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Adoption of Improved Wheat Varieties by Wheat Producers in the Bale Zone of Ethiopia

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ABSTRACT: *Wheat is a strategic food security crop in the Ethiopia. Improving production and productivity of smallholder farmers through adoption of improved wheat varieties is one of the measures presumed to bridge the persistent food gap in the country. There are several socio-economic and institutional factors that constraint farmers from adoption of improved wheat varieties and empirically unidentified in the study area. The objective of this study was to analyze the factors influencing farmer's decision in adoption of improved wheat varieties in the study area. A combination of quantitative and qualitative methods such as household survey, key informant interview and focused group discussion were utilized for this study. The probit model result showed that sex of household head, land holding size, livestock holding size, access to credit, access to market information, frequency of extension contacts, educational level of household head, membership in cooperatives and perception on yield capacity significantly influenced adoption decision of improved wheat varieties. Therefore, policy and development interventions should give emphasis towards the improvement of such economical and institutional support system so as to achieve wider adoption of improved wheat varieties, increased production and productivity of smallholder farmers***.**

KEY WORDS: Adoption, improved wheat varieties, Binary probit model.

INTRODUCTION

Wheat (*Triticuma estivum L*) is one of the world's leading cereal grains serving as a staple food for more than one third of the global population. Accounting for a fifth of humanity's food, wheat is second only to rice as a source of calories in the diets of consumers in the developing countries. Wheat is an especially critical "stuff of life" for approximately 1.2 billion "wheat dependent" and 2.5 billion "wheat consuming" poor men, women and children who live on less than USD 2 per day; and for approximately 30 million poor wheat producers and their families (CIMMYT, 2012).

Ethiopia is the largest wheat producer in sub-Saharan Africa by cultivating wheat on over 1.70 million hectares of land, accounting for 13.33% of the total grain crop area, with an annual production of 4.54 million tons, contributing about 15.81% of the total grain production (ATA, 2017, FAOSTAT, 2018). In terms of area of production, wheat ranks fourth after *teff* (*Eragrostistef Zucc*.), maize (*Zea mays L*.) and Sorghum (*Sorghum bicolor L*.) and in total grain production, wheat ranks third after teff and maize in the country (CSA, 2017).

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To improve production and productivity of smallholder farmers, the government of Ethiopia is also doing its best by complementing the existing technologies with new technologies (improved wheat varieties). Despite this fact, the introduced improved wheat varieties were not widely accepted as expected in different parts of Ethiopia (Shiferaw *et al*., 2014; Jaleta *et al*., 2015). For instance, according to Taffes *et al*. (2017), at national level the percentage of improved wheat varieties use in Ethiopia is 4.7 percent. Essentially, the observed failure of farmers to adopt improved wheat varieties and fully put into practice could be attributed to various factors which appeared to have some bearing on the farmers' decision to adopt the technologies and further investigation on factors impeding these are suggested (Jaleta *et al*., 2016; Beshir, 2016; Biftu and Diriba, 2016; Hagos, 2016).

Moreover, adoption decision of improved wheat varieties by smallholder farmers is influenced by different demographic, socioeconomic, institutional and psychological factors differently in different areas. This indicates that, in order to identify the influence of different factors in different areas; location and crop specific research should be conducted. Therefore, the study was conducted to examine the adoption status of smallholder farmers and to identify the major factors influencing farmer's decision in adoption of improved wheat varieties in the study area.

Review of Related Literature

Empirical Studies on Adoption

Sex: Sex differentials are one of the most important factors influencing adoption of improved agricultural technologies. Regarding the relationship of household head sex with adoption of agricultural technologies, many previous studies reported that household head sex has positive effect on adoption in favor of males (Berihun *et al*., 2014; Hailu *et al*., 2014; Jaleta *et al*., 2016). Similar studies by Menale *et al*. (2012), Solomon *et al*. (2014) and Tesfaye *et al*. (2014) also confirmed that as compared to male-headed households, female-headed households were less likely to adopt technologies than male-headed farmers due to their lower labor endowment, lower farm land holding and livestock unit ownership, and less access to information on improved agricultural technologies compared to their counterpart.

Education: With regard to educational level of the household head there is a general agreement that education is associated with adoption, because educational level of the household head is one of the important indicators of human capital (Obayelu *et al.,* 2017). Several studies have reported that education level of the household head had positive and significant relationship with adoption of improved agricultural technologies (Merga and Urgessa, 2014; Leake and Adam, 2015). The other study conducted by Hassen *et al*. (2012) on determinants of fertilizer technology adoption in north eastern highlands of Ethiopia has shown that the farmer's likelihood of adopting improved agricultural technologies increases with farmers' formal educational level. Similarly, Sisay (2016) reported positive relationship between educational level of family members and adoption of improved agricultural technologies.

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Farming experience: Farming experience is another important household related variable that has relationship with adoption. Longer farming experience implies accumulated farming knowledge and skill which has contribution for adoption (Yu and Nin-Pratt, 2014) The study conducted by Leake and Adam (2015) on factors influencing allocation of land for improved wheat variety in Adwa district reported positive relationship of household head wheat crop farming experience with the adoption of improved wheat variety by smallholder farmers. Similar Studies conducted by Assefa and Gezahegn (2010), Solomon *et al*.(2013) and Hassen *et al*.(2015) indicated positive relationship of household head farming experience with farmers decision to adopt improved agricultural technologies.

Farm Size: Concerning farm size, different studies reported its effect differently. For example, studies by Assefa and Gezahegn (2010) and Kebede *et al*. (2017) found a positive and significant effect of farm size on adoption of improved agricultural technologies and the probable reasons for those studies were farmers with large farm size are likely to adopt a new technology as they can afford to devote part of their land to try new technology unlike those with less farm size. However, Tafese (2016) reported negative influences of large farm size on adoption of improved technology especially in the case of an input-intensive innovation.

Livestock ownership: Concerning tropical livestock, different studies reported positive relationship between livestock ownership and the probability adoption of improved agricultural technologies (Hassen *et al.*, 2015; Tafese, 2016). Similar studies conducted by Solomon *et al.*(2013) and Sisay (2016) reported that farmers with large number of livestock are more likely to adopt the technologies, indicating that farmers with relatively more livestock unit make use of their income obtained from sale of livestock and their byproducts for the purchase of inputs (seed, fertilizer, herbicide, etc.) whenever the need arises. This implies that being owner of more livestock unit increase the probability of adoption of improved agricultural technologies.

Family size: Several studies have reported the positive effect of household labor availability on adoption of improved agricultural technologies. According to Tafese (2016) family size had significantly influenced the probability of adopting row planting by farmers. The probable reason for this significant positive effect of family size was that row planting is labor intensive and hence the household with relatively high family size uses the technologies on their farm plots better than others. Similar studies by Leake and Adam (2015) and Moti *et al*. (2016) also reported positive effect of household labor availability on adoption of agricultural technologies by smallholder farmers.

Extension contact: The relationship between farmers' access to extension services and adoption has been reported repeatedly as positive and significant by many authors. The study conducted by Merga and Urgessa (2014) on adoption and impact of agricultural technologies on farm income revealed that significant relationship between access to extension and adoption of agricultural technologies. It also indicated that the frequency of contacts farmers made with extension workers was an important factor in discriminating the adopters from non-adopters (Biftu *et al*., 2016). Similarly, Solomon *et al*. (2013), Leake and Adam (2015) also found that

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frequency of contacts with extension agent has positively and significantly influenced the adoption decision of smallholder farmers. Access to extension services helps to spread information about new agricultural technology leading to adoption. This help to reduce transaction cost incurred when passing the information on the new technology to a large heterogeneous population of farmers (Obayelu *et al.,* 1017).

Access to credit: Capital and risk constraints are key factors that limit the adoption of high value crops by small scale farmers because these improved agricultural are more costly to produce per hectare than traditional crops and most growers require credit to finance their production (Girma, 2016). Access to credit affects the ability of a farmer to obtain the necessary improved agricultural technologies at the right time and in suitable quantities. In line with this, studies conducted by different authors have reported positive and significant relationship of credit with adoption of improved agricultural technologies by farmers (Sisay, 2016; Kebede *et al*., 2017).

Market distance: Access to markets is not only needed as an outlet for production but also as a means of securing inputs. If there is no markets that can bear the extra supply, farmers' investment in new agricultural technologies will be for nothing, because farmers need something to do with their increased output. Different studies reported negative relationship between distance from market center and the probability adoption of improved agricultural technologies. The study undertaken by Kebede *et al*. (2017) showed that distance from market was negatively and significantly associated with the adoption of improved wheat technologies. Households near to market centers tend to have easier market access to dispose of their production (Gebresilassie and Bekele, 2015).

Cooperative membership: Cooperatives are among the strongest social institutions that play crucial roles in adoption of improved agricultural technology. Farmer's membership to cooperative has positive and significant influence on adoption behavior, implying that farmers who are members of farmer cooperative are more likely to adopt improved technologies (Ahmed, 2015; Kebede *et al*., 2017). A probable reason for this result relates to the fact that cooperatives provide information sharing platforms between farmers about the price, profitability and status of the new technology for member farmers. As a result, farmers in cooperatives tend to adopt improved technologies faster than farmers who are not members..

Perception on technology attributes: According to Duvel (1975) Perception is a key dimension in behavioral change process. However, major adoption studies have not considered in the analysis of the determinants of adoption decisions. Farmer's perception of specific characteristics of technology significantly condition adoption decision (Biftu *et al*., 2016; Mantegeb 2018). In addition, the studies conducted by Adam *et al*. (2014); Bayissa (2014) and Wen-chi *et al.* (2015) revealed that farmers have subjective preferences for technology characteristics and these could play major role in adoption behavior. They indicated that the perceived advantages and farmers' individual risk preferences and their ability to bear the risk of new technology play crucial roles in adoption of improved agricultural technology.

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METHODOLOGY

Description of the Study Area: The study area, Gololcha district is located at 550 km to south-east from capital city of Ethiopia which is Addis Ababa. The mean annual temperature of the district is 19^{o}c whereas the mean annual rainfall of the district is 750mm. The major crops grown in the district are cereals (wheat, barley, maize, teff, and other cereals), pulses (beans, peas and linseed) and vegetables. At present, in the district, all kebeles of the district produce wheat and it ranks first in terms of area coverage (41.24%) and production (44.42%) followed by barley, maize and teff respectively.

Sampling Techniques: Multistage sampling method was employed to draw sample respondents with a combination of purposive and simple random sampling techniques. In the first stage,the Gololocha district was purposively selected because it is among the major wheat producing districts of eastern Bale zone. At the second stage, out of 25 major wheat producing kebeles in the district, a total of 12 potential wheat producing kebeles were identified. At the third stage, among the12 potential wheat producing kebeles four kebeles were randomly selected. Finally, representative sample respondents were randomly selected by probability proportional to size technique (PPS) of the number of households in each four sample kebeles. The sample size for the study was determined based on Yamane (1967) $n = \frac{N}{1+N(e)^2}$.Where, n is the sample size for the study, N= Total number of wheat producers in the district (26837) and e is the precision level (6%). Based on the formula, the total sample size of the study was 202 farmers.

Data Collection: Both quantitative and qualitative data were collected from primary and secondary sources for this study. The primary data sources were wheat producers, key informants and focus group discussants while the secondary data related to wheat production, input used, productivity and trends of wheat production, general socio-economic information of the district were acquired from zonal office of agriculture, published and unpublished documents such as CSA of Ethiopia.

Before conducting the actual survey; the interview schedule was translated into the local language (*Afan Oromo*). Then the interview schedule was pre-tested by administering on non-sample farmers and based on the feedback from pretest, a modification was made. Ten enumerators, all diploma holders, were selected and recruited on the basis of their adequate knowledge about the area, prior exposure to similar work and well acquainted with the culture and language. The necessary theoretical and practical training was given to enumerators about the methods of data collection and content of the interview schedule for one day by the researcher. They collected the necessary data under the close supervision of the researcher. Moreover, two focus group discussions and eight Key Informants Interviews were conducted in order to supplement and triangulate the data collected through structured interview using check list to collect the data.

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Data Analysis: In order to analyze the quantitative data, descriptive and inferential statistics and econometric model analysis were used. The chi-square test was employed to see the significant percentage difference between improved wheat varieties adopter and non-adopter households in terms of dummy independent variables. On the other hand t-test was conducted to see if there was a statistically significant mean difference between improved wheat varieties adopters and non-adopters with respect to continuous variables. This study utilized the probit model to analyze likelihood of adoption of improved wheat varieties by smallholder farmers.

Specification of the Probit Model

$Yi* = \beta X_i + \mu_i$

$Yi = Yi*, if\ Yi* > 0$

$Yi = 0\ otherwise,$

Where, $Yi*$ and Yi is latent and observed level of participation in improved wheat production respectively, β is a vector of parameters to be estimated and X_i is a vector of variables (demographic, Socio-economic, institutional and psychological factors) influencing the households' status of adoption in improved wheat varieties and μ is a vector of error terms.

Before running the model, the existence of multicollinearity problem among the hypothesized independent variables was checked. In order to check this, variance inflation factor (VIF) and contingency coefficients (CC) test were used for continuous and discrete variables respectively. Narration and interpretation were used to analyze the qualitative data.

Operational definition of variables and hypothesized relationships

Dependent variable: It is dummy variable which represents smallholders improved wheat varieties adoption decisions that takes value of 1 for adopter and 0 for non- adopter of improved wheat varieties.

Table 1.Definition of Explanatory Variables and Expected Effect

Variable Description	Variable Types and Measurement	Expected Sign
Farming experience	Continuous, years of farming	+/-
Sex of household head	Dummy; male/female	+
Educational level	Continuous, years of schooling	+
Land holding size	Continuous, measured in hectares	+
Livestock holding size	Continuous, measured in TLU	+
Family size	Continuous, family size number	+/-
Access to credit	Dummy; yes/no	+
Frequency of extension contact	Continuous; days	+
Market distance	Continuous, kilometers	-
Perception on yield capacity	Dummy. yes/no	+
Membership to cooperative	Dummy; yes/no.	+
Access to market information	Dummy; yes/no	+

Source: own definition, 2019.

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RESULT AND DISCUSSION

Econometric Model Result

Before running the model, outliers were checked by box plot graph so that there was no problem of outlier and no data were lost due to outliers. In addition, multicollinearity which is a common problem of cross-sectional data was also checked. The test indicated that, the largest VIFs value is 2.21 and that of CC is 0.5871 which are below the maximum value of 10 and 0.75 respectively. The probit model was employed to identify factors influencing adoption of improved wheat varieties by smallholder farmers in the study area. The chi-square ($\chi 2$) distribution was used as the measure of overall significance of a model in probit model estimation. Hence, the adoption decision of improved wheat varieties by households is best explained by the probit model. The specification of the model is significant for the estimation of determinants of adoption of improved wheat varieties implying that the null hypothesis that all slope coefficients are zero does not hold true at 1% statistical error.

The results of the model show that out of the twelve variables included in the model, nine variables were found to be significantly affecting the likelihood of adoption of improved wheat varieties in the study area. The probit model outputs showed that sex of household head, land holding size, live stock holding size, frequency of extension contacts, educational level of household head, access to credit, access to market information, Perception on yield capacity of improved wheat varieties, and farmers membership to cooperative are the significant factors that affecting the probability of adoption of improved wheat varieties in the study area (Table 11). They are discussed one by one as follows:

Sex of household head: As it was hypothesized, the result of probit regression showed that, there was a positive and strong significant relationship between sex of the household head and adoption of improved wheat varieties at 10 % significance level. Accordingly, male-headed households were more probable to adopt improved wheat varieties by about 23.6% higher than that of their female counterparts. This could be attributed to various reasons related to the economic or social status of female-headed households, such as shortage of labor, limited access to information and required inputs. Moreover, culturally reproductive role, such as food preparation and child care are considered as duties of females in the rural area that brought the work load on them. In congruent with the finding; Aman *et al.* (2014) and Tesfaye *et al*. (2015) in Ethiopia concluded that there were gender gaps in land ownership, family size, asset ownership and farm income in agricultural production.

Land holding size: The size of land holding was hypothesized to affect adoption of improved wheat varieties positively. Similar to the expectation the model result showed positive and significant influence of land holding size on adoption of improved varieties at 5% significance level (Table11). Other variables held constant, an increase in total land holding by 1ha would result in an increase in the probability of adoption of improved wheat varieties by 16.7%. This result showed that farmers who have relatively more land holding are more likely to adopt improved wheat varieties than farmers who have smaller land holding size. The probable reason

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for this was a farmer with larger farm size means relatively harvest more thus more money flow into the family. Moreover, larger farmers have more likely to be better informed, allow their land for multiple crops, be able to take risks associated with adoption of new technologies and practices and have more opportunity to experiment new technologies with large size farms. This result is consistent with the findings of Chilot and Dawit (2016) and Sisay (2016).

Education level: Education was expected to influence the adoption of improved wheat varieties by smallholder farmers positively. The result shows that education has a positive and significant influence on adoption of improved wheat varieties at 5% significant level (Table11). Keeping other variables constant, as farmers formal education increase in a year the probability of adoption of improved wheat varieties would increase by 14.3%. The result of the model and qualitative data were coincide each other in this study. The focus group discussants and key informants indicated that, educated households are more eager for a change and understand information and advises delivered by extension agents easily. According to them, literate households adopt inputs and apply them according to the recommendation. Similarly studies conducted by Sisay (2016) and Mantegeb (2018) found a similar result in their research findings.

Access to credit: Farmer's access to credit was expected to influence the adoption of improved wheat varieties by smallholder farmers positively on the assumption that access to credit improves the financial capacity of improved wheat varieties producing farmers to buy modern inputs, thereby increasing production. As expected the model result showed positive and significant effect of credit access on farmer's adoption of improved wheat varieties at 5% significant level (Table11). This variable accounts for 12.9% of the variation in adoption of improved wheat varieties keeping other factors constant. The reason behind this can be credit relaxes the financial burden of a farmer; it goes a long way towards facilitating crop production and farm productivity by enabling the farmer to use improved cultural practices and technologies and thereby improve household income. Therefore, strengthening and expansion of credit institution in to rural area is a crucial importance to address credit needs of farming community. Studies conducted by Hassen (2014), Negera and Getachew (2014), and Berihun *et al.* (2014) found similar results.

Livestock holding size (TLU): Livestock are important source of income, food and traction power for crop cultivation generally in Ethiopia and particularly in the study area. The model result showed positive and significant influence of livestock holding on adoption of improved wheat varieties at 1% significant level. Results of marginal effect analysis show that a unit increase in tropical livestock unit increases the decision of improved wheat varieties adoption by 17.7% keeping the other factors constant. This is because farmers with relatively more livestock unit make use of their income obtained from sale of livestock and their byproducts for the purchase of improved seed and other inputs for cultivation of wheat grain. This implies that being owner of more livestock unit increase the probability of adoption of improved wheat varieties. The study is supported by Hassen *et al*. (2012), Berihun *et al*. (2014), Tolesa (2014), Leake and Adam (2015) and Sisay (2016) which confirmed the same results.

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Frequency of extension contact: Frequent extension advice related to wheat production was hypothesized to influence farmer's adoption of improved wheat varieties positively. As it was hypothesized, the result showed that frequency of extension contacts positively and significantly affected adoption of improved wheat varieties at 1%significant level. Keeping other variables constant, for each additional day a farmer made contact with extension agent, will increase the probability of adopting the improved wheat varieties by 24.4%. This is due to the fact that, frequency of contacts with extension agents increases the probability of acquiring up-to-date information on improved wheat varieties. This result is cohesive with what focus group discussants said that, farmers who have more frequency of extension contacts with development agents update themselves on the availability and arrival of improved wheat varieties and aware of its application techniques than those less visited by development workers. This result is consistent with Teklemariam (2014), Victor (2016) and Mantegeb (2018).

Access to market information: Market information access from different sources on price of farm input and output of improved wheat varieties was expected to influence farmer's adoption decision in improved wheat varieties. Similar to the expectation the model result showed positive and significant effect of market information access on farmer's adoption of improved wheat varieties at 1% significant level. This variable accounts for a variation in adoption of improved wheat varieties by 16.6% keeping other factors constant. This is due to the fact that price attracts farmers and can change farmers' decision and also smallholder farmers require proper and adequate market information in order to plan their activities, make choice of the inputs and use technologies and eventually decide when and where to sell their products. This result goes along with the study done Negera and Getachew (2014).

Perception on yield capacity: Farmer's perception on yield capacity of improved wheat variety was positively and significantly influenced adoption decision of improved wheat varieties at 1% significance level. Keeping other variables constant, a farmer who perceived better yield capacity of improved wheat varieties than that of local varieties has a chance to make a decision to adopt the improved wheat varieties by 25.5%. Concerning with the perception of farmers towards certain attributes of improved wheat varieties the focus group discussants result also revealed that farmers in the study area seek specific varietal attributes, such as yield potential, tolerance to disease, better wheat grain price and short maturity period. This result is consistent with the findings of Ermias (2013), Bayissa (2014) and Mantegeb (2018).

Membership to cooperative: farmer's membership to organizations like cooperative was expected to positively influence farmer's adoption of improved wheat varieties. Similar to the expectation the model result showed positive and significant effect of cooperatives membership on farmer's adoption of improved wheat varieties at 1% significant level. Keeping other variables constant, being member of cooperative increases the probability of adopting improved wheat varieties by 22.7 %. A probable reason for this result relates to the fact that farmer's cooperatives provide information sharing platforms between farmers about the price, profitability, status of the new technology for member farmers and members can easily access to credit and essential agricultural inputs such as improved seeds, chemicals, and fertilizer. This

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result is consistent with the findings of Aman and Tewodros (2016), Mengistu *et al*. (2016) and Mantegeb (2018).

Table 1.Estimated results of probit model likelihood of adoption of improved wheat varieties

Variables	Coefficient	Robust.Std.Err	P>z	Marginal effects
Sex of household head (1=male)	0.533*	0.377	0.087	0.263
Farming experience(year)	0.008	0.015	0.136	0.007
Educational level(year)	0.275**	0.136	0.028	0.143
Distance to market center(km)	-0.0513	0.038	0.129	-0.0201
Family size (AE)	-0.0097	0.045	0.942	-0.007
Land holding size(ha)	0.423**	0.292	0.025	0.167
Livestock holding size t (tlu)	0.193***	0.058	0.007	0.177
Access to credit(1=yes)	0.892**	0.443	0.032	0.129
Frequency of extension contact(day)	0.622***	0.160	0.008	0.245
Access to information (1=yes)	0.971***	0.321	0.004	0.166
Perception on wheat variety(1=yes)	1.438***	0.318	0.000	0.255
Membership to cooperative(1=yes)	1.146***	0.286	0.006	0.227
Constant	-2.674***	0.832	0.005	
Number of observation	202			
Wald chi^2 (12)	52.15***			
Prob> chi^2	0.0000			
Pseudo R^2	0.3047			
Log pseudo likelihood	-87.10			

*, ** and *** indicates significant at 10 %, 5%, and 1 % significance levels, respectively
Source: Own survey 2019**.**

CONCLUSIONS

This study was initiated to fill the gap of information on what factors influence the adoption of improved wheat varieties by smallholder households in Gololch district. Cross-sectional data were collected from sample of 202 farmers selected through multistage sampling procedures following probability proportional to sample size techniques. Descriptive statistics and econometric data analysis methods were employed. The survey result showed that 45% of sample household heads were adopters of improved wheat varieties in 2018/19 production year. The study identified the key factors that influencing farmer's adoption process in the study area. The prominent variables were categorized as household personal and demographic, socio-economic, institutional and psychological factors.

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The probit model results showed that the contributing factors on the probability of adoption of improved wheat varieties were sex of households head, land holding size, tropical livestock unit, frequency of extension contacts, access to market information, perception of farmers' towards attributes of improved wheat varieties, and farmers' membership to cooperatives. The results revealed that factors such as educational level, land holding size, and, access to credit service influenced the decision to adopt improved wheat varieties positively and significantly at 5 % significance level whereas variables like tropical livestock unit, frequency of extension contacts, access to market information, perception of farmers toward improved wheat varieties attributes and membership to cooperative have more influence on farmer's decision in adoption of improved wheat varieties positively and significantly at 1 % significance level. Whereas deviated from most of previous studies, variables like family size, farming experiences of household head and distance from market center did not have effects on adoption of improved wheat varieties by smallholder farmers in the study area.

Recommendations

Based on results of descriptive statistics and the econometrics models, recommendations are suggested for future research, policy and development intervention activities to promote adoption of improved wheat varieties so as to improve farmers' income from farm activities. Therefore, the following recommendations were generalized based on results of this study:

Sex of the household head affected adoption of improved wheat varieties positively; entailing male headed households adopted more than female-headed households. This is due to the fact that male-headed households had more access to resources such as land, capital and information than their female counterparts. Therefore, the policies should aim at supporting the female-headed households through creating awareness for the community on the gender division of labor to share partly the domestic work laid on the shoulder of females. Enabling them to have equal right to control over resource, thereby, increase women's access to asset and enhancing their knowledge in wheat production through training so as to improve their participation in improved wheat variety production.

Land is a limiting factor of production in agriculture. Farmers with more land are more likely to adopt and allocate a relatively higher share of their land for improved wheat varieties. Thus, adoption becomes more difficult in the farms with relatively small land size. However, increasing the size of landholding cannot be an option to increase improved wheat varieties adoption since land is a finite resource. But in Gololcha district there are some households who have large farm size without using it for production of improved wheat varieties and other related high yielding crop varieties. On the other hand there are some farmers who constrained by lack of enough farm land to expand their production in improved wheat varieties. The results from both focus group discussants and key informants revealed the absence of strong legal procedure that facilitates land rent between the farmers, therefore, the policy should improve farmers' access to land through encouraging farmers' participation in land renting markets by setting rule and regulation as it can allow the transfer of land from less efficient farmers to better efficient farmers. But on top of all, intervention aims to increase productivity of wheat per unit area of land by proper utilization of land resource and promoting technologies that would

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increase productivity of wheat is a better alternative solution to enhance smallholder adoption of improved wheat varieties.

Livestock holding is also an important determinant of adoption of improved wheat varieties. Therefore, appropriate livestock packages need to be introduced and promoted in the study area in order to make farmers accumulate capital as a cattle and design household assets building mechanisms. This may be, for instance, through improved veterinary service, feed and water development as deemed necessary.

It was also learned that, within the study area education was positively and significantly related to adoption. This indicates that literacy campaigns and adult education strategies must be designed and implemented to improve the households' literacy level.

Membership to farmer's cooperatives has a significant positive influence on the adoption of improved wheat varieties. Thus, it is important to strengthen the existing farmer cooperatives to reinforce farmer-to-farmer knowledge sharing through providing awareness creation, incentives and providing various facilities such as offices and stores by the regional and local government. Institutions like cooperatives play an enormous role in disseminating technologies such as improved seeds and fertilizers, and in providing information for farmers in order to disseminate technologies and further attempts to address farmers through cooperatives, therefore, play great roles in enhancing adoptions of technologies.

As revealed by focus group discussants and key informants market related problems like high cost of farm inputs and low price of farm outputs and timely availability of farm inputs with the required quality are the major bottleneck of improved wheat varieties production in the study area. Similarly, from the model result, market information accessibility is one of the major factors influencing farmer's decision in adopting improved wheat varieties in the study area is found to be one of the key areas of intervention to enhance farmer's adoption of improved wheat varieties. This can be achieved through developing wheat marketing channels in which the farmers can participate in both the input and output sides of wheat production as cooperative/union is very important. Therefore, it recommended that different stakeholders at zonal and woreda level in general and Gololcha distict office of agriculture, development agents and farmers institutions/organizations in the district in particular, should take measures for the initiation and development of effective wheat marketing channels to enhance farmers adoption of improved wheat varieties in the study area.

Frequency of extension contact is found to be an important determinant of the adoption of improved wheat varieties by households. Contact of extension agent with farmer was limited in the study area. This is because of development agents spending more time in non-agricultgural activities. Therefore, it is recommended that providing non-overlapping and congruent responsibilities to extension workers. Effective and efficient evaluation mechanism should be launched to monitor and evaluate the activities of development agents and their performance in order to advance adoption of improved wheat varieties in the study area

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Credit access had significant and positive impact on adoption of improved wheat varieties in the study area. Thus, the credit facility should be accessible and target poor farmers especially those who were not adopting the technologies due to lack of operating capital. This may encourage farmers to do commercial farming practice in which they can build their asset to implement adoption of improved wheat varieties in their farms. Therefore it is recommended credit organizations should provide credit service to farmers at an affordable rate of interest and credit collateral condition to increase adoption of improved wheat varieties.

Perception on yield capacity significantly and positively affected adoption of improved wheat varieties, implying that it is important to take farmers' preferences into consideration in the design of a research and development program. Thus, research centers and extension system has to give more attention to participatory research which considers farmers' priorities and needs

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