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# Determinants Affecting Lime Technology Adoption on Agricultural Land in Senan District, North West Ethiopia

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**To cite this article:**

Lakachew Ayenew. Determinants Affecting Lime Technology Adoption on Agricultural Land in Senan District, North West Ethiopia. *International Journal of Environmental Chemistry*. Vol. 6, No. 1, 2022, pp. 28-35. doi: 10.11648/j.ijec.20220601.13

**Received:** March 28, 2022; **Accepted:** April 20, 2022; **Published:** May 10, 2022

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**Abstract:** Agriculture is the back bone of Ethiopia's economy and Major Ethiopians' livelihood depends on this sector. Even it has large contribution in the country, still it is not well developed due to different constraints such as soil degradation, poor management, insufficient of capital and technology and others. Now a day's soil acidity is one of the problems that resulted low productivity in the country. Based on this idea researchers conducted their study on this sector to solve problems and to increase agricultural productivity by alleviating soil acidity problems. But still there was no any research conducted on soil acidity in the study area and in the study area the soil acidity problem is worse. So this problem initiates me to conduct my study on this issue. This study was conducted in Senan District, North West Ethiopia and the main objective of this study was to investigate the basic factors influencing farmers' adoption of lime technology. The study employed mixed research design. The data was collected from: sample household heads (HHs); Woreda office heads, team leaders and experts; from Development Agents (DAs) and from kebele administrative staffs. Primary data were collected through questionnaire, interview, and focus group discussions. Descriptive statistics such as percentage, mean, standard deviation and inferential statistics such as independent t-test and chi-square test were used. Binary logistic regression model was also used for the study. The result of the study showed that; age, educational status, leadership status, economic level, family size, farm size, and access to extension expert contact had significant relationships with adoption of agricultural lime inputs on acidic soils. On the other side; sex, marital status, non-farm activities had no significant relationship with lime adoption in the study area. The binary logistic regression result also indicated that; educational status, leadership status, economic level, family size, and access to extension contact were positive determinant factors in lime adoption. Whereas, age and farm size of the HHs were negative determinant factors in lime adoption. As the result showed, the adoption rate was low; and affected by different factors and to solve the problems: providing training for HHs; improving experts support; sharing of experiences between adopter and non-adopters; and maximize the adoption rate of lime by solving problems were some important ideas.

**Keywords:** Soil Acidity, Lime Technology, Adoption, Soil Productivity

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## 1. Introduction

According to Ministry of Economic Development and corporation of Ethiopia Ethiopia is one of the ten largest African countries with a total land mass of 1,106,000 km<sup>2</sup> (112.3 million ha) and it shares about 0.7% of the world's land area and about 3.6% of Africa's total land area [16]. And the report of Central statistical Agency of Ethiopia revealed that, in Ethiopia, agriculture is an old and dominant economic activity which has been practiced since 400BC and it is the back bone of the country's economy

[7]. For the last decade agriculture accounts for about 43% of the country's Growth Domestic Product (GDP), 85% of the country's total population employment, about 90% of the country's export and about 70% of the country's raw material requirement for large and medium scale agro-based industries [7]. Crop production is estimated to contribute on average about 60 percent, livestock around 27 percent, forestry and other sub-sectors around 13 percent in Ethiopia's economy [16].

Despite its role, the agricultural sector is characterized by low productivity and high exposure to risk due to diverse

environmental conditions like soil acidity [6]. It is estimated that approximately 50% of the world's arable soils are acidic, of which the tropics and sub tropics accounts for 60% of the acidic soils in the world [22]. 28.8% of the African continent has acid surface soils [9]. Currently, it is estimated that about 40.9% of the total arable land of Ethiopia is affected by soil acidity [1]. The report of Amhara Agricultural Bureau showed that, in Amhara National Regional State, 24% of land area is affected by soil acidity [2]. In line with this, feeding the ever-increasing human population is most challenging in Ethiopia and the region because of soil related problems.

Although these problems faced, there are a number of ways of increasing of agricultural production and soils productivity. Soils nutrient depletion and soils acidity is corrected by the use of agricultural inputs of lime materials [8]. However, the adoption rate of new agricultural technology (lime requirement) by the smallholder farmers in Ethiopia are often low and not uniform due to insufficient amount used [8]. As a result, the productivity of the soil decreases from time to time and led to low production of different type of crops [10].

From the 24% of affected soils by soil acidity in Amhara region, only 3584 ha (3.6 percent) treated by lime [2]. In the study district, from the total land area i.e. 43134ha, 40% of the land is affected by soil acidity and only 235ha were treated by lime in 2016/2017 budget Year [2]. According to Amhara National Regional State Soil survey Institute (ARSSI) lab result report, the study district's soil pH is 5.1 [3]. Based on this result, nearly 100 times decrease soil suitability for crop production. Therefore the extent and severity of the problem is very high.

Based on the above raised issues; there have been various empirical studies conducted to identify the determinants of adoption of agricultural technology including lime in Ethiopia.

For instance, a study by Ashenafi, conducted in the Amhara and Tigray Regions, a study by Assefa and Gezahagn in Ethiopia can be mentioned [5].

According to *Senan Woreda's* Agricultural Office report, from the 16 rural *kebeles/sub districts/* of *Senan woreda* 3/three/ of them (*Yeted, Woleke, and Tach chabi*) have been more affected by soil acidity, and due to this problem; there were some critical problems occurred in these *kebeles/sub districts/*; among these: now majority of the area is covered by eucalyptus trees; the farmers engaged in non-agricultural activities; the farmers become seasonal migrants; the production capacity of the agricultural land decreased from time to time; the type of crops which are grown in the areas changed (now *Gibto/Lupin lupinus angustifolius*) and *local oater/Engido (Avena Fatua)* become dominant crops [19]. Even if, these problems existed, there was no any research conducted in the *woreda/district/* that helps to identify the determinant factors that affect lime adoption on agricultural lands [19]. And this inspires me to conduct the study. So, the main objective of this study was to investigate the basic factors influencing farmers' adoption of lime technology.

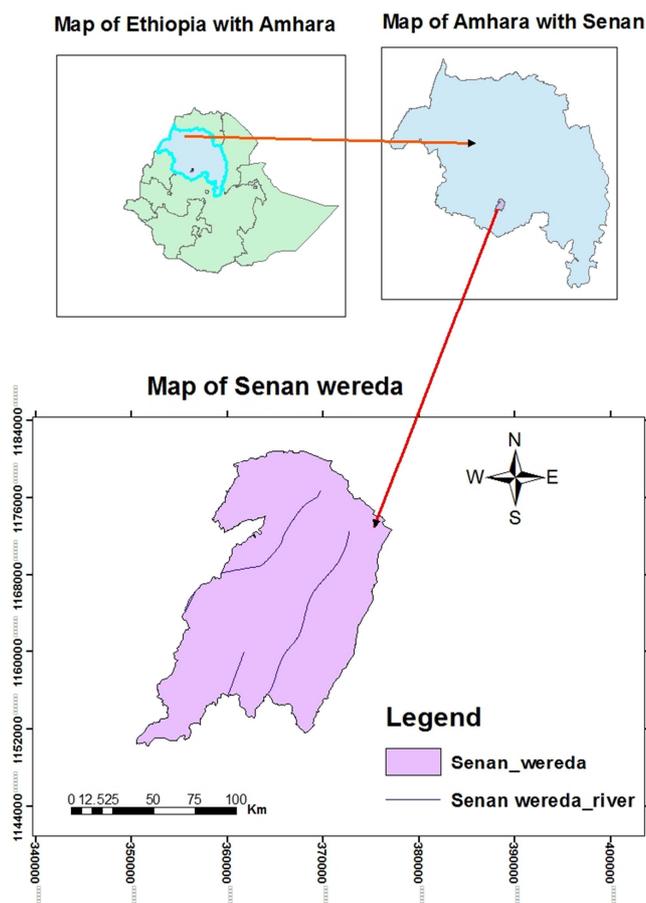


Figure 1. Map of the study woreda/district/.

## 2. Materials and Methods

### 2.1. Description of the Study Area

*Senan woreda/district/* is located in East *Gojjam* Administrative zone, which is located in the Amhara National Regional State of North Western Ethiopia. *Senan woreda* is one of the rural *woreda* lies within range of 10° 25' 13" N and 10° 40' 30"N latitudes and 37° 40' E and 37° 50' 20" E longitudes. According to *Senan Woreda* Plan Commission, *Senan woreda* is located at about 327 km away from Addis Ababa in North West direction; at about 292 km from Bahir Dar the capital city of Amhara national regional state in South East direction and at about 27 km from Debre Markos, in North direction [20]. There are 18 *Kebeles/sub-districts/* in the *woreda*. *Sinan Woreda* Plan Commission reported that, agro-ecologically the *woreda* is classified in to three agro-ecological zones; these are *Wurch* (Alpine) 2%, *Dega* (temperate) 73%, and *Weina Dega* (subtropical) 25% [18]. The land form of the *woreda* is made up of plateau and plain surface 25%, mountain and hills 60% and valley 15% [20]. Vegetation of the study area is largely dominated by *Juniperus procera* and *Eucalyptus globules*. According to SWAO the *woreda* dominated by red soil type that constitutes 75% and brown soil type constitutes 25% [18].

According to SWPC population data, the study *woreda's* population in 2018 is 119242, out of which 59168 and 60074 are

male and female respectively [20]. The rural population size constitutes 105979 (88.87%) where 53218 are male and 52761 are female. The *woreda* occupied a total area of 43134ha. Out of the total areas of the *woreda* 24178 ha (56.05%) is cultivated land; 6477 ha (15.01%) is forests, wood lands and bushes; 8503 ha (19.71%) is grazing lands; 1326 ha (3.07%) is covered by villages and 2440 ha (5.65%) is out of use & the rest 210 ha (0.48%) is for other purposes [19].

**2.2. Research Design**

Mixed research design particularly concurrent design by merging both quantitative and qualitative research approaches were used in this study. The purpose of a convergent (or parallel or concurrent) mixed methods design enables to collect both quantitative and qualitative data, merge the data, and use the results to understand a research problem simultaneously.

**2.3. Sample Size Determination and Sampling Techniques**

*Senan woreda* was selected purposively as a target area because of the researcher’s personal experience of the area and existence of acidic soils. Since *Senan woreda* is clustered in 18 *kebeles*/sub districts/, 3 (three) of these *kebeles* (*Woleke, Tach chabi and Yeted*) or totally *Yeted* cluster were selected by using purposive sampling techniques because, this cluster is more affected by soil acidity than other clusters [19]. The target population of the study includes households from each *kebele*, *kebele* Development Agents (DAs), *kebele* administrative staffs, and *woreda* agricultural office experts, team leaders and office heads.

The researcher determined the size of sample *kebele* households by using the formula [13] as follows:

$$n = \frac{z^2 \cdot p \cdot q \cdot N}{e^2(N-1) + z^2 p \cdot q}$$

$$n = \frac{(1.96)^2 \cdot (0.03) \cdot (1 - 0.03) \cdot (3060)}{(0.03)^2(3060-1) + (1.96)^2(0.03) \cdot (1 - 0.03)}$$

$$n = \frac{(3.84) \cdot (0.03) \cdot (0.97) \cdot (3060)}{(0.0009)(3059) + (3.84) \cdot (0.03) \cdot (0.07)}$$

$$n = 342/2.86 \sim 120$$

- Where, n = sample size
- z = value standard variation at 95% confidence level (1.96).
- p = sample proportion or result of plot study (0.03).
- q = 1 – p
- N = number of total household population
- e = the estimated true value

In the next stage, the proportional sample size of each sample *kebeles*’ household heads identified by using the proportional sampling formula as follows:

- $P = \frac{t}{T}$  where, P = common multiple t = number of sample size
- T = total number of household heads of the selected *kebele*

$$P = \frac{120}{3060} = 0.039 = 3.9\%$$

*Yeted* = 48 sample HH heads; *Woleke* = 42 sample HH heads and *Tach Chabi* = 30 HH heads.

Total = 120 HHs

Systematic sampling techniques from households list of each *kebele* was used to identify sample respondents. Because of their responsibility and their understanding about the issue; from core *kebele* administrative staffs only *kebele* agricultural administrative staffs selected through purposive sampling technique. *Kebele* DAs; and *woreda* agricultural office heads, team leaders, and experts selected by through comprehensive sampling techniques because the members are small in number and they are all necessary for the study.

**2.4. Sources of Data and Data Gathering Instruments**

Primary and secondary sources were used in this study. Closed and open ended Questionnaires were prepared and administered for the systematically selected 120 HHs. In addition to questionnaire, interview was administered to SWAO team leaders, office heads and *kebele* DAs. Focus group discussion has been also held for Agricultural administrative staffs and *woreda* experts. Secondary sources obtained from the *woreda* office documents.

**2.5. Data Analysis Techniques**

The gathered quantitative data coded and entered in SPSS version 20 computer software program. And then, the collected data analyzed by using descriptive and inferential statistic. The descriptive statistics describe the frequency, percentage, mean, and standard deviation value of the explanatory variables. The inferential statistics i.e. Chi-square test and Independent t-test were used. And also, binary logistic regression model used in this study. The qualitative data analysis carried out by narrative analysis.

**2.6. Model Specification Binary Logistic Regression**

Binary logistic regression is a model used to show the relationship between categorical dependent variables and one or more explanatory variable that may be continuous or categorical [21]. Following to Maddala [14] and Gujarati [11] the logistic distribution function for the adoption of agricultural inputs can be specified as:

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

Where,  $P_i$  is the probability of adoption of lime inputs for the  $i^{th}$  farmer and it ranges from 1–2 (i.e., the binary variable, p = 1, an adopter, p = 2, non- adopter).  $e^{z_i}$  stands for the irrational number e to the power of  $Z_i$ .  $Z_i$  is a function of n-explanatory variables which is also expressed as:  $Z_i = B_0 + B_1X_1 + B_2X_2 + \dots + B_nX_n$  Where,  $B_0$  – is the intercept,  $B_1, B_2 \dots B_n$  are the logit parameters (slopes) of the equation,  $X_1, X_2, \dots X_n$  = explanatory variables in the model. The slopes tell how the log-odds ratio in favor of adoption of lime inputs changes as an explanatory variable changes. The relationship between  $P_i$  and  $X_i$  which is non- linear can be expressed as follows:

$$P_i = \frac{1}{1 + e^{B_0 + B_1X_1 + \dots + B_nX_n}}$$

Therefore, in this study binary logistic regression model was used to identify the determinants of farmers' adoption of lime inputs and to show the relative significant relationship of explanatory variables with the dependent variables. Because the study's dependent variable was dichotomy (dummy) which represent as 1 = adopters and 2 = non – adopters, the predictor variables were of all type (discrete, categorical and continuous), had large sample size (120 sample size).

#### *Model Specification for Collinearity and Model of Fitness*

In a given study, before taking the selected variables into the binary logistic regression model, it is necessary to check for the existence of multicollinearity among the continuous variables and verify the associations among discrete variables. The reason for this is that the existence of multi collinearity will affect seriously the parameter estimates. The coefficients of the interaction of the variables indicate whether or not one of the two associated variables should be eliminated from model analysis [11]. Formally, Variance Inflation Factors (VIF) technique was employed to detect the problem of multi-collinearity for continuous explanatory variables. VIF value is equal to 1 there is no multi-collinearity problem among the factor variables. A VIF value greater than 10 is used as a signal for the strong multi-collinearity [11]. A multi-collinearity measurement associated with the VIF ( $X_i$ ) is specified as:

$$VIF (X_i) = (1-R_i^2)^{-1} = VIF = \frac{1}{1-R_i^2}$$

Where,  $R_i^2$  is the coefficient of multiple determinations when the variable  $X_i$  is regressed on the other explanatory variables. Additionally, there are also associations between discrete variables, which can lead to the problem of multi-collinearity or association. To detect this problem, contingency coefficients were computed from the survey data. Contingency coefficient is a chi-square based measure of association where a value 0.75 or above indicates a stronger relationship [12]. The coefficient contingency is expressed as follows:

$$C^2 = \frac{x^2}{n+x^2} = C = \sqrt{\frac{x^2}{n+x^2}}$$

Where,  $C$  = Coefficient of contingency,  $n$  = total sample size and  $x^2$  = a chi-square value.

Therefore, in this study multi-collinearity diagnostic test were used to identify the situation weather the correlations among and between explanatory variables are strong or not.

Thus, variance inflation factor (VIF) was used for testing the existence of multi-collinearity problem among and between continuous variables; and Coefficient of Contingency was used for discrete variables. There are different statistical testes for

determining the significance or goodness of fit for logistic regression models. These are Pearson chi-square, Likelihood Ratio test, Hosmer-Lemeshow Goodness-of-Fit test and Nagelkerke Pseudo R - square. Goodness of fit of the model can also be measured by considering how well the model classifies the observed data or examining how likely the sample results actually are and given the estimates of model parameters. The goodness-of-fit is considered to be good if the overall correct classification rate exceeds 0.05. The goodness-of-fit test statistic is greater than 0.05, as we want for well-fitting model; the model's estimates fit the data at an acceptable level. Therefore, in this study Pearson chi - square and Hosmer-Lemeshow Goodness-of-Fit test were used to test the model-of -fitness of the study.

## 3. Results

### *3.1. Adoption Categories of the Household Heads*

In this study the sample households were categorized in to two categories based on their adoption decision of agricultural lime inputs i.e. adopter and non-adopter and accounts 43.3% and 56.7% respectively. This indicated that majority of the respondents were non-adopters of lime technology.

### *3.2. Demographical Characteristics of Respondents*

From the total 120 samples household heads 104 (86.7%) were male headed and 16 (13.3%) were female headed. The age group indicated that; young (<29 years), adult (29-64 years) and old age group (>64 years) and accounts, 31.7%, 35.8% and 32.5% respectively. From the respondents, 72.5% were married, 18.3% single, 4.2% divorce, and 5% were widowed. 42.5% of the households have leadership role and others have not. And from the household heads, illiterates account (55%), followed by adult education (13.3%). On the other hand, 12.5% of were 1-4 completes, 10.8% grade 5-8 completes, and 5.8% of respondents were from 9-12 completes and 2.5% were College and above completes.

### *3.3. Determinant Factors and Lime Adoption*

*Sex of the Household Heads and Adoption Categories:* As shown in Table 1, out of 52 households who adopted lime technology, 86.5% of the household heads were males and 13.5% were females. On the other hand, from 68 household heads who did not adopt agricultural lime inputs 86.8% were males and 13.2% were females. The result of the chi-square test indicated that there was insignificant association between household heads' sex and adoption of lime at 5% significance level ( $x^2 = 0.001$ ,  $p = 0.971$ ).

**Table 1.** Sex of the Household Heads and Adoption Categories.

Sex of the HH Heads	Adopter		Non – Adopter		Total		x <sup>2</sup> - test	p-Value
	Number	%	Number	%	Number	%		
Male	45	86.5	59	86.8	104	86.7		
Female	7	13.5	9	13.2	16	13.3		
Total	52	100	68	100	120	100		

ns: not significant at 5% level of significance.

*Age Group of the Household Heads and Adoption Categories:* Out of 52 adopter sample households, 46.2% were young, 40.4% adult and 13.5% were old age group. On the other hand, 20.6%, 32.4% and 47.1% were young, adult and old age group HH heads among the non – adopter sample households respectively. The result of the chi-square test indicated that there was negative and significant association between households’ age group and adoption of lime at 1% significance level ( $\chi^2 = -16.847, p = .000$ ).

*Educational Status and Adoption Categories:* From 52 adopter sample households, 40.4% were illiterate and 59.6% were literate. On the other hand, 66.2% and 33.8% were illiterate and educated among the non – adopter sample households respectively. The chi-square test showed that there was significant relationship between the educational status of the household heads and the adoption of lime inputs at 1% significance level ( $\chi^2 = 7.920, p = 0.005$ ).

*Marital Status of the Household Heads and Adoption Categories:* In this study from the total of 52 adopter sample households, 78.8% were married and 11.5% were single, 1.9% Divorced and 7.7% widowed. On the other hand, 67.6%, 23.5%, 5.9% and 2.9% were married, single, divorced, and widowed among the non – adopter sample households respectively. The result of the chi-square test revealed that, there was no significant association between household heads’ marital status and adoption of lime at 5% significance level ( $\chi^2 = 5.260, p = .154$ ).

*Leadership Status and Adoption Categories:* leadership status in different position has its influence on the adoption of different technologies. In this study, from 52 lime adopters, 63.5% participated in *kebele or woreda* governmental leadership activities and 36.5% didn’t participate in leadership activities. And from non-adopters, 26.5% participated and the rest 73.5% didn’t participate in leadership activities. The Chi-square test result indicated that there was significant association between leadership status and lime adoption at 1% significance level i.e. HHs who participated in leadership activities was more likely adopt lime technology than non-participants. ( $\chi^2 = 16.499, p = .000$ ).

Group discussion participants also stated that, farmers those participated in different leadership activities they can get information from concerned bodies early and they can apply the agricultural technology more than who do not have leadership positions.

*Economic Level of the HHs and Adoption Categories:* This study showed that, 11.5%, 51.9% and 36.5% were grouped in to poor, medium and rich out of 52 adopter HH heads respectively. And from 68 HHs who did not adopt lime technology poor, medium and rich classes accounted 60.3%, 23.5% and 16.2% respectively. In this study to assess the level of significance, chi-square test employed. And the result indicated there was significant association between HH heads economic level and adoption categories ( $\chi^2 = 29.400, p = .000$ ). The samples who were participated in focus group discussion and interview said that, economic level of the

household heads affected the adoption of lime in the study area. As they stated if the HH heads found in low economic level, then they can’t buy and adopt the technology because it needs high level of income.

*Non-farm Activities of the Household Heads and Adoption Categories:* The study result showed that, out of 120 sample households 61.5% and 58.8% of the adopters and non-adopters were involved in non – farm activities respectively. The chi-square test result indicated that there was insignificant association between non – farm activities of the households and the adoption of lime at 5% level of significance ( $\chi^2 = 0.090, p = 0.764$ ).

*Access to Experts’ Support and Adoption of Lime:* The survey result revealed that, out of 120 respondents 44.2% made contact with development agents and 55.8% didn’t get support and had not contact with development agents. In addition to this, 63.5% and 29.4% of adopter and non – adopter sample households heads got access to extension experts support/contact/ and 36.5% and 70.6% of the adopter and non – adopters had not contact with development agents respectively. The chi-square test indicated that there was a significant association between access to contact with development agents and adoption of lime at 1% level of significance ( $\chi^2 = 13.854, p = 0.000$ ).

*Farm Size of the Household Heads and Adoption Categories:* The result of this study indicated that, the average land holding size of the adopter sample households is 1.19 hectare (4.79 *timad*) with standard deviation of 1.764. And the average land holding size of the non-adopter sample households is 1.53 hectare (6.12 *timad*) with standard deviation of 1.732. The independent t-test result implied that there was significant mean difference between the adopters and non-adopters in relation to farm size at 1% significance level ( $t = -4.132, p = 0.000$ ) (Table 2).

**Table 2.** Farm Size of the Household Heads and Adoption Categories.

Adoption categories	N	Mean	St.D	t-test	p-value
Adopter	52	4.79	1.764	-4.132*	.000
Non – Adopter	68	6.12	1.732		

\* Statistically significant mean difference at 1% level of significance

*Family Size and Adoption Categories:* The average family size of the adopter and non – adopter is 6.15 and 4.44 with a standard deviation of 1.696 and 1.343 respectively. The result of the independent t-test showed that there was significant mean difference among the adoption categories of the family size at 1% level of significance ( $t = 6.174, p = 0.000$ ).

**3.4. Determinant Factors and Binary Logistic Regression Model Result**

To identify the determinant factors that affect farmers’ adoption of lime, binary logistic regression was used due to the categorical nature of the dependent variables (i.e adopters and non – non adopters) and the large size of the sample.

The goodness-of-fit test statistic is greater than 0.05 and the model’s estimates fit the data at an acceptable level. The

overall correctly prediction of the model is 91.7% with the correctly prediction of adopters and non – adopters were 92.3% and 91.2% respectively. In the binary logistic regression result (Table 3), the value of regression coefficient (B) indicated that the association between the dependent and independent variables. The negative value B is indicated that an increasing independent variable and decrease of adoption of lime inputs. The positive value of B indicates the increasing of independent variable with an increase the adoption of lime inputs. The standard error is a measure of how stable our estimate is. A large standard error means the estimated coefficient isn't that well estimated, and a low standard error means we have a fairly precise estimate. Wald in the regression result is the significance of individual regression coefficient for each independent variable. It represents the significant of each explanatory variable in its ability to contribute the model. Exp (B) in the regression result gives the odd ratio of the adoption of lime inputs. When the odds ratio value is greater than 1; then, the probability of higher category increases, the odds ratio is less than 1; then, the probability of higher category decreases. Odds ratio value is interpreted with the reference category, where the probability of the adoption of lime inputs increased or decreased. In continuous variables, it is interpreted with 1 unit increase in the independent variable, corresponding to the increase or decrease of the units of the adoption of lime inputs.

In this study, there are 10 independent variables tested by binary logistic model. Out of these variables which were hypostasized to affect the adoption of lime application 7 variables (Age, Family size, Education level, Leadership status, Farm size, Economic level and Expert support) were significant which determined farmers' decision to the adoption of lime inputs application on acidic soil farm plots. And others (Sex, Marital status and non- farm activities) were not significant.

**Table 3.** Binary Logistic Regression Result of Independent Variables and Adoption of Lime.

Explanatory Variables	B	S.E.	Wald	Sig.	Exp (B)
Sex	-.224	1.163	.037	.847	.799
Age	-3.028	.884	11.725	.001*	.656
Family	.875	.365	5.748	.017**	1.417
Education	3.139	1.187	6.993	.008*	23.080
Marital	-.127	.507	.063	.802	.880
Leadership	3.329	1.072	9.640	.002*	27.905
Timad/farm size	-.531	.250	4.533	.033**	.701
Ecolevel	2.836	.781	13.190	.000*	20.059
Non_farm	-1.349	.914	2.177	.140	.259
Expert	1.648	.817	4.067	.044**	5.197

\*significant at 1% significance level \*\* significance at 5% significance

## 4. Discussion

In relation to sex of the HHs, the result of the chi-square test indicated that there was insignificant association between household heads' sex and adoption of lime at 5% significance level ( $\chi^2 = 0.001$ ,  $p = 0.971$ ). This result is congruent with the

finding of Hassen *et al.*, (2012) i.e sex has no significant effect on probability of lime technology adoption. And also the result of this study revealed that, young age groups adopted more than adult and old age groups. This is similar to with the findings of Assefa and Gezahegn (2004) i.e., old age groups have low tendency to adopt agricultural technologies. The result obtained from this study in relation to educational status revealed that there was significant relationship between education levels and adoption of improved agricultural inputs and the finding of Tesfaye and Alemu) study confirmed the result [23].

The chi-square test result based on marital status revealed that, there was no significant association between household heads' marital status and adoption of lime at 5% significance level ( $\chi^2 = 5.260$ ,  $p = .154$ ). And the result is similar with Assefa's and Gezahegn's research findings. Leadership participation in different levels contributes much more to the full engagement in technology adoption, because it raises the awareness of the participants. In this study, the Chi-square test result indicated that there was significant association between leadership status and lime adoption at 1% significance level i.e. HHs who participated in leadership activities was more likely adopt lime technology than non-participants. ( $\chi^2 = 16.499$ ,  $p = .000$ ). Group discussion participants also stated that, farmers those participated in different leadership activities they can get information from concerned bodies early and they can apply the agricultural technology more than who do not have leadership positions. Economic level has its influence in technology adoption by farmers. The finding of this study is congruent with the findings of Seife and Calorine [17]. The study indicated that, small holder farmers who used improved agricultural inputs have more assets or have high level of income.

In relation to the participation of farmers in non-farming activities, this study's finding is opposite with the results of Ashenafi [4] study; the comparison of mean land size between adopters and non-adopters reveals that in Amhara and Tigray regions, as they said, the land holding of adopters is statistically greater than that of non-adopters of agricultural input.

It is expected that farmers those who have high contact with development agents more likely to adopt agricultural input of lime than farmers who have no contact with development agents. FGD participants reflected that, HHs contact with the extension experts could affect farmers' adoption of lime technology. As they respond if farmers obtain adequate support from DAs they can adopt the lime technology as expected and the reverse is true. Contact with extension agents increases the adoption of agricultural inputs [4, 17, 5].

Farm size is one of the factors which affect farmers' decision to adopt or not to adopt new improved agricultural input technologies. The independent t-test result implied that there was significant mean difference between the adopters and non-adopters in relation to farm size at 1% significance level ( $t = -4.132$ ,  $p = 0.000$ ) (Table

2). In relation to Family Size and Adoption Categories, in this study, the average family size of the adopter and non – adopter is 6.15 and 4.44 with a standard deviation of 1.696 and 1.343 respectively. The result of the independent t-test showed that there was significant mean difference among the adoption categories of the family size at 1% level of significance ( $t = 6.174$ ,  $p = 0.000$ ). This finding congruent with Ashenafi's (2006) finding, i.e. the mean family size of adopters is statistically greater than that of non-adopters.

## 5. Conclusions and Recommendations

The adoption of modern agricultural inputs on agricultural lands contributes a lot to the productive enhancement of the agricultural sector in Ethiopia. However, the adoption of the recommended and required amount of agricultural inputs is still found at lower level including the study area /*Senan woreda*/. This study was conducted in *Senan Woreda*, East *Gojjam Zone*, Ethiopia. The main objective of this study was to investigate the basic factors influencing farmers' adoption of lime technology. The result of this study revealed that, determinant factors such as; age, educational status, economic level, farm size, leadership status, extension expert support and family size of the households were significant factors in adoption of lime inputs. But sex, marital status and engagement in non-farming activities were insignificant factors to the adoption of lime inputs. The binary logistic regression result also identified the positively and negatively determined factors. Thus, education status, leadership status, family size, economic level and expert support were positive significant determinant factors, and age and farm size were negatively significant determinant factors of adoption of lime inputs. But the explanatory variables such as sex, marital status, and non-farm activities were insignificant factors to determine the adoption of lime inputs. Respondents who were participated in interview and focus group discussion confirmed that; age, educational status, farm size, leadership status, economic level, expert support, and family size were the major significant determinant factors of adoption of lime inputs in the study area.

Generally, in this study, the analysis result showed that the adoption of recommended and required amount of lime inputs application in the study area was low due to different factors. Therefore, to overcome the problems: designing training programs for HHs and create awareness, increase expertise support for farmers, improve credit access both in amount and interest rate, sharing of experiences between adopters and non-adopters and maximizing adoption rate by reducing (avoiding) factors which affecting farmers' adoption of lime inputs are some recommended points.

## Disclosure Statement

It is the sole work of the author and all sources are acknowledged.

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