} \times 100\% \quad \ldots\ldots 14)$$

where,

NB = Net Benefit

GB = Gross Benefit

TC = Total Cost

MRR = Marginal Rate of Return

MB = Marginal Benefit

MC = Marginal cost

NBIV = Net Benefit of Imroved Variety

NBLV = Net Benefit of Local Variety

TCIV = Total cost of Improved Variety

TCLV = Total cost of Local Variety

3. RESULTS AND DISCUSSION

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

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

3.1.1. Household size and structure

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

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

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

Table 2. Distribution of sampled households by demographic characteristics

Description of Variables	Overall		Adopter		Non-adopter		Test value
	Mean	SD	Mean	SD	Mean	SD	χ^2/t
Households' average family size	7.1	2.3	7.8	2.49	6.6	2.13	3.15**
Average number of economically active members	2.99	1.31	3.28	1.58	2.7	1.02	2.22**
Average labor force (ME)	3.7	1.44	4.3	1.5	3.2	1.1	5.43***
Dependency ratio	1.62	1.05	1.7	1.2	1.55	0.92	0.870

Note, SD= standard Deviation
***, ** Significant at 1% and 5 % level respectively
Source: Own survey, 2013

3.1.2. Characteristics of household heads

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

Table 3.Distribution of sampled households by the characteristics of household heads

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

Note, SD= standard Deviation, f= frequency, %= percentage, χ= mean of sample farmers
***, ** Significant at 1% and 5 % level respectively
Source: Own survey, 2013

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

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

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

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

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

3.1.3. Cropland holding and acquisition

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

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

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

Table 4.Distribution of sampled households by crop land holding

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

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

3.1.4. Livestock holding and oxen ownership

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

The average size of livestock kept by adopters and non-adopters are presented in Table 6. The livestock species found in the study area are cow, oxen, sheep, goat, chicken, donkey, camel, sheep, calves and heifers. To help the standardization of the analysis, the livestock number was converted to tropical livestock unit (TLU).The conversion factors used were based on Freeman et al. (1996) and it is shown in Appendix 4.The average livestock ownership of sampled households was 5.81 TLU, while for the adopters was 6.45TLU and for the non adopters was 5.4 TLU. The mean comparison showed that the cattle owned mean difference between the two groups is statistically significant at 5 percent significant level. The implication is that adopters have more access to financial capital by selling their cattle to purchase improved seed from suppliers.

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

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

Table 5.Distribution of sampled households by livestock holding

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

** Significant at 5 % level

Source: own survey results data 2013

3.1.5. Access to knowledge and information

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

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

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

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

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

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

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

Table 6. Distribution of sample households by access to information and knowledge

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

*** Significant at 1% level

Source: own survey result, 2013.

3.1.6. Use of credit and timely availability of agricultural input

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

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

Table 7.Distribution of sampled households by use of credit and agricultural input

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

Source: Owen survey, 2010

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

3.1.7. Access to market

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

Table 8.Distribution of distances from market center to residence of sampled households

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

***Significant level at 1% significant level

Source: own survey results 2013

3.1. 8. Non- crop incomes and sources

3.1.8. 1. Livestock incomes and sources

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

Table 9.Income Sources of sampled households from sale of livestock and product

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

**Significant level at 5% significant level

Source: own survey results 2013

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

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

Access to off /non-farm sources of income can affect the decision to adopt new sesame varieties. This is particularly true if the adoption of the new sesame technology would require a minimum investment in purchased inputs. Most of the farmers interviewed reported that they had no access to off/non-farm income because of poor infrastructure development in the area. Only 22% of the sampled households had accessed to off/non-farm income during the time of survey. Type of off/ non-farm activities available for farmers in the study area include, sale of charcoal, goats trade, employee (*daily labor*), and selling of different items in shop. Sample households on average had earned Birr 183.57 annually from off/non-farm activities during the survey year. The average annual off/no-farm income received by improved sesame adopters and non- adopters were about 188.02 and 179.03 Birr, respectively (Table 11). The mean comparison between the two groups is statistically not significant.

Table 10.Source of income for sampled households from off/ Non-farm activities

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

Source: own survey 2013

3.2.4 Reasons for non adoption improved sesame Technology

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

Table 11.Distribution sample household's reasons for not using improved sesame varieties

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

Source: own survey results 2013

3.3. Profitability of Improved Sesame Technology

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

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

Respondents were asked to quantify the amount of labor they put on major activities of improved and local sesame production on a hectare of land. Average working hours for all activities was 7.7 hours per day. The farm gate prices used for partial budgeting analysis were, 10.2 and 8.5 birr per kilogram for the improved sesame and local sesame seed respectively at time of planting.

3.3.1 Partial budget analysis results and its implications

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

According to marginal rate of return analysis, improved sesame raised the farmers' net benefit by 78 %

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

Table 12 .Results of partial budget analysis for the improved sesame varieties and local ones

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

Source: own survey result data 2013.

3.3.2. Sensitivity analysis

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

Table 13. Sensitivity analysis the net income of improved and local sesame with regard the input price increase by 15%

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

Source: own computation

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

Table 14 Sensitivity analysis the net income of improved and local sesame with regard the output price decrease by 10%

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

Source: own survey result data 2010

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

3.4. Perceptions about Relative Advantages of Sesame Technology Attributes

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

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

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

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

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

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

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

Table 15.Farmers' perceptions on improved sesame varieties attributes as compared to the local

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

**, * significant at 5 and 10 % level respectively
Source: own survey 2013

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

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

3.6.2 Econometric results and discussion

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

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

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

Table 16.Maximum likelihood estimate of logit model results for determinants of adoption

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

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

***, **and * significant 1%, 5% and 10% level, respectively
Source: model results (2013)

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

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

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

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

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

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

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

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

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

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

3.6.3. Relative importance of factors of significant explanatory variables

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

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

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

Table 17.Change in the probability of adoption of typical farmers with regard to dummy variables

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

Source: own survey result data 2013

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

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

Table 18.Change in the probability of adoption of typical farmer with regard to continuous variables

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

Source: own survey result data 2013

4. SUMMARY, CONCLUSION AND RECOMMENDATIONS

4.1 Summaryof the Key Finding and Conclusion

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

This study was conducted in order to assess the financial benefit, perceptions about attributes of sesame varieties, and the role of farmer- to- farmer knowledge sharing in adoption and to farmer's perception about improved sesame varieties attributes inWest Haraghe Zone. Furthermore, econometric analysis was conducted to identify the factors that influence adoption of improved sesame varieties and to quantify the relative importance of the various factors.

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

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

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

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

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

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

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

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

4.2. Policy Implications

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

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

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

The survry results revealed that the livestock ownership positively influenced doption decision of improved sesame varieties becuase of additional inocme.Therefore, promotion of improved animal breeds and husbandary would enhance adoption of new technologies and improvement of standard of living of farm families.

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

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

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

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

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

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

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

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

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