Factors Influencing the Adoption of Conservation Tillage Technology in Haru District, Oromia Regional State, Ethiopia

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Abstract

The study determines the status and factors affecting adoption of conservation of technology in Haru district, Oromia regional state, Ethiopia. A multistage sampling technique was used to select 144 sample households from four PA's. Descriptive statistics such as mean, standard deviations and frequencies were used to summarize the data while binary logit model were fitted to identify the most important variables influencing CT adoption decision behavior of sample households. Binary logit model indicated that frequency of contact with extension agent, frequency of participation in CT training, and frequency of participation in CT field days, education and social participation were found to have positive and significant influence on adoption of conservation tillage technology. Generally conservation tillage has economical and environmental benefit. This calls for the integration of policy makers, researchers, extension worker and farmers in planning, implementation, monitoring and evaluation. Therefore, the linkage of all actors to promote CT is a crucial for the present and future generation.

Key words: Conservation tillage, Adoption and herbicide

1. INTRODUCTION:

Agriculture is the core of the Ethiopian economy and the people at large. It contributes 43% of gross domestic production (GDP) and 90% of exports employs 85% of the population and the main income-generating sector for the majority of the rural population. About 11.7 million smallholder households account for approximately 95 percent of agricultural GDP and 85 percent of employment. Despite its importance agricultural sector is dominated by subsistence, low input-low output and rain fed farming system. The use of agricultural technology is quite limited despite Government efforts to encourage the adoption of modern, intensive agricultural practices. Low agricultural productivity can be attributed to limited access by smallholder farmers to agricultural inputs, financial services, improved production technologies, irrigation and agricultural markets and more specifically poor land management practices that have led to land degradation. Ethiopia has one of the highest rates of soil nutrient depletion in sub-Saharan Africa. Estimates suggest that the annual phosphorus and nitrogen loss nation wide from the use of dung for fuel is equivalent to the total amount of commercial fertilizer applied. Land degradation is further exacerbated by overgrazing, deforestation, population pressure and inadequate land use planning.

In Ethiopia (World Bank, 2007), agricultural productivity is low and declining, and degradation of natural resources is significant. The country loses 30,000 hectares of soil or one billion tons of top soil, 30 kilograms of nitrogen, and 15-20 kilograms of phosphorous per hectare annually from soil erosion. Serious soil degradation has led to a decline in crop yields and reduced the effectiveness of fertilizer use in raising farm productivity.

The agriculture sector in Ethiopia is the most important sector for sustaining growth and reducing poverty. However, lack of adequate nutrient supply, the depletion of soil organic matter, and soil erosion are major obstacles to sustained agricultural production (Kassie and Kohlin, 2008). In general, Ethiopian agriculture characterizes low productivity. The crop yield per year is expected to decline by one to three percent, while the population is growing at the rate of 3.3% implies the challenge of feeding the present and future population (Mitiku Haile et al., 2006). Despite of abundant natural resources, the country are unable to harness all the benefits due to the problems of natural and manmade calamities which caused the main obstacle in the agricultural development. The traditional agricultural practices are the man made calamities which exposed the agricultural land for soil erosion and consequently leads to land degradation is a crucial problem of today's agriculture in the country.

In an attempt to increase agricultural productivity and improved food security at both national and household level, efforts have been underway to generate and disseminate improved agricultural technologies among smallholder farmers. Conservation tillage (CT) is one of the technologies promoted in Ethiopia for enhancing sustainable agriculture. It includes several practices such as no or minimum tilling, non-selective herbicide and zero tillage, soil cover, crop rotations, organic amendment, that permit the management of soil for agrarian uses, altering its composition, structure and natural biodiversity as little as possible and protecting it from erosion and degradation. It has both environmental and socio-economic benefits, but traditional crop production methods invert the soil and destroy its structure. Therefore, world wide conservation tillage practices have been the general solution to the traditional crop production methods (Derpsch, R., 2008).

For the benefit of CT some countries like North and South American countries such as Brazil, Argentina, Canada and USA is widely adopted (Yadete, 2007). Especially, these days its adoption is growing at fastest rate throughout the world as its benefit is recognized over years. In sub Saharan African (SSA) countries in general and Ethiopia in particular, the use of CT is reported to be low. However, in some countries such as South Africa, Zimbabwe and Zambia, CT is well established under large-scale commercial farming. In Ethiopia, despite the fact that soil degradation is severe, CT is not widely practiced by farmers. Recently, however, recognizing its predetermined benefit, government and non-government organizations are widely promoting its use among smallholder farmers throughout the country (Yadete, 2007).

Among the areas in Ethiopia, conservation tillage which includes the use of non-selective herbicide and zero tillage are being promoted in Haru Woreda of the Oromia Region since 2003. Haru is one of the districts found in West Wellega zone where the study was conducted due to good potential for agricultural activities. The livelihood of the area based on mixed farming system including the crop and livestock production. The productivity is low due to poor farming practice on undulated topography and agricultural land exposed to soil erosion. To utilize the existing natural and human potential effectively as well as to shift the traditional agricultural practices through extension services provided for the rural farmers in the district was to adopt conservation tillage technology.
The technology is appropriate in the study area where there is high rain fall ranges for six months aggravate rapid weed growth and soil erosion. The wise use of the conservation tillage technology reduces weed infestation and conserves the soil.

Majority of Ethiopia's farmers have been using traditional way of agricultural practices. This has contributed for low productivity of the agricultural sector. According to (World Bank, 2007), in Ethiopia, agricultural productivity is low, declining and degradation of natural resources is significant. The consequence of natural resource degradation contributed for declining of crop yield. In Ethiopia the crop yield per year is expected to decline by one to three percent, while the population is growing at the rate of 3.3 percent implies the challenge of feeding the present and future population (Mitiku Haile et al., 2006).

The same thing is also true for the study area. Conventional tillage conducted for different crops vary from two to four times in the study area because the area has high rainfall as a result soil erosion is high and weed growth is very fast which colonize crop fields within a short period of time and reducing crop yields substantially. Farmers in Haru use various practices to combat weed infestation including repeated ploughing, hand weeding and herbicide use (Maize and Teff). However, repeated ploughing exposed the top layer of the soil for soil erosion, and nutrient run off. In order to arrest the loss of the topsoil, build organic matter, improve soil structure, enhance water and nutrient capacity, the traditional system must be exchanged for a conservation tillage approach (SG 2000, 2007and Annoymous, 2008).

To increase agricultural productivity and improved food security at both national and household level, efforts have been underway to generate and disseminate improved agricultural technologies among smallholder farmers. Conservation Tillage is one of the technologies promoted in Haru for enhancing sustainable agriculture. However, the introduced technologies are not widely accepted by farmers in the study area as expected. This indicates that there are different factors influencing the adoption of technology that believed to bring change in smallholder farmers' productivity.
But the reasons for, why majority of the farmers do not adopt the CT technologies are not yet well understood. Till today, factors that limit adoption of CT technologies are not studied. Therefore, the main focus of this study was to identify the factors influencing adoption of the recommended conservation tillage technology in the study area.

2. MATERIALS AND METHOD

2.1 Description of Sampling Site

The particular study area, Haru district, geographically situated in West Wollega Zone of Oromia region of Ethiopia. The total area of Haru district is 46700 ha and the altitude of the woreda ranges from 1350 to 1900 m.s.l. It is located in western part of Ethiopia 442 km far from Addis Ababa (AA). The area is characterized by the mixed farming system such as production of crops and livestock simultaneously in a one piece of land. The crops included coffee production and cereal crop production like maize, sorghum and teff. The extension interventions and resource allocation has been given entire attention for crops in order to meet the food demand.

The area has only one crop season Maher season and has wider valley bottom fields utilized for growing off-season maize using residual moisture and high fertility resulting from alluvial deposits from up slops during the rainy season.

2.2. Sampling Design

2.2.1. Selection of the study area

Haru district was selected purposively for the study because implementation of conservation tillage was here from the last 9 years, having more agricultural potential for mixed farming system and extension services. The district has 27 PAs, among these 18 PAs are found in the mid altitude have been started conservation tillage practices in the area

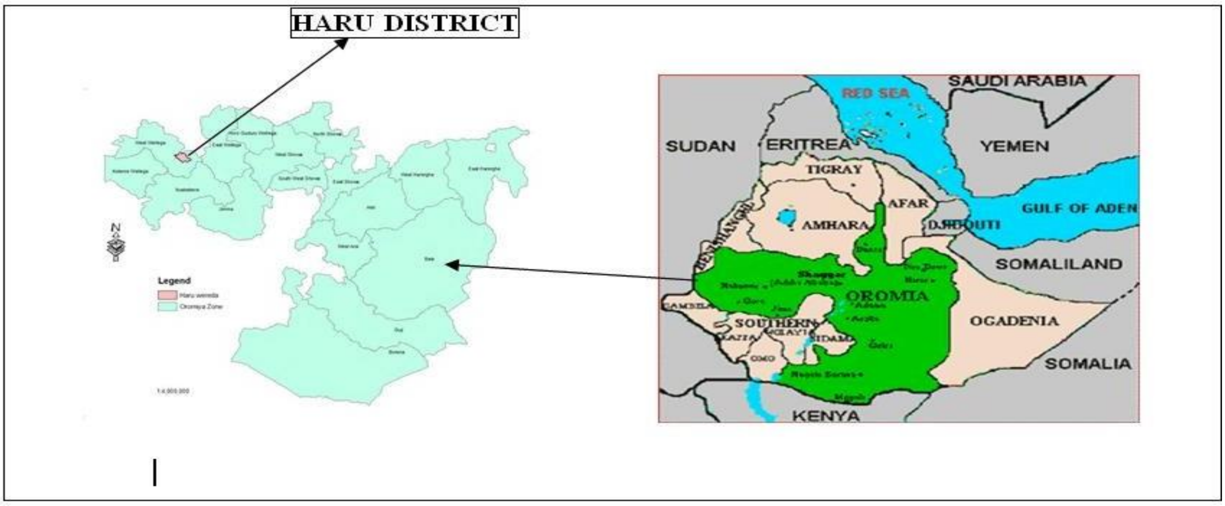

Figure 1: Location of study area in the map of Oromia Region (OBLEP, 2010).

2.2.2 Selection of Sample Households

A multistage sampling technique was employed in selecting sample households. In the first stage, out of 27 Peasant Associations PAs, 18 PAs were selected purposively based on adoption of conservation technology in the PA's. In the second stage, out of 18 PA's, 4 PA's were selected purposively on the adoption of conservation technology in the 2005-06. In the third stage, each PA was divided into two strata. The conservation tillage adopters and non-adopters were stratified in to strata 1 and strata 2, respectively. Finally, the selection of adopters and non -adopters were done by using simple random sampling technique based on probability proportion to sample size from the selected PAs. Finally, a total of 144 household heads were selected from the selected PAs. In this study adopter was defined as one who was using either zero tillage only or zero tillage in combination with herbicide on at least in one of the plot**.** Conversely a non-adopter was one who practiced conventional tillage in all of the plots. The distribution of sample respondents in each selected PA's is given below in Table 1.

Table 1: Distribution of sample respondents in each sample PA

Name of Sample PAs	Total HH (Household Heads) Members of PAs	Sample HHs		
		Adopter	Non adopter	Total
Gurach allata	488	18	18	36
Mannetiachoo	538	20	20	40
Kombolicha	534	19	19	38
Geneti abboo	418	15	15	30
Total	1978	72	72	144

Source: Field survey, 2011

2.3 Data Collection and Analysis

Both qualitative and quantitative data were collected to analyze the research. The study was based on primary data. The primary data was collected from the sample households using a pre-tested questionnaire through a personal interview method for the agricultural year 2011. Descriptive statistical tools were used to analyze the quantitative data. The statistical measures were used to summarize and categorize the research data were means, percentages, frequencies, standard deviations, chi-square and t-test. Variation in an adoption among the sample households was assessed in view of various factors that are theoretically known to influence farmers' adoption behavior of new technologies. These variables were categorized as personal and demographic, economic, socio-psychological, and institutional /extension variables.

The interest of the study is to analyze the factors influencing the decisions of households to use conservation tillage technology. The response to questions such as whether a household had used conservation tillage involving non-selective herbicide in association with zero tillage or not could be yes or no, which is a typical case of dichotomous dependent variable. Hence, a binary logit model (Gujarati, 2004) is used to analyze the factors influencing CT technology among sample households. To test the existence of multicollinearity the variance inflation factor (VIF) for association among the continuous explanatory variables and contingency coefficients for dummy variables was employed. VIF shows how the variance of an estimator is inflated by the presence of multicolinearity (Gujarati, 2003).

2.3.1 Model specification

Gujarati (2004) and Green (2008), the logistic distribution for the adoption decision of conservation tillage technologies can be specified as:

$$Pi = \frac{1}{1+e^{-z(i)}} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(1)$$

Where, Pi is a probability of adoption of conservation tillage technologies for the ith farmer and ranges from 0 to 1, e- Represents the base of natural logarithms and Zi is the function of a vector of n explanatory variables and expressed.

$$Zi = \beta_0 + \sum \beta_i X_i \ldots\ldots\ldots\ldots(2)$$

Where βo is the intercept and βi is a vector of unknown slope coefficients. The relationship between Pi and Xi, which is non-linear, can be written as follows:

$$Pi = \frac{1}{1+e^{\beta_0+\beta_i+X_i+}} \ldots\ldots\ldots\ldots \beta_n X_n \ldots\ldots(3)$$

The slopes tell how the log-odds in favor of adopting the technology changes as independent variables change. If Pi is the probability of adopting given technologies, then 1-Pi represents the probability of not adopting and can be written as:

$$1 - Pi = \frac{1}{(1+e^{-z_i})} = \frac{e^{-z_i}}{(1+e^{-z_i})} = \frac{1}{1+e^{z_i}} \ldots\ldots\ldots\ldots(4)$$

Dividing equation (1) by equation (4) and simplifying gives:

$$\frac{P_i}{1-P_i} = \left(\frac{1+e^{z_i}}{1+e^{-z_i}}\right) = e^{z_i} \ldots\ldots\ldots\ldots(5)$$

Equation (5) indicates simply the odd-ratio in favor of adopting the technologies. It is the ratio of the probability that the farmer will adopt the technology to the probability that he will not adopt it. Finally, the logit model is obtained by taking the logarithm of equation (5) as follows.

$$L_i = L_n\left[\frac{P_i}{1-P_i}\right] = Z_i = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots\ldots\ldots\ldots \beta_n X_n \ldots\ldots\ldots\ldots(6)$$

Where Li is log of the odds ratio, which is not only linear in X, but also linear in the parameters. Thus, if the stochastic disturbance term Ui is taken into account, the logistic

$$Z_i = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots\ldots\ldots\ldots + \beta_n X_n + U_i \ldots\ldots\ldots\ldots(7)$$

This econometric model is estimated by using the iterative Maximum Likelihood Estimation (MLE) procedure due to the non-linearity of the logistic regression model. The MLE procedure yields unbiased, asymptotically efficient, and normally distributed regression coefficients (parameters).

3. RESULTS

3.1 Socio- Economic variable

The study shows that 88.9% of adopters were literate and 11.1% were illiterate and from non-adopters 75 % were literate and 25% were illiterate. The result shows that levels of education have an association with adoption of CT technologies (Table 2). The finding of this study is inconsistent with Davey (2006), but similar with many of the previously conducted studies. For example, Ashenef (2008) reported a positive and significant relationship of education with adoption of triticale (wheat). In this study, like our prior expectation, the χ^2 showed significant association between the education level of the HH head and adopting of CT technology at less than 10% probability level. This could be an implication that adopters of CT technology have better formal educational status than non-adopters

Table 2: Association between educational status of the household head with adoption

Education status of House hold(EDUHH)	Adopters category		χ^2	P-value
	Adopters	Non -adopters		
Literate	88.9%	75%		
Male	60 (83.3)	50 (69.4)		
Female	4 (5.6)	4 (5.6)		
Illiterate	11.1%	25%		
Male	8 (11.1)	16 (22.2)		
Female	-	2 (2.8)		
Total	100	100	3.802	0.051*

Source: Field Survey, 2011

Note: 1.* Indicated significant at less than 10% probability level

2. Figures in parenthesis are percentages

The result reveals that the age of the household heads has a range from age of 20 years to 81years. The average age of the sample household heads is 39.1 years. Age can either generate or erode confidence in new technology, that is, with more experience a farmer can become more or less risk-averse when judging new technology. Adopter farmers had an average age of 37.9 years, while non-adopters had an average age of 40.3 years. An independent-sample t-test was conducted to test if there is significant difference in the mean age of adopters and no adopters. The t-value (t= 1.224) indicates that there is no significant difference between the mean age of adopters and non-adopters. The result indicates that with the increase in the age of the farmer his ability to accept new technology decreases and age affects conservation tillage technology negatively.

On the other hand in table 3, mean farm experience of non-adopter was 19.6 years. This study has identified that about 27.8% of the respondents have less than 10 years of farm experience, where as around 58.3% of them had 11-30 years experience. The result reveals that adopters and non adopters had no years of difference farm experience. To check whether there is a significant mean difference in farm experience between adopters and non-adopters t-test statistics was run. The result of t-test showed (T=0.166, P=0.869ns) that there was statistically non significant mean difference between adopters and non-adopters at 5% level of significance. This finding was consistent with findings of Niranjan (2009).

Table 3: Association between personal/demographic variables with adoption

Variables	Adopters category				T value	P-value
	Adopters		Non-adopters			
	Mean	SD	Mean	SD		
Age of households (AGEHH)	37.9	11.6	40.3	12.3	1.224	0.223ns
Farm experience (FAREXP)	19.3	11.5	19.6	11.6	0.166	0.869ns

Source: Field Survey, 2011 Note: ns indicated non-significant at 5% probability level

3.2 Economic variables

Total land holding (FARSIHH): Table 4 clearly indicates that, the average land holding for non-adopter group was 1.62 ha with standard deviation of 0.65 while adopters were 2.1 ha and 1.75 ha standard deviation. The results of independent sample t-test (with value of t= -2.271) shows a statistically significant mean difference between adopters and non-adopters at less than 5% significant level. The result of this study confirms the earlier findings of Mesfin (2005), Rahmeto (2007) and Thah (2007) that having more land increases the likelihood of adaption.

Number of livestock owned (LIVSTOP): The result of this study indicated that livestock holding of sample population ranges from 0.00 to 35 implying the existence of large variation among the households in livestock ownership. The average livestock holding of the sample population was 7.1 with standard deviation of 7.22. As indicated in Table 4, non adopters of conservation tillage technology had average livestock holding of 5.31 and adopters had 8.86. Test of mean difference using independent sample t-test showed that there was significant mean difference (t=-3.033) between adopters and non-adopters at less than 1% significance level. This clearly shows the significant role of livestock holding in adoption of conservation tillage technology and confirmed the prior expectation that livestock holding size is an important indicator of wealth status of the households in the study area. Regarding relationship of livestock holding with adoption, many adoption studies so far conducted have also reported similar results. To mention some, for instance, Yishak (2005) and Rahmeto (2007) have found that livestock holding has positive and significant influence on adoption of improved agricultural technologies.

Active family labor force (ALFOHH): Family labor was assumed to be the main source of labor required for farm operations such as land preparation, planting, weeding, harvesting and transporting to home. The survey result on labor availability across adopter categories in Table 4 shows that, the average number of available labor force in terms of man equivalent for adopters was 1.86 with standard deviation of 0.93 and for non adopters 1.83 with standard deviation of 1.

This study shows non significant difference with regard to the size of labor force between adopters and non-adopters. This is evident from the result of independent simple t-test (t=0.171, p=0.864) which shows non significant mean difference between adopter and non-adopters at 5% significance level (Table 4). The result of this study is similar from the earlier findings of Yishak (2005) & Rahmeto (2007).

Participation in non-farm activities (NONFARIN)

During non farm periods, some farmers can earn additional income by engaging in various non farm activities. This is believed to raise their financial position to acquire new inputs. In the study district, petty trading, daily labor activities, house making were found to be some of the non-farm activities in which sample households were participating. Out of the total households interviewed 14.6% had participated in non-farm activities. Among the households who participated in non-farm activities, adopters accounted about 7.6 % while non-adopters accounted 6.9% with slight difference in terms of percentage. Participation in non-farm activities had significant relationship with adoption of CT technology. Participation in non- farm and off farm activities gives different result. The difference is the mean income from these activities and significance level. The mean annual income generated from non farm activities for adopters were 461.9 ETB and 187.9 ETB for non adopters (table 4). The probable reason might be most of the farmers in the study districts are dependent on crop production and animal production. This implies most of the farmers in the study areas relay on on-farm and non farm income rather off- farm income.The results of this study is similar from the findings of, Mesfin (2005) and Taha (2007).

Participation in off- farm activities (OFFINCOM): Off farm activity is one of the means to generate additional income for resource poor house holds. The common off farm activity in the study area was working as daily laborers outside their farm. About 10.4 % of the sampled farmers were engaged in this activity. Out of these, adopters accounted for about 4.8 %, while non-adopters comprise 5.6%.Table 4 shows the mean annual income generated from off farm activities were 84.3 ETB for adopter while 94.6 ETB for non-adopters. However, the difference was statistically tested and it was found to be insignificant (t=-0.216, p=.829).

Table 4: Association between Economic variables with adoption (n=144)

Variables	Adopters Categories				T Value	P-value
	Adopters		Non-adopters			
	Mean	SD	Mean	SD		
Total land holding (FARSIHH)	2.1	1.75	1.62	0.65	-2.271	0.025**
Livestock (LIVSTOP)	8.8	5.9	5.3	5.04	-3.033	0.003**
Active labor force (ALFOHH)	1.86	0.9	1.83	1	0.171	0.864ns
Nonfarm (NONFARIN)	461.9	906.5	187.9	413	-2.333	0.021**
Off-farm (OFFINCOM)	84.3	278.2	94.6	296.1	0.216	0.829ns

Source: Field Survey, 2011

Note: 1:*** and ** Indicated significant at 1% and 5% level respectively

2: ns indicated non significant at 5% probability level

3.3 Institutional/Extension variables

Credit (CREDITAC) service is component of institutional variables that influences adoption of agricultural technologies, especially for poor farmers to relax the limited finance for purchasing agricultural inputs. As presented in Table 5, from the total sample households only 4.2% (n=6) said “yes” that is they were get and used credit to purchase herbicide. Majority of the sample households purchase the herbicide on cash. The table also illustrates 8.3 % of adopters used credit and 91.7 % from adopters and 100% from non-adopters were non users. The chi-square test shows that there is significant difference between adopters and non adopters with respect to credit use ($\chi2$=4.348, P=0.037).The result of this study is consistent with the findings of Mariam et.al., (2010).The focus group discussion and key informant interview confirmed that, even though the credit access in the area exist majority of the farmers interested to purchase agricultural input including herbicide by cash. The reasons explained by the group are limited collateral, majority of the farmers have a potential to purchase herbicide on cash instead of paying interest rate.

Table 5: Distribution of households by credit utilization in crop season

Credit use for non-selective herbicide (CREDITAC)	Adopters category		Total	χ^2	P-value
	Adopters	Non- adopters			
	No.	No.	No.		
Yes	6(8.3)	0	6 (4.2)	4.348	0.037*
No	66 (91.7)	72 (100)	138 (95.8)		
Total	72	72	144		

Source: Field Survey, 2011

Note: 1 ** Indicated significant at less than 5% probability level.

2. Figures in parenthesis are percentages

3.4 Extension contact (EXTSER)

Access to information or extension messages as well as various extension services was one of the institutional characteristics hypothesized to influence farmer's decision to adopt a new technology. In the study area, agricultural extension service is one of the services mostly provided by offices of government at different level in order to promote agricultural technologies to the farmers. When there is contact with extension agent, the greater is the possibility of farmers being influenced to adopt agricultural innovations. The village level worker is one of the most important sources of information on agricultural innovations to farmers.

Table 6: Association between contact with extension agent and adoption

Contact with extension agent	Adopters category		Total	$\chi 2$	P-value
	Adopters	Non –adopters			
	No.	No.	No.		
Yes	72(100)	62(86.1)	134(93)		
No	0	10(13.8)	10(7)		
Total	72	72	144	8.709	0.003***

Source: Field survey, 2011

Note: 1. *** indicated significant at less than 1% Probability level

2. Figures in parenthesis are percentages

The result on sampled farmers contact with extension agent indicated that of the total 144 sample respondents, 93 percent farmers reported having contact with development agents and 7 percent farmers reported having no contact with development agents (Table 6). The Table also illustrates that 86.1% of non-adopters and 100% adopters had contact with extension agents. The chi-square result ($\chi 2$=8.709 and P=.003) shows there was statistically significant difference between adopters and non- adopters with respect to farmers' contact with extension agent. The result of this study indicated that contact with extension agent is influencing adoption positively. This agrees with priori expectation and confirms the study carried out by Abrhaley (2006) and Almaz (2008).

Frequency of contact with extension agent (EXTFREQ)

This refers to the number of contacts per year that the respondent made with extension agents. The effort to disseminate new agricultural technologies is within the field of communication between the extension agent and the farmers at the grass root level. Here, the frequency of contact between the extension agent and the farmers is hypothesized to be the potential force which accelerates the effective dissemination of adequate agricultural information to the farmers, thereby enhancing farmers' decision to adopt CT technologies. The score for frequency of contact with extension agent was calculated on the basis of scores, score of zero was given for having no contact with extension agent, score of 1 was given for those who have contact once in a year, 2 was given for those who have once in six months contact with extension agent, and score of 3 was given for those who have monthly contact with the extension agents, a score of 4 given for those having bi-weekly contact with the extension agent and a score of 5 given for those having weekly contact with the extension agent. Accordingly, the maximum score to be achieved by a farmer was 5.

Table 7 Shows that the averages score of adopters was 2.13 with standard deviation of 0.877 and for non-adopters 1.63 with standard deviation of 0.877. The independent sample t-test showed that there was significant mean difference (t=-3.421, p=0.001) between adopters and non-adopters in relation to score achieved for frequency of contact with extension agent. This result agrees with the finding reported by Girmachew (2005), Abrhaley (2006) and Rahmeto (2007). Similarly the focus group and key informant interview confirmed the frequency of extension contact was contributed for adoption of CT in the area.

3.5 Attending field day (FRQFIDP) and training (FRQCTTR)

The other means through which farmers get agricultural information is by participating in different extension events arranged by different institutions. Among the extension events field days and training were the decisive extension events for the adoption of new agricultural technology. The result on farmers' participation in different extension events in relation to conservation tillage technology indicates that only 34% of sampled farmers have attended field day on conservation tillage technology and majority of the farmers (66%) did not attend field day. Training equips farmers with new knowledge and skill, which help them to perform new practice properly. If a farmer has no skill and know-how about certain technology, he may have less probability of adoption. The skill acquired through training helps to carry out a new technology effectively and efficiently. According to the finding, more proportion of adopters (47.2%) and only 20.8% of non-adopters have attended field day .Out of the total sample respondents, 66% did not have chance of field day. Similarly, the difference was statistically tested and it was found to be significant at 1% level of significance (Table 8).

Concerning training 52.8% of adopters and 13.9% of non-adopters attended training, out of total respondent farmers only 33.4 % of them were found to have attended and the rest 66.6% did not attend the training program. Table 8 shows that the frequency of participation in field day of adopters was 0.64 with standard deviation of 0.77 and for non-adopters 0.25 with standard deviation of 0.55, and frequency of participation in training of adopters was 0.81with standard deviation of 0.95. The independent sample t-test showed that there was significant mean difference (t=-3.473, p=0.001 & t=-5.469, p=.000) between adopters and non-adopters in relation to frequency of participation in field day and training respectively. The result of this study is in agreement with the findings of many authors. For instance, Yishak (2005), Rahmeto (2007) and Taha (2007) reported attending extension events were positive and significant relation with adoption of new technologies. These findings also confirmed during focus group discussion and key informant interviewed and the group reported that field day and training were organized in a year once only during the first three years of CT promotion period that is why majority of the respondents (non-adopters) were not participated in field days and training. This finding showed that further attention should be required for implementation of extension events in the area.

Market distance (MARKETD).Regarding the distance taken to travel from home to the nearest input market place, sample farmers reported that they had to travel an average of 10.89 km (adopters 10.84 km and no adopters 10.95 km). This shows there is no distance variation between adopters and non-adopter to the nearest market. Guyii town is nearest input and out put market in the study area. The independent sample t-test showed that there was non-significant mean difference (t=0.084 p=0.933) between adopters and non-adopters in relation to market distance. This finding also supported by focus group discussion and the group identified that to transport input from market center and out put to the market center in each kebele there is an access of road and three extension agents were recruited to provide extension service and facilitate input provision on time through farmers service cooperatives organized in each PAs. Therefore this finding showed that there is no technology up take difference between PAs due to the distance in the study area.

Table 8: Association between institutional/extension variables with adoption

Variables	Frequency of mass media exposure average score (%)				T-value	P-value
	Adopter Category					
	Adopters		Non-Adopter			
	Mean	SD	Mean	SD		
Field day (FRQFIDP)	0.64	0.77	0.25	0.55	-3.473	0.001***
Training(FRQCTTR)	0.81	0.95	0.15	0.399	-5.469	0.000***

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Frequency of extension (EXTFREQ)	2.13	0.87	1.63	.877	-3.421	0.001***
Frequency of mass Media(TOMA MEDIA)	14.26	2.05	13.861	1.966	-1.201	0.232ns
Market distance (MARKETD)	10.84	7.43	10.95	7.49	0.084	0.933ns

Source: Field Survey, 2011
Note: 1: *** Indicated significant at 1 % probability level
2: ns indicated non-significant.

3.6 Socio-psychological variables

Participation in social organization (SOCILPP)

The entire respondents are the member of PA. Of the total sampled households, 56.2% were non participated in different committee of formal organization where as 43.8% of the respondents were participated in different committee and leader of the formal social organization. When we analyze with in the category, 59.9% of adopters of CT technology participated as a member and leader of the organization while 43.1% of the adopters where not participated in different committee and leader of the formal social organization while 30.6% of non adopters were participated as a member and leader of formal organization and 69.4% of the non adopters were not participated in different committee and leader of the formal social organization (Table 9). The higher figure for the adopters when compared with the non-adopters may indicate that as the head of the household assumed some responsibility, the chance of getting information and hence understanding about the uses of CT technology increases thereby contributing to decide to adopt the technology.

The χ2-test result shows that there is a statistical significant mean difference between adopters and non-adopters of CT technology with respect to leadership status of the household (χ^2=9.143 P =0.002) at less than 1% levels of probability. This is an implication for a prior expectation that having different leadership status in the community increases access of information of new technology utilization. This result consistent with previous findings of Rahmeto (2007) and Almaz (2008).

Table 9: Formal organization participation status of households

Participation of the HH head in formal organization	Frequency of mass media exposure average score (%)		Total Value
	Adopter Category		
	Adopters	Non-Adopter	
	Frequency	Frequency	Frequency
Total participant	41 (56.9)	22 (30.6)	63 (43.8)
1. PA committee member	26 (36.1)	16 (22.2)	42 (29.2)
2. PA Leader	3 (4.2)	0	3 (2.1)
3. Religious Leader	2 (2.7)	1(1.4)	3(2.1)
4. Service cooperative committee memeber	9 (12.5)	4(5.6)	13(9)
5. Service cooperative leader	1 (1.4)	1(1.4)	2(1.4)
Non- participant in different committee	31(43.1)	50(69.4)	81(56.2)
Total	72	72	144
χ^2=9.143			P-value= .002***

Source: Field Survey, 2011
Note: 1. *** Indicated significant at less than 1% probability level.
2. Figures in parenthesis are percentages

Information seeking behavior (TOTINFSBH): Information seeking behavior is the degree to which the respondent is eager to get information from various sources on different roles she/he performs. As presented in Table 9, the t-test showed that, there was no significant difference between adopters and non-adopters in CT technology based on their information seeking behavior**.**

3.7 Determinants of adoption of CT technology

In order to explain this binary variable, it is necessary to construct a model that relates the dependent variable to a vector of independent variables. The logit model was employed in this study to estimate the effects of the hypothesized independent variables on adoption of CT technology. Nineteen independent variables were included in the model. These are age, sex, education, farm experience, farm size, livestock population ,active labor force, social participation status, off-farm income , non-farm income, credit access, herbicide price, field day participation, CT training, information seeking behaviour ,extension service frequency , mass media exposure, total technology perception and market distance. These variables were selected on the basis of theoretical explanations, personal observations and the results of the survey studies. All these variables were entered in a single step.

Table 10 : Binary logit model estimates for factors affecting conservation tillage technology

Variables	B	S.E.	Wald	df	Sig.	0dds ratio
AGEHH	-.014	.019	.534	1	.465	.986
SEXHH	1.719	1.427	1.452	1	.228	5.582
EDUHH	1.442	.845	2.915	1	.088*	4.229
ALFOHH	-.342	.251	1.860	1	.173	.710
FAREXP	-.006	.029	.041	1	.840	.994
FARSIHH	.280	.352	.630	1	.427	1.323
LIVSTOP	.019	.051	.137	1	.711	1.019
FRQFIDP	1.008	.510	3.904	1	.048**	2.741
FRQCTTR	1.709	.526	10.549	1	.001***	5.521
OFFINCOM	.000	.001	.003	1	.958	1.000
NONFARIN	.000	.000	1.515	1	.218	1.000
SOCILPP	1.009	.521	3.755	1	.053*	2.742
TOTINFSBH	.149	.110	1.854	1	.173	1.161
EXTFREQ	.883	.304	8.446	1	.004***	2.417
PPHERPRS	-.263	.193	1.867	1	.172	.769
TOTALYIPP	.060	.283	.044	1	.833	1.061
MARKETD	-.005	.043	.015	1	.902	.995
CREACESS	22.211	1.345	.000	1	.999	4.425
Constant	-8.184	3.477	5.539	1	.019**	.000

-2 Log likelihood ratio=112.53
Chi-square value=87.09
Correctly predicted =overall sample=79.2%
Correctly predicted adopters=75%
Correctly predicted non-adopters=83.3%
Source: Model out put
***Significant at1%, ** significant at 5% and* significant at 10%.

4. DISCUSSION

It is important to *summarize* the results of the descriptive statistics before passing to other analysis topic. In this study respondents were treated in two categories. The differences between adopters and non-adopters were assessed using t-test and Chi-square test statistics for continuous and dummy/categorized variables, respectively. The mean and SD were used to discriminate the two categories for continuous variables. Out of the hypothesized 19 explanatory variables, six (6) from continuous variables 3 (three) from dummy variables total of nine (9) of them had shown significant association with adoption of conservation tillage technology. There were also variables in continuous variables which failed to discriminate between adopters and non-adopters. This might be due to the homogeneity of the sample respondents in that factor.

5. CONCLUSION:

Based on the descriptive statistics, household's personal and demographic factors, education was found to be significantly related to adoption of CT technology. The data indicated that an educated farmer has a capability to understand and interpret easily the information transfer to them from DAs and others. The study also found that, household's economic variables are the other important factors which influence adoption of conservation tillage technology. Total land holding, livestock holding and non-farm activities were found to have positive and significant relationship with adoption. Adopter groups have relatively larger land size and livestock and more in come from non-farm income compared to the non-adopters. With regard to the household's socio-psychological variables, adopter groups have relatively better participation in social organization as compared to non-adopter groups. The social participation was found to be positively and significantly related with adoption of CT technology. Total CT technology perception and information seeking behaviour are non-significant relation with adoption of conservation tillage technology. In addition, participation in extension events like in field day and training were higher in adopters compared to non-adopters. The frequency of contact with extension agent and participation in extension events was found to have positive and significant relationship with adoption of CT technology.

On the other hand, results of the logit model indicated the relative influence of different variables on adoption of CT technology. All hypothesized explanatory variables were included in the model of which five (5) of them had shown significant influence on adoption of conservation tillage technology. Accordingly, two variables frequency of participation in CT training and frequency of extension contact are significant at 1% probability level. Frequency of field day is significant at less than 5% probability level. The other two variables like education and social participation are significant at less than 10% probability level to influence adoption of CT technology.

Therefore, the wise use of conservation tillage reduces the labour and oxen requirements, combat soil erosion, improve the productivity of farm land and increase the household income. Hence, the practice of adoption of CT technology has to be promoted in the region by different means.

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