Innovations

Determinants of Adoption of Improved Maize Bh540 Variety among Smallholder Farmers in Ethiopia: The Case of Burie Zuria District, West Gojjam Zone Amhara National Regional State, Ethiopia

[1]Bantayehu Tamrie Alemu;[1] Wubneh Mulat

1. Debre Markos University, College of Business & Economics, Department of Economics. Ethiopia

Corresponding Author: **Bantayehu Tamrie Alemu**

Abstract: *The adoption of agricultural technology by smallholder farmers plays a pivotal role in accelerating Ethiopia's economic transformation, particularly within the agricultural sector. Despite the government's policy initiatives to promote active technology adoption, a significant proportion of smallholder farmers remain reluctant to embrace modern agricultural innovations. This study aimed to explore the factors influencing the adoption of the improved maize variety, Bh540, among smallholder farmers in BurieZuriaWoreda, West Gojjam Zone, Amhara Regional State. The research utilized primary cross-sectional data collected from a total sample of 368 smallholder farmers. A multi-stage sampling method was employed, with respondents selected using a probability proportional technique. The collected data were analyzed using a binary logit model to identify the most significant determinants of Bh540 adoption. The findings revealed that key factors influencing adoption included gender, educational attainment, access to market information, farmers' attitudes toward the Bh540 variety, farming experience, and access to training programs. Based on these results, stakeholders in the region are encouraged to implement awareness campaigns, improve formal education opportunities, and expand access to training initiatives tailored to the specific needs of smallholder farmers. Such measures are essential for enhancing the adoption rate of improved maize varieties and fostering sustainable agricultural development.*

Key words*: Smallholder farmers, Adoption, improved Maize Bh540 variety, Ethiopia*

Introduction

In Ethiopia, farming is a key factor in promoting economic development, eradicating poverty, and reducing food insecurity. Farming is an apparatus for the Ethiopian budget by donating 34.9% to the country's GDP (MoA,2014; WB, 2018); providing 80% of the employees who depend on agriculture for their livelihood (IFPRI,2011; Shiferaw, 2017); supplying 70% of inputs for the nation's agricultural manufactories and contributing about 70% of export incomes (FAO, 2015). This implies that the agricultural sector still serves as the primary source of income for the majority of Ethiopian people and desires countless care for the development and renovation of the sector.

Ethiopian agriculture still takes the lion's share (72.7%) in terms of employment. The sector is the livelihood of the overwhelming majority of Ethiopians (MoARD, 2008; MoFED, 2010). It is the source of food and cash for those who are engaged in the sector and others. Most agricultural holders acquire the food they consume and the cash they need to cover other expenses only from farming activities. Since, fanning in Ethiopia is often precarious and usually at the mercy of nature it is invariably an arduous struggle for the holders to make ends meet. This, it often transpires is true to the frequent shortfalls in the volume of production that occur in the country (Cho, 2013; Mwangi&Kariuki, 2015; Simtoweet al.2016).

Agricultural production can be increased through extensification (i.e., through expansion of farm lands) or intensification (i.e. by using more inputs and technologies per unit of land). However, extensification is not a viable strategy to increase agricultural production in most of the food insecure countries where high population pressure is a critical bottleneck. Where land is scarce, intensification which entails investments in modem inputs and technologies is a better option to increase agricultural production and reduce food insecurity. This option was effectively Implemented by several Asian countries in 1970's and was clubbed the green revolution". New agricultural technologies and improved practices play a key role in increasing agricultural production (and hence, improving national food security) in developing countries. Where successful, adoption of improved agricultural technologies could stimulate overall economic growth through inter sectoral linkages while conserving natural resources cited by Tsegaye. Given the close link between food insecurity, fanning and environmental degradation the impact of cultivation practices has received significant attention in the last two decades. New cultivation techniques have been introduced in many countries to enhance productivity in the agriculture sector.

Maize is the most nutritionally rich crop, it provides a need for bone, kidney, and heart disease, it protects against cancer, includes a red blood cell number, reduces fat accumulation, advice to eyes and skin quality and it increases the immune system.

Maize is a high value and profitable cereal crop. The economic viability of maize production is determined by the commercial utilization of its sub-products of three forth of the maize produced is consumed at the household level by the small-scale producers themselves (CSA, 2017).

Maize is the main vital crop in relation to the availability and utilization of enhanced agricultural packages such as fertilizer, enhanced seed varieties, pesticides, herbicides, and better agronomic practices than other cereal crops. So far, several studies on maize technology adoption in other parts of Ethiopia have been conducted. Among these are Abera (2013), Alene et al. (2015).

Ethiopia is one of the least developing countries in Africa in which majority of its population is dependent on agricultural activities of crop production and animal rearing (Sisay et al., 2016). Moreover, about 80% of GDP, more than 60% of employment and 70% of export earning is generated from the agricultural sector even if it follows backward method of production with obsolete technologies. So, to increase the welfare and living standards of Ethiopian citizens, more emphasis must be given for these sectors and modern technologies like, fertilizers, improved seeds and pesticides has to be used by farmers in rural areas. Asfaw (2011) indicates that increasing the productivity of rural farmers can lead to improvements in living standards and welfare of Ethiopian citizens if it is supported by the introduction of highly advanced new agricultural technology adoption either by dissemination of new pesticides and insecticide or by providing new and productive improved seeds.

Rashid et al. (2013)& Solomon et al. (2017) studied determinants of adoption of improved maize varieties for male headed and female headed households in West Harerghe zone. The study was based on cross sectional data of 148 maize producing farmers. The study used the logistic regression model applied to assist in estimating the probability of adoption of improved maize verities. Cultivated farm size, number of Livestock (TLU), Extension contact affected positively and significantly while Age and Distance to the nearest input market affected a negatively and significant the probability of adoption of improved maize varieties.

Improved maize varieties like BH 540, PHB 3250, BH 140, and BH 660 were introduced to the study area by MoARD that were tested by the Ethiopian National Seed Industry and Ethiopian Agricultural Research Organization (EARO). The decision to adopt or not hinges upon a care full evaluation of factors influencing adoption of maize varieties in the study area. Furthermore, the farmers are not adopting the intended maize varieties completely and efficiently as recommended by the agronomist. That is the adoption rate and level remained at low level and the output is not satisfactory (BZWAO, 2023).

Even though, the potential of maize productivity in Ethiopia is not exploited and is unable to contribute to the expected role in reducing food insecurity and poverty

reduction. The estimate average productivity of maize in Ethiopia was 3736 kg per hectare, which is low slung as compared to the world average of 5818 kg per hectare in 2017 (FAO, 2019). Similarly, the estimated mean production of maize in Amhara national regional state average of 3508 kg per hectare in 2015/16 (CSA, 2017)

Even though the Adoption of agricultural technology in Ethiopia is suffering by different barriers, the studies that have been conducted in order to solve the factors that affects the adoption of agricultural technology in Ethiopia are inadequate, as a result of these, study are contradicting eachother. Previous studies conducted in general case that means adoption of agricultural technology.They lack accessibility andawareness to the society. As a new technologytherefore, the intention of this study wasfilling this gap by investigating the main factors that affectadoption of improved maize seed variety (BH-540) in BurieZuriaWoreda, Ethiopia.

Materials and Methods

Description of the Study Area

West Gojjam is one of Amhara Region zones, Ethiopia, located 350 km northwest of Addis Ababa. West Gojjam is bordered by the Abay River on the south, which separates it from the Oromia region and Benishangulgumuze region; on the northwest by Alefa; on east-by-east Gojjam; on the north-by-NorthGojjam; and on the west by theAwi zone.There are14 rural administrations and 6 city administrations (BZWAO, 2023).

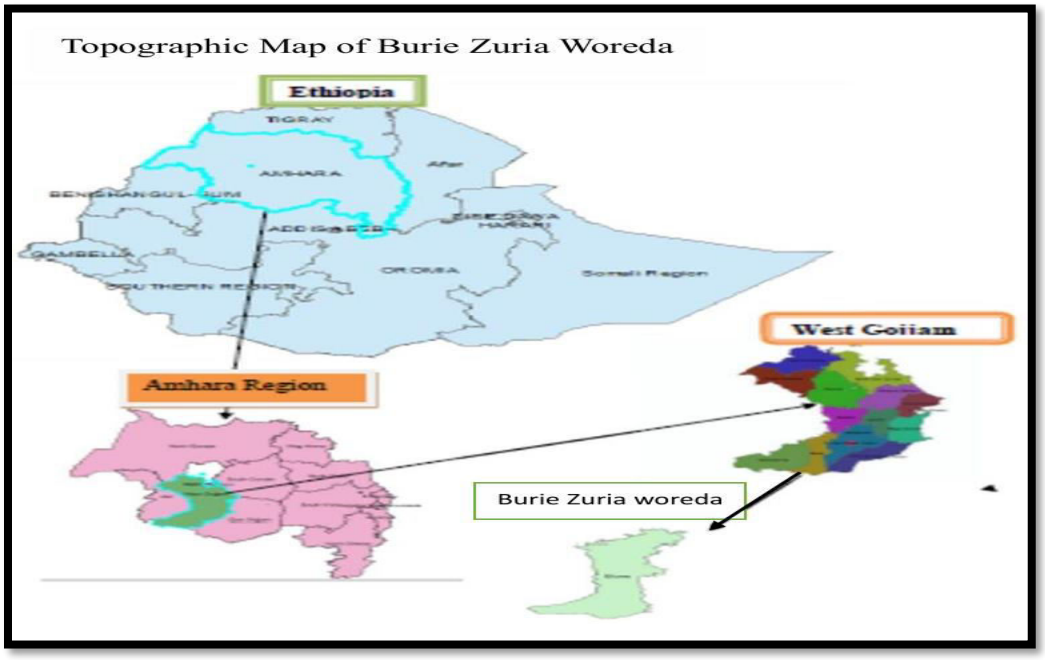

Figure 2: map of the study area source: Ethiopian GIS.

Data Source and Method of Data Collection

The primary sources of data were collected from the answers of the respondents. Interview schedule, focus group discussion and structured questionnaire were used. The main data collection technique used in the study was a questionnaire for those who can read and write and an interview for those who cannot read and write and focus group discussion for triangulation.

Research Design

A descriptive research design was used. In addition, Logistic regression model applied explanatory variables, which show a significant effect on the adoption of improved maize BH540 variety among smallholder farmer.

Sampling Procedures and Sample Size

Multi-stage sampling method was applied to select sample respondents to study factors affecting the adoption of improved maize seed (BH540) varieties among smallholder farmers. In the first stage, out of the 7 woredas of west Gojjam zone, Buriezuriaworeda was selected purposively. In the second stage from 25 maize producing kebeles of the woreda, 5 kebeles were selected randomly. At the third stage, 371 sampled farmers were determined using the formula given by Gujarati (2004).

Sampling size

This study was used the following formula to calculate sample size.

$$n = \frac{z2.p.q.N}{e2(N-1)+ z2.p.q}$$

Where;

n is the sample size

N is Total number of populations

p is the estimated proportion where 0.5 is usually considered;

q represents (1 – p);

Z is the abscissa of the normal curve (1.96); and

e is precision level (5% is consider).

Buriezuriaworeda have 20,051 farmers. From the 8,763 are live in the five rural kebeles in 2023/2024 (woreda population projection, 2024). Therefore, the sample size should be:

$$n = \frac{z2.p.(1-p).N}{e2(N-1)+ z2.p.q} = \frac{(1.96)2(.0.5).(1-0.5).(8763)}{(0.05)2(8763-1)+(1.96)2.(0.5).(0.5)} = 368.0664\sim368$$

The stratum also calculated as follows

$$n_i = \frac{Ni}{N} * n$$

Where Ni=number of farmers in each kebele

ni =sample size from each kebele
N =total number of farmers in the 4 kebele
n = sample size
By using, the above-stratified sampling formula the proportional number of respondents in each kebele is calculated as follows:
Table 1 proportional sample size determination

No.	Kebele name	Number of populations	Sample size
1.	Wadra	2239	94
2.	Alefa	2081	87
3.	Denbul	1527	64
4.	Zalma	1480	62
5.	Gulm	1436	61
	Total	8,763	368

Method of Data Presentation and Analysis
To estimate the determinants of adoption of improved maize BH540 variety among smallholder farmer using the logit model.
Econometric model specification
Even if there are several methods to analyze the data involving binary outcomes, for this study, Binary Logit model was selected for the sake of its comparative mathematical simplicity.
The binary logistic probability model is econometrically specifying as follows:

$$Pi = E(Y = 1/Xi) = \frac{1}{1+e-(\beta 0+\beta 1Xi)} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

In the logistic distribution equation, Pi is the probability of a farmer to be Adopter; Xi is the data that is the possibility of a preference by an individual (option of having 1 and 0 values). When $\beta 1+\beta 2Xi$ in Equation 1 is replace by Zi, Equation 2 is obtained:

$$Pi = \frac{1}{1+e^{-zi}} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

Zi is between -∞ and +∞, and Pi is between "1" and "0". When Pi shows the possibility of an adopter, the possibility of non-adopter farmers is 1- Pi. Then, the possibility of non-adopter can explain as in Equation 3 as follows:

$$1 - \frac{1}{1+e^{-zi}} = 1 - Pi \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3)$$

Equation 4 is obtained by dividing the adopters by non-adopters:

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

Now $(\frac{Pi}{1-Pi})$ is simply the odd ratio which is the ratio of the probabilities that a given farmer being aa adopter in improved maize seed (BH540) varieties to the probability of that it will not being adopter in improved maize seed (BH540) varieties.

Finally, taking the natural log of equation (5), we obtain:

$Li = \ln(\frac{Pi}{1-Pi}) = Zi = \beta 0 + \beta 1Xi + \ldots\ldots + \beta nXn + Ui$………… (5)

Where Pi is the probability of being adopter in improved maize seed (BH540) varieties range from "0" to "1". Zi is a functional explanatory variable (X) which is also express as:

$Zi = \beta 0 + \beta 1Xi + \ldots\ldots + \beta nXn$………………………… (6)

Bo is an intercept

B1, B2--Bn are slopes of the equation in the model.

Li is the log of the odd ratio

Xi is the vector of farmers‟ characteristics.

Ui = Error term

Odds and odds ratio are significant terms in logit model. In Equation 4, two probabilities, adopters and non-adopters' probability of an event are proportioned and this is the odds of proportion. It is important to understand that possibility, odds, and logit concepts, are three different ways of explaining the same thing (Gujarati, 2004).

Additionally, the marginal effect was calculated to show the actual impact of each variable on the probability decision. The marginal effect captures changes in the predicted probabilities as the binary independent variable changes from 0 to 1 when all other variables equal their means. Similarly, it shows how much the response variable changes with a unit change in one continuous independent variable, maintaining other independent variables constant.

$Zi = \beta_o + \sum \beta iXi + Ui$………………………………………………………(7)

$Y = \beta o + \beta_2 MARST + \beta_3 GEN + \beta_4 INC + \beta_5 FARMLSIZE + \beta_6 FARMEXP + \beta_7 ATT + \beta_8 DM + \beta_9 EDUL + \beta_{10} ACCMKTINF + \beta_{11} ACCTRN + \beta_{12} ACCREDIT + \beta_{13} ACF + \beta_{14} LIU + Ui$ ………………. (8)

Where:

Y is the probability of an individual Adopting improved maize seed (BH540) (ADBH540); β is parameter of explanatory variable.

y = 1, an individual Adopt improved maize seed BH540 varieties

y = 0, otherwise

Ui = Error term

The error term "U" contains many important determinants of Adopting improved maize seed (BH540) varieties among smallholder farmers, which are ignore. Which is out of the researcher's scope.

Table 2 Summary of explanatory variables

Variable	Possible short Form	Description	Expected signs.
Educational level	EDUL	EDUL = 1, if literate, otherwise 0.	Positive (+)
Gender	GEN	Gen = 1, If the respondent is male, otherwise 0.	Positive (+)
Family size	FAMSIZE	Continuous	Positive (+) or Negative (-)
Marital status	MARTS	MARTS = 1, if married, otherwise 0.	Positive (+) or Negative (-)
Farm experience (year)	FARMEXP	Continuous	Positive (+)
Access to market information	ACCMKTINF	"1" if a respondent has market access, "0" otherwise.	Positive (+)
Access to fertilizer	ACF	"1" if there is access to Fertilizer, "0" otherwise.	Positive (+)
Farm Land Size(hectare)	FARMLSIZE	Continuous	Positive (+)
Distance from the farmers' market(km)	DM	Continuous	Negative (-)
Income (annually in ETB)	INC	Continuous	Positive (+)
Access to training	ACCTRN	"1" if there is access to training, "0" otherwise.	Positive (+)
Attitude of respondent on farmers' adoption	ATT	Att = 1, If attitudes of the respondent on farmers' cooperative are good, otherwise 0.	Positive (+)
Number of Livestock	LIU	Continuous	Positive (+)
Access to credit	ACCREDIT	"1" if there is access to credit, "0" otherwise.	Positive (+)

Results and Discussions

Descriptive Results

In this study, out of the total of 368 sample respondents, 188 (51.09%) of farmers are adopters and 180(48.91%) non-adopters of Improved Maize Bh540 Variety during the agricultural season of 2023/24.

Characterization of members and Non-members by Demographic Factors

Table 3:Characterization of adopter and non-adopter smallholder farmers by demographic factors

Variable			Adoption status			$\chi 2$ –value
			Adopters (N = 188)	Non adopters (N = 180)	Total (N= 368)	
Gender	Male	N	129	123	252	50.2263
		%	68.62	68.33	68.48	
	Female	N	59	57	116	
		%	31.38	31.67	31.52	
Marital status	Married	N	96	68	164	6.5705
		%	50.06	37.78	44.57	
	Single	N	92	112	204	
		%	48.94	62.22	55.43	
Level of Education	Literate	N	124	45	169	50.2263
		%	65.96	25	45.92	
	Illiterate	N	64	135	199	
		%	34.04	75	54.08	
Attitudes of respondent toward Adoption	Positive	N	132	51	183	64.5144
		%	70.21	28.33	49.73	
	Negative	N	56	129	185	
		%	29.79	71.67	50.27	

Source: Own field survey data formulation (2024)

Gender of the Respondent

As indicated in table 3, out of the sampled respondents 252(68.48%) were male and the remaining 116(31.52%) were female. Of the total sampled respondents, 57(31.67%) of the non-Adopters were female respondents whereas, 123(68.33%) of the non-adopters were male respondents. Based on Table 3 the chi-square value ($\chi 2$= 50.2263; P=0.000) showed that there is a statistically significant association between adoption status and sex of adopters and non-adopters' respondents. This implies that being male or female had a statistically significant effect on the adoption decision of the smallholder farmers.

Marital status of respondent smallholder farmers

Of the total sampled smallholder farmers, 164 (44.57%), and 204 (55.43%), were married and single respectively (Table 3). Among the non-adopters, 68 (37.78%)

were married, 112 (62.22%) of them were single. The chi-square test indicated that there was no statistically significant association between marital status and farmers' cooperative status of members and non- member respondents ($\chi 2$ = 6.5705; P = 0.0000). Therefore, the result of the study showed that being married, and single, had significant effect on respondents' Adoption of Improved Maize Bh540 Variety. Thus, married, and single respondents had different socio-cultural background regarding respondents' Adoption of Improved Maize Bh540 seed.

Attitudes of respondents toward adoption decision

Of the total sampled smallholder farmers, 183(49.73%), and 185(50.27%) had a positive and negative attitudes towards Adoption of Improved Maize seed (Table 3). Among the non-adopters, 51(28.32%) had a positive attitude toward adoption of Bh540 whereas 129(71.67%) of them had a negative attitude towards Bh540 adoption. The Chi-square value ($\chi 2$ = 64.5144; p= 0.0000) of the sample respondents indicated that there was statistically significant association between attitudes of respondent towards Adoption of Improved Maize Bh540 and farmers' Adoption status of adopters and non-adopters. The implication was that respondents who had positive attitude towards adoption had the different probability to be an adopter of Improved Maize than respondents who had a negative attitude towards Adoption of Improved Maize Bh540.

Education Level of smallholder farmers

Education enhances the capacity of individuals to obtain, process, and utilize information through different sources. According to the survey results, the total sampled smallholder farmers, 199(54.08%), and 169(45.92%) were illiterate, and literate respectively (Table 3). Among the non-adopters,135(75%) were illiterate, 45(25%) of them were literate. On the other hand, 64(34.04%) of the adopters were illiterate, 124(65.96%) were literate.

Table 4: Characterization of adopters and non-adopters by Family size, farm experience

	Adoption status			
Variable	Adopter (N= 188) Mean (std.dev)	Non-adopter (N = 180) Mean (std.dev)	Total (N= 368) Mean (std.dev)	t-value
Farm experience	22.46 (14.95)	15.62 (12.94)	19.11 (14.40)	-4.6821***
Family size	5.53 (3.25)	4.97 (2.95)	5.26 (3.11)	-1.7123

Source: Own field survey data formulation (2024)

Family Size

From the above table farm experience is statistically significant showing a significance difference between adopters and non-adopters.

Characterization of Adopters and non-adopters by socio-economic Factors

Table 5: Characterization of adopters and non-adopters by socio-economic factors

Variable	Adoption status			
	adopters (N =188) Mean (std.dev)	Non adopters (N=180) Mean (std.dev)	Total (N=368) Mean (std.dev)	t-value
Annual income	60173.18 (75574.5)	44986.9 (50853.3)	52745.1 (65033.27)	-2.2517
Farmland size	1.009 (1.040)	0.736 (0.786)	0.876 (0.933)	-2.8329
Distance from Market	9.17 (8.346)	9.38 (7.966)	9.27 (8.152)	0.2438
Livestock holding	7.787 (7.179)	8.639 (8.157)	8.203 (7.674)	1.0643

Source: Own field survey data formulation (2024)

Farmland size of the respondent smallholder farmers

From the survey results, the Farmland size of the respondent smallholder farmers for adopters and non-adopters was 1.009 and 0.736 hectares respectively. The result also revealed that adopters had more farmland than non- adopters did. The t-value (t = -2.8329; P=0.0002) showed that there was statistically significant difference between the farmland size of adopters and non- adopters.

Annually income of the respondent smallholder farmers

As shown in Table 5, the annual income of the sample smallholder farmers was calculated in ETB and found by the researcher. The average annual income of the sample respondents and the standard deviations was ETB 52745.1 and ETB 65,033.27 respectively. Furthermore, the average annual income of the adopters and non-adopters was ETB 60173.18 and ETB 44986.9 respectively. The mean income indicated that there was a greater annual income difference between adopters and non- adopters. The t-value (t= -2.2517; P=0.006) also showed that there was statistically significant mean difference between the annual income of adopters and non- adopters with respect to their income levels.

Characterization of Adopters and non-adopters by institutional Factors

Table 6:Characterization of Adopters and non-adopters by Institutional Factors

Variables			Adoption status			
			Adopters (N =188)	Non adopter (N =180)	Total (N= 368)	X^2-value
Access to credit	Yes	N	97	91	188	0.0389
		%	51.6	50.6	51.1	
	No	N	91	89	180	
		%	48.4	49.4	48.9	
cess to fertilizer	Yes	N	99	89	188	04
		%	52.7	49.4	51.1	
	No	N	89	91	180	
		%	47.3	50.6	48.9	
Access to Training	Yes	N	131	61	192	47.2101
		%	69.7	33.9	52.2	
	No	N	57	119	176	
		%	30.3	66.1	47.8	
Access to market informatio n	Yes	N	126	74	200	24.8817
		%	67.0	41.1	54.3	
	No	N	62	106	168	
		%	33.0	58.9	45.7	

Source: Own field survey data formulation (2024)

Attainment of adoption training by respondents

It is an important factor to create awareness about the superfluous benefits of doing adopters of improved maize Bh504 verities. As indicated in the above about 192(52.2%) of the sampled respondents have participated in adoption training and 176(47.8%) of the sampled respondents have not participated in adoption training. The Pearson chi-square value (z= 47.2101; p= 0.000) indicated that there is a relationship between adoption and adoption training.

Access to credit for respondents

Out of the total sample farmers, 188(51.1%) received credit, and the rest that means 180(48.9%) have no credit access. There is no a significant difference between adopters and non-adopters in different access to credit at any significant level. The Pearson chi-square value (z= 0.0389; p= 0.141).

Access to market information for the respondents

From the total sample of smallholder farmers 200(54.3%) of them had access to market information from different means of media such as radio which was widely owned and used by the majority of the society while 168(45.7%) of them had no access to market information, therefore, they are supplying their product without being well informed about the current situation in the market. Of adopters 126(67%) of them had access to market information while 62(33%) of them had no access to market information. 74(41.1%) non-adopter farmers have access to market information but 106(58.9%) of them had no market information.

Econometric Analysis of the Response of smallholder farmers' Adoption status concerning its Determinants

Discussion of estimated logit model

Table 7: *Maximum likelihood estimates of the Binary logit model*

Explanatory variable	Estimated coefficient	Standard error	Marginal effect
Family size	0.0528	0.0459109	0.0131585
Gender (female = 0)	1.0385***	0.3408608	0.2534731
Edu_level (0=illiterate)	1.1647***	0.3364447	0.2819074
Marital status (0 = single)	0.2513	0.2888409	0.0625685
Farm land size	0.0517	0.2335525	0.0128855
Annual Income	2.32e-08	2.24e-06	5.79e-09
Access to training (0 = no)	1.0449***	0.2886749	0.2553085
Access to Fertilizer (0 = no)	0.2102	0.2916739	0.0523807
Access to credit (0 = no)	-0.2912	0.2995423	-0.0724983
Farm experience	0.03173*	0.0152066	0.0079145
market information (0 = no)	1.1685***	0.2927056	0.2837731
Distance form Market	-0.0181	0.0173513	-0.004521
Attitude (0= Negative)	1.8677***	0.2951738	0.4348332
Livestock unit	-0.0175	0.0178213	-0.0043573
Cons	-3.7605	0.5772285	_
Sensitivity 80.85% No of observation 368 Pseudo R2 0.3727	Specificity77.2 %	Correctly classified LR chi-square (P-value) Log likelihood	79.08% 190.08(0.0000) -159.94893

*** = statically significance at 1% and ** = statically significance at5%.

Source: Model output (2024)

Marginal effects and its interpretation

In terms of marginal effect, the model is:

Adoption status = 0.01famsize + 0.06marst +1.04gen + 5.79e-09inc + 0.01farmlsize + 0.01farmexp + 0.43att – 0.005dm + 0.28edul + 0.28accmktinf + 0.26acctrn – 0.07accredit + 0.05acf - 0.004tlu……(8)

Gender of the respondent

The econometric analysis revealed a positive and significant association between gender and the decision to adopt this variety at a 1% significance level. Holding other factors constant, the likelihood of adoption was, on average, 25.3% higher among male respondents compared to their female counterparts. This finding underscores the importance of addressing gender disparities to enhance the adoption of improved agricultural technologies.

Level of education

The econometric analysis revealed a positive and significant correlation between education level and the decision to adopt the improved maize Bh540 seed variety, with a significance level of 1%. When smallholder farmers transition from being illiterate to literate, the likelihood of adopting the improved maize Bh540 variety increases by 28.2%, assuming other factors remain constant. This is likely because higher education levels enhance farmers' knowledge and ability to access information, making it easier to understand and appreciate the benefits of adopting improved technologies.

Farmers Attitude towards Adoption of improved Maize Bh540 Seed

This variable is found to be significant at 1% and has positive association with adoption status in adoption of Improved Maize Bh540 seed Variety. All other factors constant, on average, the probability, smallholder farmers who has positive Attitude towards Adoption of improved Maize Bh540 are greater than the smallholder farmers who has negative towards Adoption of improved Maize Bh540 varieties by 0.435(43.5%).

Farm experience

This variable is found to be significant at 10% and has positive association with adoption status in Adoption of improved Maize Bh540 varieties. Moreover, as the Farm experience increased by one year, on average, the probability of smallholder farmers adoption status of improved Maize Bh540 varieties increased by 0.008(0.8%) citrus paribus.

Access to market information for the respondents

This variable is statistically significant at the 1% level and demonstrates a positive relationship with adoption status. Holding all other factors constant, smallholder farmers with access to market information have, on average, a 28.4% (0.284) higher probability of adoption compared to those without access to market information.

Conclusions and Recommendations

Conclusions

The descriptive statistics indicate that several explanatory variables, including access to market information, gender, marital status, attitude, farm experience, access to training, farmland size, educational level, and annual income, showed a statistically significant association with smallholder farmers' adoption status. In contrast, variables such as access to credit, family size, distance to the input market, access to fertilizer, and tropical livestock unit did not demonstrate a statistically significant association with adoption status.

The binary logit analysis revealed that several factors significantly influenced the adoption of improved maize BH540 seed varieties. These factors include gender, level of education, farming experience, attitudes, access to training, and access to market information. On the other hand, variables such as marital status, distance from the input market, annual income, access to fertilizer, farmland size, family size, tropical livestock unit, and access to credit did not show any statistically significant effect at any level of significance.

Recommendation

Based on the findings, the followings recommendations were forwarded:

Stakeholders at various management levels should prioritize efforts to improve farmers' education through adult education programs. Providing training and creating awareness are essential strategies to raise the educational level of smallholder farmers. This will empower them to become more proactive and efficient in adopting improved maize seed varieties like Bh540, ultimately benefiting their agricultural productivity.

Bh540, targeted training programs, public meetings, and workshops should be organized to raise awareness about the benefits of using improved seeds. These initiatives should involve collaboration with non-governmental organizations (NGOs) and higher education institutions operating in the area. The training strategy should emphasize experience sharing among farmers and highlight the advantages of adopting improved maize varieties to ensure widespread understanding and acceptance.

The government and other concerned body should establish and strengthen information-sharing platforms (e.g., digital tools, radio, community centers) to

disseminate market-related information. Provide mobile and internet connectivity in remote areas to bridge information gaps. Develop farmer cooperatives and networks for collective bargaining and knowledge sharing.

Efforts to promote the adoption of improved maize varieties, such as BH540, by smallholder farmers should be strengthened. However, it is equally important to ensure that the benefits of adoption are distributed equitably among these farmers. To achieve this, the government and other relevant authorities should prioritize improving the adoption rate of improved seeds, particularly among poor smallholder farmers. This can be accomplished by providing formal education and enhancing access to training programs tailored to their needs.

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