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Factors Affecting Adoption Decision of Wheat Row Planting Technology: The Case of Agarfa District, Bale Zone of Oromia National Regional State, Ethiopia

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Abstract
Ethiopian economy is highly dependent on agriculture, especially crop production takes the major share in economic growth. Hence, supporting the sector through introducing new agricultural technologies, like row planting technology is crucial. However, application of better technologies remained low in Ethiopia and also in the study area due to several factors. Therefore, study was to assess the status of adoption decision of wheat row planting technology and identify factors affecting it in Agarfa district. Two stage sampling procedure was used to collect data. In the first stage, three major wheat producing kebeles were selected purposively from twenty kebeles of the district. In the second stage, 165 household heads were selected randomly from three kebles based on probability proportional to population size. Data were analysed using descriptive and inferential statistics methods and binary logistic regression model was used. The result from binary logistic regression model shows that education level of household head, farming experience, availability of family labor, mass media exposure, and perception towards wheat row planting positively and significantly affected adoption decision of wheat row planting technology in the study area. Therefore, Based on the findings of this study it can be concluded that policy and development interventions should give emphasis towards improvement of such economical and institutional support system so as to achieve wider adoption decision of wheat row plating technology, increased production and productivity of smallholder farmer.
Keywords: Adoption, Binary Logistic model, Technology, Wheat row planting, Agarfa.
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1. INTRODUCTION

Agriculture is the main sector of Less Developed Countries (LDCs) in general and Sub-Saharan Africa (SSA) in particular. The economic development of Ethiopia is highly dependent on the performance of its agricultural sector since it is the major economic support of economic growth of the country. Agriculture contributes 36.5% Gross Domestic Product (GDP), 72% of the employment opportunity, 75% of the export level, and provides 65% of the country raw material demand of the large and medium scale industries found from this promising sector (ATA, 2017). Cereals are the major staple food crops both in terms of area planted and volume of production obtained. In 2013/14 main crop season, cereals were cultivated on 9.9 million hectares of land producing 22 million tons of food grains. This represented 79.38% and 85.81% of the total area and production of food grains in the country, respectively (CSA 2014).

Among cereals, wheat is the second most important food crops in the country behind maize (FAO, 2014a). Dorosh and Rashid (2013) on their study found that the demand for wheat has been increased due to growing population, urbanization and the expansion of food processing industries in the country. If the country is to feed the rapidly growing population and meet the high demand, it needs to increase the yield of wheat. However, increasing yield requires successful adoption of improved agricultural technologies. Adoption of row planting by smallholders is considered one of the farming practices for improving wheat yield in the country. Compared to the traditional broadcasting system, row planting gives better yield with quality of the seed at harvesting period (Joachim *et al*., 2013).

According to the Ministry of Agriculture and Rural Development row plantation on average increases production by 30% and reduces the amount of seed to one-fifth of existing seed use. It is important increases in crop production need improved agronomic practices in addition to improved hybrids (Tafese 2016). In order to increase the production and productivity of agricultural production, the use of modern agricultural technologies are very important, out of which fertilizer, high yielding variety and row planting of crops are the most important technologies to increase the level of crop production (Mekuria 2013).

In an effort to improve wheat production and productivity and meet high wheat demand in the country, Ministry of Agriculture (MoA) through Regional Bureau of Agriculture (RBoA) had introduced a wheat row

planting technology in 2012 all over the regions. As a result, planting of wheat in rows has become one of the agronomic practices of smallholder farmers in the country (Berihun *et al.,* 2014). However, this technology is not widely accepted as expected and the majority of farmers in different parts of the country are continued to use the traditional broadcasting method of wheat production thereby in the study area.

Oromia region is one of the wheat producing regions in Ethiopia and Arsi, Bale and Shewa administrative zones of Oromia region are among the major wheat producing areas with 53.4% of the wheat produced in the region coming from these zones (CSA, 2015). Bale zone of Oromia region is included among the wheat belts in eastern Africa. Bale zone constitute about 166,539.45 hectares of land devoted to wheat production, predominantly by subsistence farmers and a few profit oriented state farms (CSA, 2017).

Wheat is one of the most important cereal crops for the Agarfa district which is the main source of food and cash for smallholder farmers. In the district, majority of the farmers have been using tradition way of agricultural practice and using old cultivar that has low production and productivity as well as at risk to disease. There are few farmers who adopt wheat row planting technology (ADRDAO, 2017). This indicates that there are different factors directly or indirectly influencing the adoption of wheat row planting technology. Therefore, this study was focus on the identification and analysis of major factors affecting the adoption decision of wheat row planting technology in the district.

1.1. Objectives of the Study

The general objective of this study is to assess the adoption of wheat row planting technology in the study area.
The specific objectives of the study are:
1. To assess the current status of adoption of wheat row planting technology in the study area.
2. To identify factors affecting the adoption decision of wheat row planting technology among farmers in the study area.

2. RESEARCH METHODOLOGY

2.1. Description of the Study Area

This study was conducted at Agarfa district which is located at a distance of about 461 km south east of Addis Ababa and 31 km from Robe the capital of the bale zone. Agarfa district, is one of the districts in the Bale zone of Oromia regional State of Ethiopia, and located in the northwestern corner of the Bale zone. The climate of the district is classified into three agro-ecological zones and the average annual temperature and rainfall of the district is 17.50 ^{0}C and 800 mm respectively. The total population for this woreda is 129,785, of whom 52,136 were men and 49,974 were women; 12,907 or 12.64% of its population were urban dwellers. The district is characterized by mixed farming system and agriculture is the main stay of the district and hence it provides the largest share of the livelihood for the population according to get the data from Agricultural Development Office of the District (ARDoD, 2018).

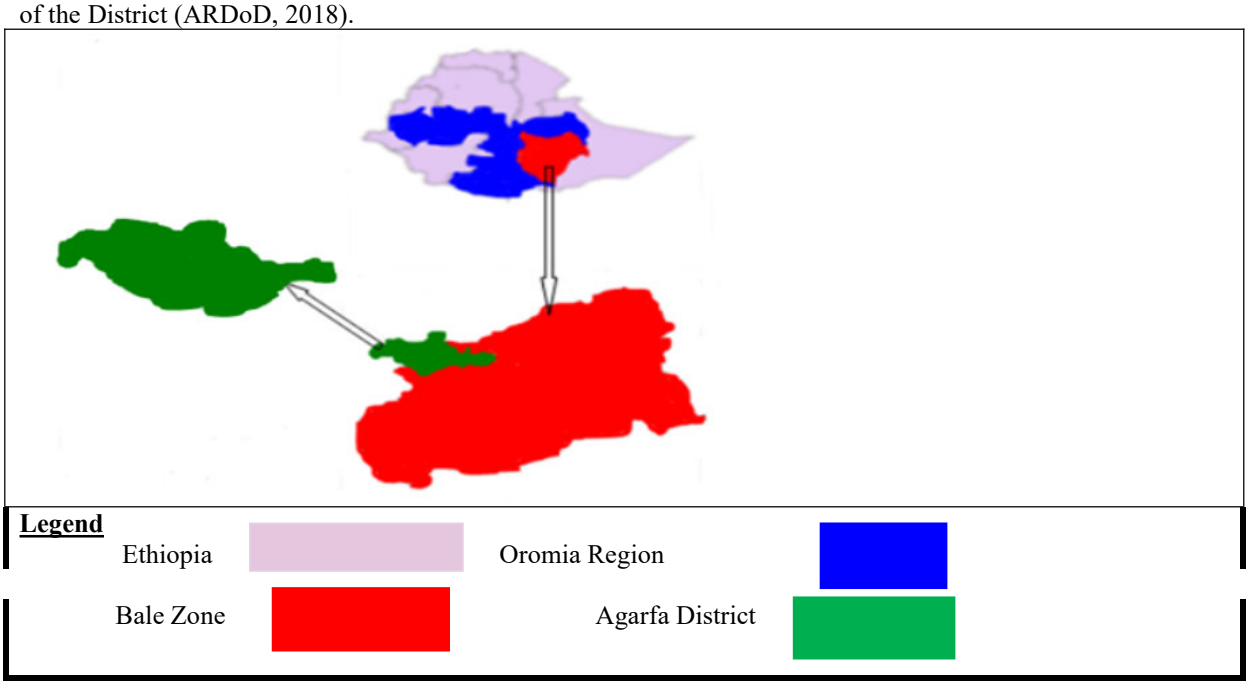

Figure 2: Location of the study area

2.2 Types of Data, Data Sources and Methods of Data Collection

For this study, both quantitative and qualitative data from primary and secondary sources were collected. Primary data were collected with the help of survey by means of structured interview schedule for the quantitative data. The qualitative data were obtained through organizing the focus group discussion, who is supposed to have clear insight about the wheat row planting technology and its local implementation. On the other hand, secondary data are collected from various secondary sources used for this purposes like different publications and unpublished documents like policy documents, official reports from district.

2.3. Sampling Technique and Sample Size Determination

The objective of this study was focused on wheat row planting technology adoption; the populations of the study were those farmers who are engaged in the producing wheat in district. Both Probability and non probability sampling technique were employed to conduct the study. Two-stage sampling technique was used to select the sample. At the first stage, from a total of 20 *Kebeles* of the *Woreda*, the major wheat producing of three *Kebeles* were selected purposively because of its wheat yield potential and their experience of adopt wheat row planting technology of the District.

At the second stage, the farmers in each Kebeles were stratified into adopter and non-adopter categories giving the relative homogeneity of the sample respondents of their adoption status of wheat row planting technology. Hence, in this study, considering those farmers used wheat row planting technology for one and more years as adopters and those not used wheat row planting technology currently as non-adopters 165 sample households were selected randomly based on probability proportional to sample size.

The sample size from each *Kebele* was determined by proportionality formula. The sample selected from each selected *kebele* was proportional to the population in each *kebele* and the formula for this purpose is given by:

$$n_i = \frac{N_i(n)}{\sum N_i}$$

Where n_i - the sample to be selected from i^{th} kebele and n - Total sample size

N_i - The total population living in selected i^{th} kebele.

$\sum N_i$ - The sum of total population in the selected three kebeles

Table 2: Distribution of sample selected from the three *kebeles*

No	Kebeles	Total number of households			Sample selected (non-adopter /adopter)	Proportion
		Adopters	Non-adopters	Total		
1.	Ali	621	819	1,440	57(30/27)	34.545%
2.	Ilani	819	995	1,814	71(37/34)	43.030%
3.	Elabidu	435	514	949	37(20/17)	22.424%
	Total	1,875	2,328	4,203	165(87/78)	100%

Source: ARDoD (2018) and own computation

2.4. Methods of Data Analysis

Both descriptive statistics and econometric model were employed for analyzing the data collected from farmers**.**

2.4.1. Descriptive and Inferential Statistics

Descriptive statistics were employed for the description of different personal and demographic, socio-economic, institutional and psychological characteristics of the sampled respondents. These are means, percent and frequency, standard deviation. These include mean and percentage of occurrence for the adopter and non-adopter of farmers in wheat row planting in the study district. The inferential statistics like t-test (to see there are significant mean differences between adopter and non-adopter households in relation to continues independent variables) and χ2-test (were administered to see if are significant proportion differences between the two groups in terms of categorical independent variables).

2.4.2. Econometric Analysis: Binary Logit Model

The econometric model was used to analyze the factors affecting adoption decision of wheat row planting technology. One of the purposes of this study was to evaluate the factors that affect the adoption decision of wheat row planting technology. The dependent variable in this case takes a dichotomous variable, which takes a value of zero for non-adopter households and one for the adopter ones. In this case, the value 1 indicates a farmer who adopted wheat row planting while the value 0 indicates the farmer did not adopt it. Therefore, the

logit model was used in the study to identify factors affecting adoption decision of wheat row planting technology in the study area. The logit function for adoption of wheat row planting technology can be specified as follows:

$$p_i = E\left(Y = \frac{1}{X_i}\right) = \beta_0 + \beta_i X_i \quad (1)$$

Where Y = 1 means the adoption of wheat row planting, X_i = is a vector of independent variable, β_0 = is a constant and β_i= i=1, 2…m are the coefficient of the independent variables to be estimated.

The probability of wheat row planting adoption:

$$p_i = E\left(Y = \frac{1}{X_i}\right) = \frac{1}{1 + e^{-(\beta_0 + \beta_i X_i)}} \quad (2)$$

Where: p_i= represent the probability that a household is being adopter xi,

X_i = represents the ith explanatory variable

e = represents the base of natural logarithms (2.718)

β_0 and β_1 are regression parameters to be estimated

$$P_i = \frac{1}{1+e^{-Zi}} = \frac{e^{Zi}}{1+e^{Zi}} \quad (3)$$

Where, $Z_i = \beta_0 + \sum_{i=1,2,3..}^{m} \beta_i + X_i$ (4)

If P_i the is probability of being adopter wheat row planting, then $1 - P_i$ represents the probability of being non-adopter it.

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

Therefore, the odds ratio can be written as

$$\frac{P_i}{1 - P_i} = \frac{1 + e^{Zi}}{1 + e^{-Zi}} = e^{Zi} \quad (6)$$

So, $\frac{P_i}{1-P_i}$ is simply the odd ratio in favor of adopting wheat row planting technology. It is the ratio of the probability that the farmer would adopt wheat row planting to the probability that the farmer would not adopt.

Then, if we take the natural logarithm of equation (4) we obtain

$$L = Ln\left[\frac{P_i}{1 - P_i}\right] = Z_i = \beta_0 + \sum_{i=1}^{m} \beta_i X_i + U_i \quad (7)$$

Before running the specified regressions model for the analysis of data, all the hypothesized exogenous variables were checked for the existence of multicollinerity problems which may arise due to a linear relationship among explanatory variables. It refers to a situation where it becomes difficult to separate effects of independent variables on the dependent variable because of strong relationships among independent variables (Maddalla, 1977). If there is multi-collinarity problem among the exogenous variable, it may cause the estimated regression coefficients to have wrong signs, smaller t-ratios, high R^2 value and it also causes large variance and standard error with a wide confidence interval. Therefore, it is difficult to estimate accurately the effect of each variable (Gujarati, 2004). Among different methods to detect the presence of multicolinearity problem among the explanatory variables, variance inflating factor (VIF) method was used (Gujarati, 2004). VIF for explanatory variable can be calculated as follows:

$$VIF = \frac{1}{1-R^2} \quad (8)$$

Where, R^2 is the coefficient of correlation among explanatory variable. The larger the value of VIF indicates the more co linearity among one or more model explanatory variables. As a rule of thumb, if the VIF of a variable exceeds 10, which will happen if a multiple R-square exceeds 0.90, that variable is said be highly collinear (Gujarati, 2004).

2.5. Definition and Hypothesis Variables

2.5.1. Dependent Variable

Adoption of wheat row planting technology (Awrpt): Adoption of wheat row planting by farm households is the dependent variable. It is a dichotomous variables representing farmer's adoption decision of wheat row planting technology.

2.5.2. Independent Variables

The explanatory variables of importance in this study are those variables which are thought to have significant effect on farmers' adoption of wheat row planting. These include farmers' personal and demographic, socio-economic, psychological and institutional variables. These explanatory variables are defined as follows.

Table 3: Summary of definition of independent variables and hypothesis

Variables	Description of the variables	Type	Expected sign
Sex	Sex of household head	Dummy (1= Male, 0= Female)	+
Credit	Credit use	Dummy (1=Use, 0=If not use)	+
Age	Age of household head in years	Continuous	-
Educl	Education level of the household head	Continuous	+
Tlu	Number of livestock holding in (TLU)	Continuous	+
Offarm	Participation in off/non-farm activities	Dummy (1= If participated, 0= If not participated)	+
Actflab	Availability of active family labor	Continuous	+
Mrktdis	Distance from the nearest market	Continuous	-
Partfd	Participation on field days	Dummy (1= If participated0= If not participated)	+
Parsorg	Participation in social organizations	Dummy ((1= If participated, 0= If not participated)	+
Fexp	Household's farm experience in years	Continuous	+
Fqcexta	Frequency of contacts with extension	Continuous	+
Avilfer	Availability of fertilizer on time	Dummy (1= If available, 0= If not available)	+
Farmsz	Farm size	Continues variables	+
Mmexpo	Mass media exposure	Dummy (1= If mass media exposure, 0=If not exposure	+
Farmper	Farmers perception towards wheat row planting technology	Dummy (1= If good perception, 0= If bad perception	+

3. RESULTS AND DISCUSSION

This chapter presents the findings and discussion of the descriptive statistics and model outputs. The main findings of the study are presented in to three sections. First section contains level of Adoption of wheat row planting technology. Second section contains analysis related with the description of variables in terms of descriptive and inferential statistics. Third section displays and deals with the findings from the logistic regression model on factors affecting the adoption decision of wheat row planting technology.

3.1. Current Level of Adoption of Wheat Row Planting Technology

In this study, farmers who did not apply/use wheat row planting technology during the survey were considered as non-adopters while the farmers who applied/used wheat row planting technology were considered as adopters. As a result, out of 165 sample respondents, 78 (47.27%) were adopters of wheat row planting adoption categories and the rest 87 (52.73%) were non-adopter households. This shows that the percentages of adopters are less than non-adopters because farmer's adoption technologies in variable level, this different level of adoption may be related to several reasons or factors.

3.2. Descriptive and Inferential Analysis Results

3.2.1. Descriptive and inferential statistics of continuous variables

The mean comparison between adopters and non-adopters showed that there is a statistically significant difference between the two groups in terms of some variables. Results showed that adopters are having large farm size, higher education level, more contact with extension agents and have many active family members than non-adopters in the study area. The discussion of each of the continuous variable is given below.

Table 4: Descriptive and inferential statistics of continuous variables

Adoption categories							
Variables	**Adopter =78**		**Non-adopter = 87**		**For total observation**		
	Mean	SD	Mean	SD	Mean	SD	t-value
Age	43.54	6.58	45.23	6.54	44.33	6.60	-1.650
Farmsz	4.45	2.39	3.12	1.47	3.75	2.06	-4.338^{***}
Educl	4.24	3.22	1.90	2.46	3.01	3.07	-5.252^{***}
Frexpr	2.42	1.55	0.78	0.96	1.60	1.25	-8.265^{***}
Fqcext	3.70	1.83	1.78	2.03	2.69	2.16	-6.350^{***}
Livestoc (Tlu)	9.22	3.47	9.41	3.29	9.32	3.37	0.796
Actflab	3.66	0.93	2.47	1.68	3.03	1.49	-5.496^{***}
Mktdis	95.29	100.08	78.85	90.97	87.07	95.53	-1.105

Source: Own computation from the survey data, 2019. ***, indicates significant at 1% level of significance.

3.2.2. Descriptive and Inferential Statistics of Dummy Variables

The proportion comparison between adopters and non-adopters showed that there is a statistically significant difference in terms of some categorical variables. Results showed that adopters are participated in social organization, participated in off/non-farm activities, participated in field days, more mass media exposure, have good perception on wheat row planting technology than non-adopters in the study area. The discussion of each of the dummy variable is given below.

Table 5: Descriptive and inferential analysis results of dummy variables

Adoption categories									
Variables	**Responses**	**Adopter**		**Non-adopter**		**Total**		$\boldsymbol{Chi^2 - Value}$	**P-value**
		N	%	N	%	N	%		
Sex	Female	11	14.10	17	19.54	28	16.97	0.863	0.353NS
	Male	67	85.90	70	80.46	137	83.03		
Avilfer	Yes	63	80.77	69	79.31	132	80.00	0.054	0.815NS
	No	15	19.23	18	20.56	33	20.00		
Parsorg	Yes	49	62.82	42	48.28	91	55.15	3.51	0.061^{*}
	No	29	37.18	45	51.72	74	44.85		
Offarm	Yes	46	58.97	38	43.68	81	49.09	3.850	0.050^{**}
	No	32	41.03	49	56.32	74	50.91		
Credit	Yes	16	20.51	23	26.44	39	23.64	0.799	0.371NS
	No	62	79.49	64	73.56	126	76.36		
Partfd	Yes	50	64.10	37	42.53	78	47.27	7.679	0.006^{***}
	No	28	35.90	50	57.47	87	52.73		
Mmexpo	Yes	60	76.92	34	39.08	94	56.97	24.02	0.000^{***}
	No	18	23.08	53	60.92	71	43.03		
Farmper	Bad	21	26.92	61	70.11	82	49.70	30.69	0.000^{***}
	Good	57	73.08	26	29.81	83	50.3		

Source: Computed from survey data, 2019

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

3.3. Results of the Econometric Model

Table 6: Logit model estimates of factors affecting the adoption decision of wheat row planting technology

Variables	Coefficients (B)	S.E	Significance Level	Marginal effects (dy/dx)
Constant	-14.011	2.909	0.000	-
Sex	-0.628	0.754	0.415	-0.155
Age	0. .048	0.045	0.305	0.012
Edulev	0.312	0.099	0.002***	0.077
Frexpr	0.990	0.238	0.000***	0.246
Farmsz	0.210	0.186	0.268	0.052
Avilfertz	-0.845	0.787	0.315	-0.207
Parsorg	1.583	0.632	0.016**	0.373
Partfd	0.751	0.637	0.272	0.184
Offarm	2.004	0.689	0.007***	0.461
Mmexpo	2.088	0.641	0.002***	0.473
Fqcextagt	0.523	0.172	0.003***	0.130
Farmper	1.846	0.658	0.007***	0.430
Livestock (TLU)	-0.018	0.075	0.814	-0.004
Actflab (ME)	0.498	0.498	0.056*	0.124
Mrktdis	0.003	0.003	0.342	0.000
Credit	0.087	0.704	0.907	0.021
Number of obs. = 165			Correctly predicted = 90.30%	
LR chi2 (16) = 145.88			Non-adopters predication =90.80%	
Prob > chi2 = 0.000***			Adopters predication = 89.74%	
Log likelihood = -41.182064			Pseudo R2 = 0.6391	

Source: Econometric model output, 2019.

Note: ***, ** and * represents Significant at less than 1%, 5% and 10% probability level respectively.

The logistic model was applied to all sample farmers (both adopters and non-adopters) to find the factors affecting the farmers' decision to adopt or not to adopt wheat row planting technology. Before going on to see the relation of variables by using the logit model, it was found important to look into the problem of multi-collinearity or linear association among the hypothesized independent variables. Variance inflation factors (VIF) was used to check the multi-collinearity problem with all variables.

Lastly the eight continuous and the eight dummy variables were entered into the logistic regression analysis. The various goodness of-fit 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 the 1 % level. This shows that the independent variables were relevant in explaining the farmers' decision to adopt wheat row planting technologies. The model predication result also shows that about 89.74% of the adopters and 90.80% of non-adopters were correctly predicted by the model. Generally, the correct prediction of all sample (count-R^2) is 90.30% of the overall sample cases. Thus, the model prediction was good for both adopters and non-adopters of wheat row planting technology.

The logistic regression results shows, the presence of relationship between the dichotomous dependent with the explanatory variables for the continuous and dummy variables for the study. These variables include education level, frequency of contact with extension agent in the year, perception towards on wheat row planting, participation in field days, mass media exposure, participation of social organization, availability of active family labor and participation of off farm activities, whereas the rest five explanatory variables were found to have no significant influence on the adoption of wheat row planting technology. The influence of the significant explanatory variables on adoption of wheat row planting technology in the study area is interpret and discussed below:

Availability of active family labor (Actflab): Availability of active family labour had influenced the adoption of wheat row planting technology positively at 10% level of significance. The result of marginal effect indicates as increase the number of active family labor in one man equivalent, the probability of adopting wheat row planting technology increases by 12.4% holding other factors constant. This is because wheat row planting technology is labour intensive and hence the households with high labour availability use the technologies on their farm plots better than others. The result was consistent with the finding of Abrhaley (2016) and Tadele (2016).

Farming experience (Frexpr): - It is significantly affected the adoption decision of wheat row planting technology at 1% significance level. This implies that farmers who have longer years of experience in using wheat row planting technology or farming have adopted wheat row planting technology than those who have the

lower years of experience in using wheat row planting. Therefore, the result of marginal effect indicates as increase the farming experience by one year, the probability of adopting wheat row planting technology increases by 24.6% holding other factors constant. This result agrees with Abera (2013) have reported farming experience positive and significant relation with adoption.

Frequencyof contact extension agents (Fqcext): Frequency of contacts with extension agents is important for creating farmers technically skillful and confidential on running agricultural production in a sustainable way. The result of marginal effect indicates as increase the frequency of contacts with extension agents by one day, the probability of adopting wheat row planting technology increases by 13% holding other factors constant. Thus, farmers' who more contacts with extension agents are believed to be exposed to different, new and update information that help them to quickly adoption of wheat row planting on their farm lands. The result was similarly with the finding of Moti *et al*. (2013) also found that the number of extension contact agents has a significant positive effect on adoption of agricultural technologies.

Mass media exposure (Masexpo): Mass media exposure is important to make farmers aware of new agricultural technologies to proceed for the next step of considering the advantage and limitation of the technology and positively influencing the adoption of wheat row planting with at 1% level of significance. The result of marginal effect of this variable 0.47 reveals that the predicted probability of using wheat row planting technology increases by 47.3% for the farmer's mass media exposure as compared to the farmers who do not mass media exposure. The finding of this research is similar with Tariku (2012).

Perception towards wheat row planting (Farmper): The perception towards wheat row planting technology has significant and positive relationship with the adoption of wheat row planting at 1% level of significance. The result of marginal effect of this variable 0.43 reveals that the predicted probability of using wheat row planting technology increases by 43.6% for the farmer's perceived wheat row planting technology as a good compared to those who perceived it as bad. The result of this research is similar with Ragasa (2016).

Education level of household head (Educl): Education level of the household head is one of the important indicators of human capital. Moreover, education enhances farmers' to make independent decision and to act on the basis of the decision and increase the households ability to acquire, analyze, interpret and use information relevant to the adoption of enhanced agricultural technologies. It is positively and significantly influenced the adoption of wheat row planting at 1% probability level. The result of marginal effect indicates as education level of household head increases by one year, the probability of adopting wheat row planting technology increases by 7.7% holding other factors constant. This result similar with the studied done by Tolesa *et al*. (2014) and Yonas (2014).

Participation in off/non-farm activities (Offarm): Participation in off/non-farm income activities was found to have positive and significant influence on the adoption of wheat row planting. Other things held constant, the result of marginal effect 0.46 reveals that the predicted probability of using wheat row planting technology increases by 46.1% for the farmer's participated in off/non-farm activities as compared to those who do not participated. This could be linked to the possibility of using money from off/non-farm activities for purchasing of inputs and hiring labor necessary to continue sowing wheat by row. This was consistent with the findings of Hassen (2014).

Participation in social organizations (Partsorg): In this study also, social participation was considered to influence adoption of wheat row planting technology positively at 5% significant level. It is a social asset that creates an opportunity to share experience and exchange information on new technology in the farming community. The model indicated that farmers who have participation in social activities were hypothesized to have more opportunity of getting access to information and adopting technologies better than the non-participants. Other things held constant, the result of marginal effect 0.37 reveals that the predicted probability of using wheat row planting technology increases by 37% for the farmer's participated in social organizations as compared to those who do not participated. This is imply that strong social participation lead to have better access of information and technologies then lead to adopt technology. This was consistent with the findings of Aberham (2012).

4. CONCLUSION AND RECOMMENDATIONS

Wheat is one of the most important cereal crops for the Ethiopia which is the main source of food and cash for smallholder farmers. Growth of the production of wheat crop encouraged through technological change is expected to support higher calorie intake and improve household's food security. The mostly rain fed wheat production in Ethiopia is still low and lagging behind many African countries and is also deficient in terms of production to meet the national requirements. The performance of wheat production has been give attention in recent years. It is understood that there is various potential for further productivity growth in wheat crop through the adoption of row planting technology which is important to meet the growing demand and food deficit particularly in the study area, hence reduce poverty and countries dependence on wheat import and then encourages economic growth of the country.

Wheat contribution to household's nutrition, income and food security is very high. As a result, out of 165 sample respondents, 47.27% were adopters of wheat row planting adoption categories and the rest 52.73% were non-adopter households. As a result of this, availability of active labor in the family, education level of household head, participation on field days, frequency of contact with extension agents, participation of social organisation, participation in off farm activities, mass media exposure and farmers' perception towards wheat row plating technology are significantly affected the adoption of wheat row planting technology. Based on the research findings of this study, the following significant variables are recommended to encourage farmers' adoption of wheat row planting technology.

Education was found to have positively and significantly affected adoption decision of wheat row planting technology. Therefore, due emphasis has to give towards strengthening farmers informal education at different levels for households using farmers training centres. Promotion of adult and youth education among the society and creating experience sharing event to simulated best practice is recommended.

Labor availability of the family was influenced adoption decision of wheat row planting technology positively. Wheat row planting technology practice needs more labour for activities during sowing wheat by row. Hence, different wheat row planting technology with relatively less labor requirements should be designed. Hence, to improve this, wheat row planter machine should be produced and provided to the farmers.

Mass media exposure is significantly influencing adoption decision of wheat row planting positively. It is important to influence adoption decision of farm households to create an awareness to show an interest to adopt the technology on which organizing farmers to share and discuss ideas from different mass media sources like radio, magazines and television with their own local development group is important to fill the available information gaps.

Frequency of contacts with extension agent positively influenced the adoption decision of wheat row planting technology. The district agricultural office should strengthened the present extension service facility as to improve farmers' number of contact with extension agents through increasing the number of extension workers and improving educational performance of the extension agents is important to improve farmers adoption of wheat row planting technology.

Perception towards wheat row planting technology is positively and significant affects the adoption decision of wheat row planting technology. Information about the profits of the new technology should be given to farmers to increase farmer's awareness about the technology and to develop a farmer's better perception towards the technology. Improved farmers to use wheat row planting technology to get advisable change in the agricultural production and development.

Participation in off/non-farm activities positively and significantly influences the adoption decision of wheat row planting technology. This additional income from participation in off/non-farm activities increased financial capacity of farmers to purchase farm inputs, hiring labor and also have a confidence. As a result, good attention is needed for the development of income generating activities.

Participation in social organization has positively and significantly influences the adoption decision of wheat row planting technology. Therefore, participation of farmers in different formal and informal social organization like farmers association, informal associations (*Ider, Ekub, Mahber* and others), farmer's cooperatives and women's association has to be strengthened so as to improve farmers' access to information and adoption of technologies.

Farming experience has positively and significantly influences the adoption decision of wheat row planting technology. More experienced household are better in adopting wheat row planting technology. Therefore, should be able to increase the awareness of household head through experience sharing events in order to increase the adoption of wheat row planting technology.

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6. APPENDEX

Appendix Tables

Table 1: Conversion factor of Tropical Livestock Unit (TLU)

Livestock Category	TLU	Livestock Category	TLU
Camel	1.25	Donkey (young)	0.35
Ox	1.00	Horse	1.10
Cow	1.00	Sheep (adult)	0.13
Bull	0.34	Sheep (young)	0.06
Heifer	0.75	Goat (adult)	0.13
Calf	0.25	Goat (young)	0.06
Donkey (adult)	0.7	Poultry	0.013

Source: Storck, *et al*., 1991

Table 2: Result of variance inflation factor for continuous explanatory variables

Variable	VIF	1/VIF
Numext	1.46	0.686064
Farmsz	1.36	0.733904
Age	1.30	0.770079
Actflab	1.27	0.784401
Partfd	1.19	0.841577
Avilfer	1.18	0.850928
Educl	1.18	0.849366
Tlu	1.20	0.836240
Parsorg	1.10	0.905514
Sex	1.12	0.894124
Mmexpo	1.08	0.925983
Offarm	1.06	0.941182
Farmper	1.12	0.891423
Mean VIF	1.20	

Source: Computed from own survey, 2019

Table 3: Conversion factor used to compute man equivalent (Labour Force)

Age group	Male	Female
< 10	0.00	0.000
10-13	0.20	0.200
14-16	0.50	0.40
17-50	1.00	0.80
>50	0.70	0.50

Source: Strock*et al*. (1991)