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Determinants of Market Participation of Maize Producer Smallholder Farmers: The Case of Dera District, South Gonder Region, Ethiopia

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Abstract
Agriculture is the main stay of the Ethiopian economy, which accounts for about 46% of the GDP of the nation and 90% of its export earnings and hold about 85% of the countries labor force. However, the sector is explained by low performance. This study was aimed at analyzing the determinant of smallholder maize farmers' market participation decision and intensity improved maize BH660 variety adoption in Dera District of South Gonder, Ethiopia. A two stage sampling technique was employed to select sample smallholder farmers. Accordingly, 150 smallholder farmers were randomly and proportionally selected from the study area. Double hurdle model was employed to identify the factor affecting market participation decision of maize output and intensity improved maize BH660 variety adoption, respectively. The model result indicated that total livestock unit, age of household head, sex of household head, educational level of household, family size in household, land size for maize, lag price and income of household had significant effect on market participation decision of maize output.
Keywords: Dera District**,** Maize, Market participation, Double hurdle
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Introduction

Agriculture in Ethiopia has contributed to increasing food self-sufficiency over the past years; the participation in the commercialization process has been a difficult task for the smallholder farmers because of inappropriate policies, insufficient access to technology, institutional obstacles, weak infrastructure and unfortunate links to markets (Motiet al., 2009 Currently, Ethiopia is the fourth largest maize producing country in Africa, and first in the East African region. It is also significant that Ethiopia produces Genetically Modified Organism (GMO) white maize, the preferred type of maize in neighboring markets. This strategy envisions exports markets 3 being a significant part of the demand sink for Ethiopian maize. despite the fact that it is Ethiopia's leading cereal crop, in terms of production, with 6.2 million tons produced in 2013 by 9.3 million farmers across 2 million hectares of land. Over half of small holder Ethiopian farmers grow it mostly for subsistence, with 75% of all maize output consumed by farming households (IFPRI, 2010). Given the large production and the potential to produce large surpluses, maize commercialization is still low (FAO, 2012).

The smallholder farming and market participation has an important role in transforming Ethiopia's agriculture from subsistence to market oriented production or commercial agricultural production. In line with this in Ethiopia, many policy documents regarding commercializing the smallholder agriculture were prepared and implemented aiming the integration of smallholder farmers to markets Siziba et al. (2011). Though there are some studies conducted to identify factors responsible for low level of market participation in Ethiopia example Haile *et al*, agriculture and food security(2022), not much research has been conducted to verify the major factors responsible for lower market participation by farmers, especially in Bonga District. This work is an attempt to fill the research gap and contributes to the generation of evidence for policy makers to realize greater market participation of smallholder farmers in Bonga district south west Ethiopia region. Therefore, this study was aimed to identify the factors affecting participation of maize output market and intensity of maize production in Dera district.

2. Methodology

2.1. Description of the Study Area

The study was conducted in Ethiopia Amhara National Regional State South Gondar Zone specific to Dera district rural households. Amhara National Regional State is located at 9° and 13° 45' north latitude and 36° and 13° 45' east longitude. Dera district is one of the 16 districts in South Gondar Administrative Zone. The total surface area of the district is 159.078 square kilometers with 36 rural and 3 urban kebeles total of 39 kebeles. The district is characterized under Woina Dega agro- ecological zone and known by potential maize production with an average rain fall ranging from 1000-1500 mm; its annual temperature is between 13 and 30°C. The district altitude ranges between 1,560 to 2,600 m.a.s.l. Flat land accounts for 51% and mountain and hills are the rest 49%. The capital is

Anbessamie located at 79 Km from Debretabor, 42 Km from Bahirdar and 610 km from Addis Abeba, which is the capital city of Ethiopia (Dera District Agricultural Office, 2018).

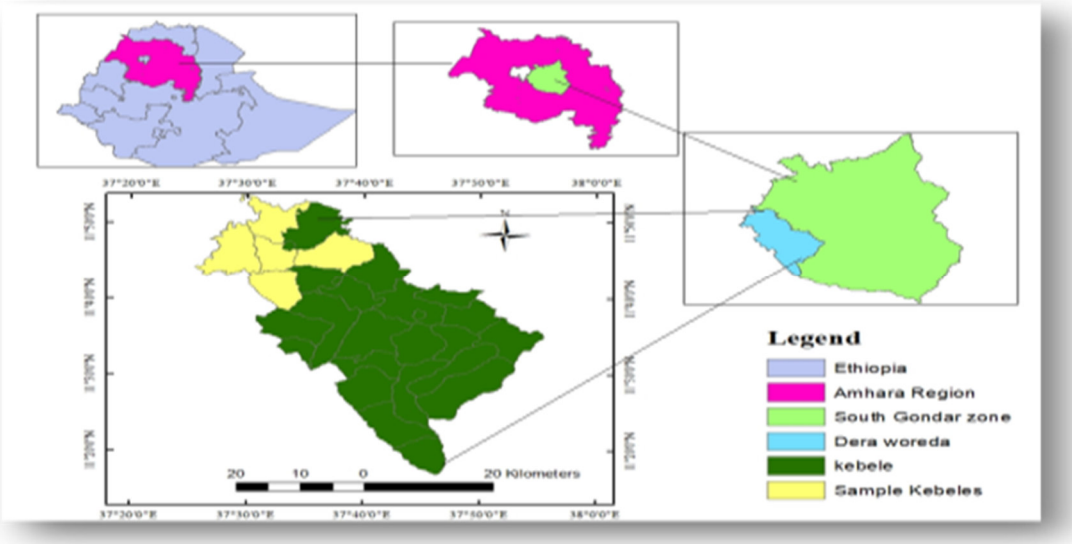

Figure 1: Map of the study area

2.2. Sampling technique and sample size

A two stage sampling technique was used to select sample producers. In the first stage, Dera district were selected purposively due to high potentials of maize production. In the second stage, using the population list of maize producer farmers from sample Kebeles, the intended sample size was determined proportionally to population size of maize producer farmers. Because for reducing biases and allows for extension of results to the entire sampling population. To determine the sample size from the target population we applied Yemane formula as follows

$$\frac{N}{1+N(e)^2} \qquad (1)$$

2.3. Sources of data and Data Collection Methods

In this study both quantitative and qualitative were collected from primary and secondary sources. The cross-sectional survey was conducted one-to-one interview using structured questionnaire, key informant interviews and administered by well trained and experienced enumerators who have knowledge of the farming system and the local language. During the personal interview information on maize varieties grown, socio-economic factors were collected.

2.4. Methods of Data Analysis

Double-hurdle Model was applied when the farmers faced with two hurdles in any agricultural decision making processes (Cragg, 1997; Sanchez, 2005; Humphreys, 2010). In according to Cragg (1971), adoption is faced by two tiers. The first is whether to adopt or not adopt the technology and second stage is related to level of adoption. In this study, double-hurdle model was chosen because it allows for the distinction between the determinants of adoption and the level of adoption in maize production through two separate stages (Burke, 2009). This model estimation procedure involves running a probit regression to identify factors affecting the decision to adoption in the activity using all sample population in the first stage, and a truncated regression model on the adopting households to analyze the extent of adoption, in the second stage. The likelihood functions for the standard double hurdle model as follows:

$$\log Lprobit = L(\alpha,\beta) = \left[1 - \phi(\mathrm{Pi}\alpha)\phi\frac{\mathrm{Xi}\beta}{\sigma}\right] \quad \text{Log truncate} = \left[\left(\left(\frac{\phi(\mathrm{Pif})}{\sigma}\right)\left(\frac{Q(Q1 - \mathrm{X'}L\beta}{\sigma}\right)\right)\right]$$

Where Φ denotes the standard normal CDF, is the univariate standard normal PDF, and σ is the variance of error terms.

The log-likelihood from the Cragg type double hurdle model is the sum of the log-likelihood from a probit and a truncated regression. More useful, is the fact that these two component pieces are entirely separable, such that truncated regression can be estimated separately (Ground and Koch, 2008; Aristei and Pieroni, 2008; Burke, 2009).

Then the log-likelihood function for the double hurdle model is: $\text{LogL} = L(\alpha,\beta) = \left[1-\phi(\text{P}i\alpha)\phi\frac{\text{X}i\beta}{\sigma}\right] + \left[\left(\left(\frac{\phi(\text{P}if)}{\sigma}\right)\left(\frac{Q(Q1-\text{X}'L\beta}{\sigma}\right)\right)\right]$

The test statistics double hurdle model likelihood ratios can be computed as in Greene (2000): LR = -2 $\left[\log LLT - (\log LLP + \log LLTR)\right] \approx \chi^2$ or LR = -2$\left[LLTobit - LLHurdle\right]$

Where: *LT*, *LP*, and *LTR* are log-likelihoods of the Tobit, probit, and truncated regression models, respectively. Rejection of the null hypothesis (LR > χ^2) argues for superiority of the double-hurdle model over the Tobit model and establishes that the decisions about adoption and level adoption are made in two different stages.

3. Results and Discussions

3.1. Results of inferential statistics for continuous variables

Among the sample respondents from Dera district, 65 (43.33%) were male headed and the remaining 6(4%) were female headed maize BH660 producers. This shows that male headed households are more likely to adopt improved maize BH660 variety than female headed. The chi-square test of sex distribution between the adopters and non-adopters was found to be significant. That means there is statistical mean difference between adopters and non-adopters in terms of sex. The average age of the adopters was 46.63 years and while it is about 47.98 years for non-adopters. The t-test of age between adopters and non-adopters was found to be insignificant. That means there is no statistical mean difference between adopters and non-adopters in terms of age.

The average labor availability in terms of man equivalent for sample household was 4.53 with standard deviation of 1.89.The average number of available labor force in terms of man equivalent for adopters and non-adopters were 4.87 and 4.20 with standard deviations of 2.13 and 1.61 respectively. The t-test of labor force between adopters and non-adopters was found to be significant at 5% level. That means there is statistical mean difference between adopters and non-adopters in terms of labor force. Education is one of the explanatory variables for this study and it helps to access, understand, process and utilize various information related to agricultural productions. Farm experience household head is taken to be the number of years when the average years of farm experience of household head for the adopter was 26 year and 26.92 years for non adopters with standard deviation of 9.37 and 9.56 respectively. The t-test of farm experience for household head between adopters and non-adopters was found to be insignificant. That means there is no statistical difference between adopters and non-adopters in terms of farm experience household head.

The t-test of total cultivabled land and land allocated for improved maize BH660 between adopters and non-adopters was found to be significant at 5% and 1% level of significance respectively indicating that there is statistical mean difference between adopters and non-adopters in terms of land cultivabled and land allocated for improved maize BH660 variety.

Table 1: T-test for continuous variables

Variables	Adopter (N=71)		Non-Adopter (N=79)		Overall mean	t-value	Sig.
	Mean	Std. Dev	mean	Std. Dev			
Age	46.63	8.96	47.98	9.12	47.35	0.91	0.3617
M.Eq	4.87	2.31	4.20	1.61	4.52	-2.19	0.0304**
Land size	2.35	.53	2.18	.55	2.26	-1.89	0.0600*
TLU	7.97	4.82	7.76	3.13	7.86	-.32	0.7514
Exp	26	9.37	26.56	.9.56	26.49	.59	0.5517
Distance	10.69	3.75	11.07	4.49	10.89	.57	0.5713
Cul.land	2.08	.42	1.90	.51	1.99	-2.33	0.0211**
Aloc.land	.32	.14	0	0	.15	21.14	0.0000***

Note: *, ** and ***, significance level at 10%, 5% and 1% respectively.
Source: Own survey result, 2019

3.2. Results of inferential statistics for Dummy variables

According to the survey results, 8 (5.33%) were literate and the remaining 63(42%) were illiterate maize BH660 producers. The chi-square test result indicates that education level of household head was found to be significant between adopters and non-adopters at 5% level of significance. This means that literate farmers are more likely to

adopt improved new technologies because education helps farmers to obtain and understand the technology more easily than illiterate farmers.

Table 2: Chi square -test for categorical Variable

Variables		Adopter		Non-adopter		Overall		Chi2-value	Sig
		Freq	%	Freq	%	Freq	%		
Sex	Male	65	43.33	64	42.67	129	86	3.4480	0.063**
	Female	6	4	15	10	21	14		
Education	Literate	8	5.33	24	16	32	21.33	8.2025	.042**
	Illiterate	63	42	55	36.67	118	78.67		0.042**
Coop-parti.ion	Yes	67	44.67	65	43.33	132	88	5.1619	0.023**
	No	4	2.67	14	9.33	18	12		
Access to Credit	Yes	38	25.33	49	32.67	87	58	1.1102	0.292
	No	33	22	30	20	63	42		
Training	Yes	58	38.67	49	32.67	107	71.33	7.0174	0.008***
	No	13	8.67	30	20	43	28.67		
Extension	Yes	61	40.67	30	20	92	61.33	36.0159	0.000***
Service	No	10	6.67	49	32.67	58	38.67	15.3378	0.000***
Demonstration	Yes	53	35.33	34	22.67	87	58		
	No	18	12	45	30	63	42		

Note: *, ** and ***, significance level at 10%, 5% and 1% respectively.
Source: Own survey result, 2019

3.3. A perception about maize BH660 variety attributes

In this study result technology attributes is needed, yield, drought resistance, early maturity, shattering, marketability, disease resistance, and non-logging. Three descriptions, i.e., superior, the same and inferior were used to facilitate the comparison by farmers of the recommended improved BH660 variety against their other seed.

About 12.67%, 25.35%, 12.67 %, 45.07 %, 30.99, %, 23.94% and 54.93% respondents perceived that the traits yield, drought resistance, early maturity, marketability, disease resistance, storability and non-logging of the improved maize BH660 variety are inferior to the other ones. about 25.35%,42.25 %,40.85%,15.49%,45.07%,46.48% and 36.62% respondents perceived that the traits yield, drought resistance, early maturity, marketability, disease resistance, storability and non-logging of the improved maize BH660 variety are the same to the other ones while About 61.98%,32.39%,46.48%,39.44%,23.94%,29.58%, and 8.45% of the improved maize BH660 variety are superior to the other one of improved maize varieties.

3.4. Determinants of adoption of improved maize BH660 variety

One of the main objectives of this study was to identify determinants of maize market participation. To do so, double hurdle model was applied. The model was statistically significant at 1%, indicating the goodness of fit of the model. The finding shows that most of the explanatory variable had negative and positive effect on market participation as expected.

Table 3: Maximum likelihood estimates of 1st Hurdle (Probit) model

Variables	dy/dx	Std. Err.	Z	P>|z|
Sex	0.309	0.129	2.40	0.016**
Age	-0.055	0.018	-3.00	0.003***
Education	-0.121	0.078	-1.55	0.121
Farm experience	0.021	0.017	1.25	0.212
Distance to market	-0.021	0.022	-0.97	0.333
Distance to road	-0.005	0.022	-0.22	0.829
Cooperative	0.328	0.117	2.80	0.005***
Family labour	0.121	0.044	3.63	0.000***
Farm size	0.048	0.298	0.16	0.871
Land cultivated	0.425	0.338	1.26	0.208
Livestock holding	-0.023	0.018	-1.27	0.206
Extension	0.604	0.085	7.12	0.000***
Demonstration	0.363	0.122	2.98	0.003**
Training	0.276	0.110	2.50	0.012***
Off farm	-0.331	0.158	-2.10	0.036**
Non-farm	-0.024	0.118	0.20	0.839
Credit	-0.267	0.117	-2.27	0.023**
Constant		1.281	-0.10	0.920
Number of obs =150				
LR chi2(17) =98.18				
Prob > chi2 = 0.0000				
Log likelihood = -54.67				
Pseudo R2 =0.4731				

Note: ***, **and* shows statistically significant at 1%, 5% and 10% level respectively.
Source: Own survey result, 2019

Sex of household head (sex):- As the probit model indicates sex of household head had positive and significant influence on the adoption of improved maize BH660 production technology at 5% significance level. This shows that being male headed households have better access to information on improved maize BH660 production technologies and are more likely to adopt new technologies than female headed households. Yenealem (2013) the binary logit model results revealed that the adoption of improved maize varieties is biased by gender, where female headed households adopt the improved varieties less. However, the variable does not cross to the second hurdle, thus insignificant. The findings contradict those of Beshir, (2014) where gender of the household head was significant and had a positive relationship on intensity of use of improved forages in Ethiopia.

Age of household head (age):- The regression result shown that age of the household head significantly and negatively influences adoption of improved maize BH660 variety at 1% level of significance. This might be due to the fact that younger farmers has better education status and more flexible on ideas and new things that would allow them adopting new technology than older farmers. Therefore, younger farmers are more likely to adopt BH660 maize variety than older farmers in the study area. An increase in the age of household head by one year decreases the probability of adopting maize BH660 variety by 5.5%, all other factors held constant. This implies that the younger people are more probability of adoption in maize BH660 variety than the older people. This finding agrees with previous studies on technology adoption such as Bamire *et al*. (2002) and Akinola *et al*. (2008), Sisay Debebe (2016) found negative relationship between age of respondent and technology adoption on their studies.

Membership in cooperative (cooperative):- Participation in cooperative society had positive influence on adoption of improved BH660 maize variety at 5% level of significance. The variable accounted for 32.8 % of the variation in probability of adoption of improved BH660 maize production. Organizing of farmers to be a member of cooperative society would facilitate access to credit, access to extension information and access to market. This implies strengthening and expansion of rural cooperatives is of paramount importance to enhance adoption of improved BH660 maize production package. The significant relationship between being member of a cooperative society and adoption is an indication for the importance of rural financial institutions in supporting agricultural production particularly new variety crops farming. Mekuria (2013) Factors influencing adoption of improved maize varieties: The Case of Goro- Gutu Woreda of Eastern Hararghe, Ethiopia. This indicated membership in cooperatives affect adoption positively and significantly.

Family labour: - Labor availability was found statistically significant at 1% probability level with the expected value and positively related with adoption BH660 maize production technology. The model result confirms that households with high labor availability in man equivalent are more likely to adopt BH660 maize production variety than households with low labor availability in man equivalent. With the assumption indicates that the probability

of adoption improved maize BH660 variety increase by one unit, as the labor force on man equivalent increases by 12.1percent while all other factors held constant. This also implies that a household with large working labor force will be in a position to manage the labor intensive agricultural activities. Moreover, large working labor force in a family means, the household may not need to hire more additional labor and the money saved due to use of own labor force could be used for purchasing other crop production inputs. Households who have larger family size of man equivalent would like to reduce the cost via participating family members in the farming activity instead of adopting technology through. The result of this study was consistent with the finding of many other researches which were conducted in different parts of the world, as well as agrees with the ideas mentioned in the hypothesis part of this thesis. Tadele (2016), Abrhaley (2016) were reported that, probability of farmers to adopt and the level of adoption of row planting technology are positively affected by family labor.

Extension contact (extension):- As hypothesized farmers' contact with extension agents positively influenced the adoption of improved maize BH660 variety at 1% level of significance, Other factors kept constant, the marginal effect in favor of adopting maize BH660 variety increases by a factor of 60.36 for the farmers who had extension contact than those who did not have extension contact. This implies that farmers who have contact with extension agents become aware of and informed about new technologies in relation to maize production packages becomes more effectively than the farmers who do not have extension contact. This is because extension agent plays a very great role in the implementation and diffusion of innovation, extension act as an agent for change and as a communication media. Also extension services popularize the innovation by providing necessary information, appropriate knowledge and special skills, which enable farmers to apply the innovation. Hence, farmers having contact with extension agents could have a higher probability of adopting improved maize BH660 variety than those who have not.

Participation in demonstration (demonstration):- Farmers can acquire new knowledge through demonstration to improve production and productivity of agriculture. The probit result indicates that the probability of maize BH660 production package adoption was positively and significantly affected by demonstration at 1% significant level.When farmers conducting a new practice they can weigh the advantage and disadvantages of the new technology and this can facilitate adoption and helps them to implement the new technology properly. This result shows that farmer who conducts demonstration is more likely to adopt new improved technology than others.

Participation in training (training):- Farmers' participation in training organized in relation to maize production influenced the adoption of improved maize BH660 variety significantly and positively at 5% significance level, other factors keep constant. Training is mechanism of promoting farmers knowledge, technical information for new technology and skills about production and adoption activities which increase farmers' decision making ability. Therefore, household heads that have an opportunity of participation in training of cereal crop are more likely to adopt BH660 maize variety for the maize production in study area. The probit model result indicates that, if a household head participates in training, the marginal effect in favor of the household head adoption of improved maize BH660 variety increases by a factor of 27.618 peresent. This also indicates that farmers participating in training acquire sufficient knowledge and skill about the use of improved maize BH660 variety which make helps respondents more likely to adopt the new variety. This is in line with previous studies by Alemitu (2011), found that farmers participate in agricultural trainings facilitate adoption of new improved technologies.

Off-farm activities: - off farm activities passed the first hurdle and negatively affected the decision to adopt. This factor was statistically significant at 5% level of significance. This suggests that farmers who had adopted improved maize BH660 were endowed with additional sources of income from the nonfarm activities and were able to purchase the maize. The marginal effect implied that while holding other variables constant, the probability of making the decision to adopt improved maize BH660 decreased by 33.1 percent. Therefore, off farm incomes had negative role on the decision of the household adopting the technologies. This finding was consistent with the results of Akudugu *et al.* (2012) which indicated that off farm activities negatively affected adoption decision of modern agricultural production technologies by farm households in Ghana. The results contrast with findings of Beshir (2012) that revealed that the availability of off-farm income had a positive significant effect on adoption.

Credit access: - Initially access credit was expected to have positive effect on the adoption of technology. However, the regression result shown that credit access significantly and negatively influences on intensity of adoption of improved maize BH660 variety at 5% level of significance while the other variables were held constant. This indicates that household head who have access to credit less adopter than non access to credit ,this because mostly poor farmers access credit than wealth farmers and their repayment performance very poor and this farmers repay debt by borrowing money from wealthy farmers. This after taking money from rural finances and returns this money to wealth farmers. Due to this reason farmers have no access to get might be due to the fact that household head did,t use buy agricultural input, buy livestock and did,t use for other essential purpose and the interest rate is higher than the paying back ability of farmers. In connection with this result, Zelalem (2007) also found that farmers with access to credit were less likely to adopt new fattening technologies.

3.5. Factors determining the intensity of adoption improved maize BH660 variety

Table 4: Maximum likelihood estimates of 2nd Hurdle (Truncated) model

Variable	dy/dx	Std. Err.	Z	P>|z|
Sex	-0.031	0.900	-0.03	0.973
Age	-0.198	0.083	-2.40	0.017**
Education	0.144	0.381	3.78	0.000***
Farm experience	0.072	0.071	1.01	0.315
Distance to market	0.206	0.097	2.12	0.034**
Distance to road	-0.191	0.092	-2.08	0.038**
Cooperative	0.159	0.937	1.70	0.089*
Man equivalent	-0.030	0.169	-0.10	0.859
Farm size	0.289	1.178	0.25	0.806
Land cultivated	1.934	1.364	1.42	0.156
Livestock holding	-0.057	0.064	-0.89	0.376
Extension	0.079	0.896	0.09	0.929
Demonstration	1.772	0.722	2.45	0.014**
Training	0.858	0.724	1.19	0.236
Off farm	1.155	0.811	1.42	0.154
Non-farm	-0.296	0.547	-0.54	0.588
Credit	-0.748	0.537	-1.39	0.163
Constant		2.195	2.89	0.004
Sigma		0.154	11.82	0.000
Limit		Lower = 0		
		Upper = +inf		
		Number of obs =71		
		Wald chi2 (17) =50.31		
		Prob > chi2 = 0.0000		
		Log likelihood = -143.04		

Note *, **and*** significant level at 10%, 5% & 1 % respectively.
Source: Own survey result, 2019

Age of the household head (age): Age of household head, was expected to have positive effect on the intensity of adoption of technology. However, the second stage of the double-hurdle model truncated regression result age of the household head shown that significantly and negatively influences intensity of adoption of improved maize variety at 5% level of significance. An increase in the age of household head by one year decreases the intensity of adoption of improved maize BH660 variety by 19.8%, all other factors held constant. This could be that young age households are more likely to devote significant amount of land to improved maize BH660 variety than old age households head. Because, younger farmer has better brush-up, more erudition and new things accepter than older farmers. An increase in the age of household head by One year the intensity of adoption of improved maize BH660variety decrease by 19.8 quintal, all other factors held constant. This is because when households get older and older, they tend to rent out their land or they shift to the production of lesser labor intensive farming alternatives; also the younger people are more receptive to new ideas and are less risk averse than the older people. Sisay (2016) agricultural technology adoption, crop diversification and efficiency of maize-dominated smallholder farming system also obtained a similar result in their studies.

Education level of the household head (education):- The results in Table 5 show that, education of the household head has a positive influence on the level of adoption of improved maize BH660 variety because educated farmers are more capable than uneducated farmers in processing information, allocating inputs efficiently, and assessing the profitability of new technologies. Once the farmer has accessed the profitability of the technology and has knowledge on how to allocate input then the probability of increasing the level of adoption is higher than the farmer with non education. Education level of the household head, which is one of the important indicators of human capital, has a positive and significant effect on the intensity of adoption of improved BH660 maize variety at 1% level of significance, implying that the likelihood of adoption increases with farmer's education level. This implies that education of the household head increased by 1%the intensity adoption of improved maize BH660 variety increased by 14.4% units while other all variables held constant. This is consistent with the research results which indicated that Hassen *et al.* (2011) factors affecting the adoption and intensity of use of improved wheat varieties in north east Ethiopia.

Distance to nearest market (market):- In the second stage of the double-hurdle model truncated regression result shown that distance to nearest market was significantly and positively affected on the intensity adoption of improved maize BH660 variety at 5% level of significance. An increase in distance from house to nearest market

by one kilometer indicated on increase intensity of adoption of improved maize BH660 variety by 20.6% .The assumption that farmer who has nearest market that the positive impact on intensity of adoption of improved maize BH660 variety, because markets tend to be important to make other business would entail expectation that quantity sale would decrease, with distance. However, it is likely that better non-farm employment opportunities in addition to farming activity for households close to the intensity of adoption of improved maize BH660 variety may account for their smaller reliance on maize sale. The possible explanation for this is that farmers who are near from market centers might face less transaction and transport costs and information marketing of input-out and experience than other farmers by extension system. This is in line with previous studies by Yenealem *et al.* (2013), Berihun *et al.* (2014), Debelo (2015) and Sisay (2016) who found that distance to nearest market affect adoption of improved maize varieties in West Harerghe zone, agricultural technologies in southern Tigray, Quncho Tef in Wayu Tuqa District and maize technology in Jimma Zone negatively and respectively.

Distance to main road (road):- This variable was significantly and negatively influenced on the intensity of adoption improved maize BH660 variety at 5% significant level. An increase in distance to main road by one km on the intensity of adoption of improved maize BH660 variety decreases by 19.1percent, all other factors held constant. This implies that distance to main road as proxy variable for transaction cost so as distance to main road increase transaction cost also increase this leads to decrease intensity of adoption of improved maize BH660 variety. This also indicates farm household who lives distance from the main road of adopt maize BH660 variety than farm household who live nearest to the road, this because of farmer who lives distance from the market road their livelihood depend on crop production and more concentrate adoption of new technology but farmer who live near to the market road their livelihood depend on non- farm and off- farm activity than producing cereal crop variety. Hassen Beshir (2014) found similar result analysis of factors influencing adoption of quncho teff; the case of smallholder farmers in dhidhessa district.

Membership in cooperative (cooperative):- Participation in cooperative society had positive influence on intensity of adoption of improved maize BH660 variety at 10% level of significance. Organizing of farmers to be a member of cooperative society would facilitate access to credit, access to extension information and access to market. This implies that member of cooperative increased by 1 unit the intensity adoption of improved maize BH660 variety increased by 15.9 percent while other all variables held constant.

Participation in demonstration (demonstration):- Demonstration was positively related to intensity of adoption of improved maize BH660 variety at 1% level of significance. The result of truncated regression indicate that households who participated on demonstration are more likely to devote significant amount of improved maize BH660 variety than households who did not participated on improved BH660 maize variety. As compared to households who did not participated on demonstration, demonstration on Participation of household head increased by 1%, the intensity of adoption of improved maize BH660 increases by 30.4% while other all variables held constant. Similar results were identified by Alemitu (2011) and Hadush (2015).

4. Conclusion and Recommendations

Based on the finding, the major problems to the development of maize BH660 production are poor marketing system. Lack of market information, lack of post harvest technology, lake of institutional support, problem of price setting and exploitation by middle men resulted in poor bargaining power of farmers. There are many BH660 maize productions opportunity was also identified in the study area.

The results of double hurdle regression model have also indicated policy relevant variables that have greatest influence on adoption and intensity of adoption improved maize BH660 variety in smallholder farmer. The age of household head negatively and significantly affected adoption and level of adoption of improved maize BH660 variety. Education status of the household head influenced adoption of improved maize BH660 variety positively. Distance from the nearest market center had positively and statistically influenced decision to intensity adoption of improved maize BH660 variety. Similarly, distance from production to main road has negatively and statistically affect intensity adoption of improved maize BH660 variety. Extension services significantly and positively influenced adoption of improved maize BH660 variety. Demonstration participation by the head of the household was found to be an important factor for adoption and intensity adoption of maize BH660 producing farmers. Training on maize BH660 production was found to be positively and significantly influenced adoption of improved maize BH660 variety. Off farm income activity has affect adoption of improved maize BH660 variety significantly.

The following recommendations are forwarded to design appropriate intervention strategy and to strengthen the existing workable strategies which are aimed at promotion of improved maize BH660 variety. New improved technologies should be demonstrated on Farmers' Training center (FTC) and on-farm site in wider locations; field evaluation and field days should be organized and participate many farmers at different maize growth stages in the study area. Farmers' Training center (FTC) should be strengthened with farm materials and serve to all farmers by demonstrating recommended improved BH660 variety technologies in the study area. Agricultural extension wing, research institutes, universities should give effective, targeted and cereal crop oriented trainings about production,

management and marketing activities to farmers easily adopt improved technologies. Other improved seed producers should be encouraged to produce quality and healthy seeds; Agricultural improved inputs should be available in the required time, quality and affordable price.

Maize production and technologies application experience should be strengthened among farmers. Maize BH660 variety type with recommended package should be available for farmer in Dera district. It is necessary to encourage and guide farmers to use improved agricultural technologies package to boost production and productivity of cereal crops. The fear of maize growers will be delayed due to the fact that the government has begun to provide sustainable solutions for researchers and other stakeholders. Researchers should be prioritizing improvement of the yield potential of improved maize BH660 variety. Policies should target strengthening the improved maize BH660 farmers to have access to information on improved maize BH660 production systems and technologies. This will help in the acceptance and dissemination of information to smallholder farmers in the rural households. Further, it is better to conduct analysis of transactions cost of market participation for maize sellers and market integration in the study area. This will help smallholder producers to enhance their competitiveness. Constraints on the adoption rate of improved maize technology are increasing and will require the intensive efforts of farmers, researchers, extension agents, seed companies, and other stakeholders. This calls for partnerships in the implementation of such programs. Government and other stakeholder should work closely with smallholder farmers in order to avoidance maize disease, pest and solve other challenges of maize BH660 production and to establish well constructed and easily accessible roads to easily deliver their product to the market.

Abbreviations

AARC:Amhara Agricultural Research Center; ANRS: Amhara National Regional State; BARC: Bako Agricultural Research Center; CDF: Cumulative Distribution Function; CIMMYT: International Maize and Wheat Improvement Center; CSA: Central Statistical Authority; DHM: Double Hurdle Model; DDAO: Dera District Agricultural Office; DDARDO: Dera District Agriculture and Rural Development Office; FAO: Food and Agriculture Organization; FTC: Farmers' Training center; GDP: Gross Domestic Product; GIS: Geographical Information System; MARD: Ministry of Agriculture and Rural Development; MLF: Maximum Likelihood Function; NOG: Non-Government Organization; OECD: Organization for Economic Cooperation and Development; PDF: Probability Distribution Function; PPS: Probability Proportional to Sample; SPSS: Statistical Package for Social Science; STATA: Statistics and Data ;TLU: Tropical Livestock Unit; UNDP: United Nations Development Program.

References

Akin bode, Wasiu and Bamire, Adebayo, 2015. Determinants of adoption of improved maize varieties in Osun State, Nigeria. Journal of Agricultural Extension and Rural Development, Vol. 7(3), pp, 65-72, March, 2015.

Akpan, S.B. Nkanta, V.S. & Essien, U.A. 2012. A Double Hurdle Model of Fertilizer Adoption and Optimum Use among farmers in Southern Nigeria. Tropicultura, 4(30), 249-253.

Alemitu Mulugeta, 2011. Factors affecting adoption of improved haricot bean varieties and associated agronomic practices in Dale Woreda, SNNPRS. MSc Thesis, Hawassa University, Hawassa, Ethiopia.

Aristei, D. and Pieroni, L. 2008. A double-hurdle approaches to modeling tobacco consumption in Italy. Applied Economics, 40(19):2463 – 2476.

Asfaw, S. Bekele, S. Franklin, S. & Messia, H. 2011. Agricultural technology adoption, seed access constraint and commercialization in Ethiopia. Journal of Development and Agricultural Economics, 3(9), 436-447.

Berhanu Kassa, Bihon Kassa and Kibrom Aregawi, 2014. Adoption and Impact of Agricultural Technologies on Farm Income: evidence from Southern Tigray, Northern Ethiopia. International Journal of Food and Agricultural Economics ISSN 2147-8988 Vol. 2: 91-106.

Beshir, H. 2014. Factors affecting the Adoption and Intensity of Use of Improved Foarges in North East Highlands of Ethiopia. American Journal of Experimental Agriculture, 4(1), 12 - 27.

Buraimo, B. Humphreys, B. & Simmons, R. 2010. Participation and engagement in sport: A double hurdle approach for the United Kingdom (Working Paper). Preston, United Kingdom: University of Central Lancashire.

CSA (Central Statistical Agency), 2017. Central Statistical Agency Agricultural Sample Survey, Report on area and production of major crops. www.csa.gov.et.Accessed 20 December 2017.

Cragg, J.G.1971. Some statistical models for limited dependent variables with application to the demand for durable goods. Econometrical, 39(5): 829-844.

DWAO (Dera Woreda Agriculture Office), 2018. Draft report on agriculture production and productivity and agro ecology of Dera Woreda.

Greene, W.H. 2000. Econometric Analysis (4th edition). Prentice Hall, New Jersey.

Hassen Beshir, Bezabih Emana, Belay Kassa and Jema Haji. 2012. Determinants of chemical fertilizer technology adoption in North Eastern highlands of Ethiopia: the double hurdle approach. Journal of Research in

Economics and International Finance, 1(2): 39-49.

Ibrahim, M., Florkowski, W.J., & Kolavalli, S. 2012. The Determinants of Farmer Adoption of Improved Peanut Varieties and Their Impact on Farm Income: Evidence from Northern Ghana. Selected Paper prepared for presentation at the Agricultural and Applied Economics Association Annual Meeting, Seattle, WA, August 12-14, 2012.

Jones, A.M. 1989. A double-hurdle model of cigarette consumption. Journal of Applied Econometrics, 4(1): 23-39.

Kapalasa, E. 2014. Assessing Factors Influencing Farmers' Adoption of Improved Soybean Varieties in Malawi. Scholarly Journal of Agricultural Science, 4(6):339-349.

Katengeza, S.P. Julius, H.M. Girma, T.K., Chloe, S. Augustine, L. Roberto, L.R. & Wilfred, M. 2012. Drivers of Improved Maize Variety Adoption in Drought prone areas of Malawi. Journal of Development and Agricultural Economics, 4(14), 393 - 403.

Kuti Woles I. 2015. Determinants of adoption of improved maize varieties in Osun State, Nigeria. International Journal of Agricultural Economics and Extension, 3(2), 115 - 121.

Mengistu Ketema1 & Degefu Kebede,2017.Adoption intensity of inorganic fertilizers in maize production *Journal of Agricultural Science; Vol. 9, No. 5; 2017 ISSN 1916-9752 E-ISSN 1916-9760.*

Mekuria Aweke, 2013. Factors influencing adoption of improved maize varieties: the case of Goro- Gutu Woreda of Eastern Hararghe, Ethiopia. MSc Thesis, Haramaya University, Haramaya, Ethiopia.

Sisay Debebe Kaba,2016. Agricultural technology adoption, crop diversification and efficiency of maize-dominated smallholder farming system in Jimma Zone, South- Western Ethiopia. PhD Dissertation, Haramaya University, Haramaya, Ethiopia.

Zelalem, T. 2007. Adoption of small ruminant' fattening package in agro pastoral areas, MeissoWereda, Eastern Oromia. (IPMS theses. Accessed 02.06.2014).