Research on Humanities and Social Sciences
ISSN 2224-5766 (Paper) ISSN 2225-0484 (Online)
Vol.12, No.7, 2022

Determinants of Maize Productivity: Evidence from Smallholder Maize Farmers in Gudeya Bila District, Ethiopia

Berhanu Alemayehu Negese Tamirat*
Department of Economics, Jimma University, Jimma, Ethiopia

Abstract
Agriculture is the center stage in the economic policy development of Ethiopia. The agricultural sector in Ethiopia is characterized by low maize productivity due to backward technology adoption. Agriculture plays a crucial role in the economic development of a country; without achieving substantial enhancement in agricultural production and productivity, no country has moved to the take-off stage of economic development. The general objective of the study is to assess the determinants of maize crop productivity in the Gudeya Bila District. The study aims to investigate the determinants of maize productivity in the study area. The primary and secondary data were collected from 100 maize growers in the study location during 2018/19. Descriptive statistics and econometric methods were developed for the data analysis. Qualitative and quantitative primary data were developed. To get the required primary data questionnaires, key informant interviews, and focus group discussions were used. For the data analysis, Ordinary Least Square Model (OLS) was employed. The study found that sex, landholding, number of oxen, fertilizers, family size, educational status, the fair price of output, and improved seed were positively influencing maize production and productivity; whereas age, the acidity of land, and credit were negatively influencing maize production and productivity in the study area. The study recommended that the stallholder farmers should be enhanced the use of oxen, fertilizer, improved seed, knowledge, and fair price of output to enhance maize productivity. Therefore, concern bodies should give important attention to maize production and productivity, which in turn increase smallholder income.
Keywords: Agriculture, Maize crop, OLS, Productivity, Smallholder farmers, Ethiopia
DOI: 10.7176/RHSS/12-7-02
Publication date: April 30th 2022

1. Introduction

Agriculture is the most important sector in many developing countries in the world. Many developing countries' economy highly depends on this sector. Poverty alleviation and food security can be achieved by agricultural growth. It creat the spillover effect on the remaining sectors (FAO, 2012). Agriculture is a primary economic activity in Ethiopia; considered the backbone of the economy (World Bank, 2008). The role of agriculture in economic development is to agriculture provides both food and raw materials required for the rest of the economy; provide an enlarged market as it expands aggregate demands; provides labor for employment in the industrial sectors and principal source of capital for investment elsewhere in the economy (Garvelink et al., 2012). Maize is one of the major cereals grown in Ethiopia and the main staple food in many parts of the country. In the country maize production is largely under smallholder who comprises 80% of the population is both the primary producer and consumer of maize it is currently grown across 13 agro-ecology zones which together cover about 90% of the country.

In Ethiopia, smallholder farmers continued to lack access to knowledge about current best practices misusing input resources at great cost and great crop loss. The barriers to an extension on large scale continue to pose a great challenge; extension agents are too few; farmers grow a too great variety of crops and speak too many languages for service providers to develop and apply a standard approach; and transportation infrastructure is inadequate, making it difficult for extension agents to reach rural communities (Oladeebo, 2004). Agricultural production is predominantly characterized by the traditional farming system with low productivity. The continuous of such farming practice over a long period with little soil conservation measure significant eroded the fertility of the soil and caused climate change. As a results increase the rate of drought and rain become fluctuated. Drought and fluctuation of rainfall lead to severe famine in a large segment of the rural population yielding variability and a low level of income for rural community market uncertainty (Ajah and Nmadu, 2012).

The yields of crops in general and cereals, in particular, are very low because of low adoption of improved agricultural technologies, severe weather fluctuation, climate change, inappropriate economic policies, rapid population growth, and difference in land size holding and livestock. Due to this crop production has not been able to satisfy the food requirement of the people (Hailu, 2008). Production and productivity of crops in the agricultural sector were severely restricted due to recurrent disasters such as drought and limited accessibility such as credit and land due to a weak substance agriculture-based economy. The severity of the food shortage problem varies from area to area depending upon the type of farming system and socio-economic problems related to a particular location. Several factors have been cited as a possible reasons for the reduction of farm output which in turn increased the level of vulnerability of food security and food security in the sector has become a burning issue (Baloyi et al., 2012).

Climate change, inappropriate economic policies, rapid population growth, and difference in land size holding and livestock. Due to this crop production has not been able to satisfy the food requirement of the people (Hailu, 2008). Production and productivity of crops in the agricultural sector were severely restricted due to recurrent disasters such as drought and limited accessibility such as credit and land due to a weak substance agriculture-based economy. The severity of the food shortage problem varies from area to area depending upon the type of farming system and socio-economic problems related to a particular location. Several factors have been cited as a possible reasons for the reduction of farm output which in turn increased the level of vulnerability of food security and food security in the sector has become a burning issue (Baloyi et al., 2012).

Maize is Ethiopia's largest cereal crop commodity in terms of total production and the number of farm holdings. It is instrumental for the poverty alleviation and food security of Ethiopian smallholders, and is the lowest cost caloric source among all major cereals, which is significant given that cereals dominate smallholder diets in Ethiopia; the unit cost of calories per US dollar for maize is one and a half, and two times lower than wheat and teff respectively. Maize is also a low-cost source of protein in comparison to other cereals; it provides 0.2 kg of protein per USD, compared to 0.1 kg of protein per USD from teff and 0.2 kg of protein from wheat and sorghum. An average Ethiopia consumes a total of 1,858 kilocalories daily of which four major kinds of cereal (maize, teff, wheat, and sorghum) account for more than 60%, with maize and wheat representing 20% each (Rashid and Lemma, 2010).

According to their study, the effect of land area, fertilizer, and hired labor were found to have a positive effect on output. The study was done by (Belay and Degnet, 2004) by using a multi regression model on the productivity of smallholder farmers, according to his study number of oxen, improved seed, fertilizer, and family size as factors positively affecting the productivity of smallholders. According to (Hailu, 2008), a study was done on the determinant of maize productivity in Ethiopia. His study found that the land, labor, physical capital, and fertilizer are significant factors determining agricultural productivity. The study was done by (Asfaw et al., 2013; Endrias et al., 2012), by using the ordinary least square method on the title factor affecting maize productivity. According to their studies improved seed, farm size, educational level, age, and irrigational activity are statistically significant and positively determine the productivity of the cereal crops.

1.1 Smallholder farmers

Smallholder farming is the backbone of Ethiopia's agriculture and food security that resides in the rural areas, the majority can be considered smallholder farmers. The term smallholder farmers refer to their limited resource endowments relative to other farmers differs between countries and between agro-ecological Zones in favorable areas with high population growth densities they often cultivate less than ha of land whereas they may cultivate 10 ha or more in semiarid areas, or manage 10 head of livestock. Subsistence farming on a small plot of land is a way of life for the vast majority of Ethiopian people and its productivity is low. The low productivity subsistence farming characteristics of most traditional agriculture result from the combination of some historical forces restricting output growth. Given the limited area of a farm, the family cultivates in the context of traditional techniques and the use of primitive tools. These small areas tend to be intensively cultivated in such conditions. Shifting cultivation is the most important economic method of using limited supplies of lobar extensive tracks of land. This historical pattern of low productivity and shifting cultivation enabled most Ethiopian tribes to meet their subsistence food requirements. Agriculture is predominantly affected by the unstable natural environment as well as by measuring economic uncertainties. The biological basis of agricultural production and its exposure to the elements pose special problems in attempting to forecast yields (Baloyi et al., 2012).

2. Methodology of the Study

2.1 Description of the Study Area

The study would have been conducted in the Gudeya Bila district in the East Wollega Zone Oromia Regional State. The Gudeya Bila district is located about 250 km away from the west of the capital city Addis Ababa. The altitude of the district Varies from 500-3500 meters above sea level. The district is bordered in the south by Gobu sayo on the west by Sibu Sire and the north by Dongoro and on the east by Jima Ganat. According to the Central Statistical Agency of 2007 the woreda has a total population of 102,228, Out of this population, 50,717 are males and 51,511 are females. The age composition of the residents of this district is similar to the demographic structure of developing countries. The majority of these populations were Christian (86%), some of them are Muslim (9%), and others (5%). The population of this district is composed of three main ethnic groups. These are Oromo (88.34%), Amhara (7.63%), Gurage people (1.02%), and others are (2%) of the total population. The residents of the district engaged in different economic activities such as; agriculture, trade, and government employees. The district has been estimated area of 1132.51 ha. About 74.2% of its surface area belongs to mid-altitude agro-climate, 5.53% of the land is highland and 20.27% is classified as low land agro climate. The mean annual temperature and mean annual rainfall is 22c and 1700mm, respectively. Agriculture provides the principal share of the source of revenue for the population of the district. Crop production took the lion's share followed by livestock production. The major crops include maize (43.6%), Teff (13.5%), sorghum (16.5%), Nuog (13%) followed by Finger millet (12.3%) of cultivated land. The remaining percent of cultivable land is covered by minor crops such as vegetables, roots, tubers, and some perennial crops.

2.2 Sampling Techniques

The study applied both probability and non-probability sampling techniques such as simple random sampling and purposive sampling to select the sample from the given population. For the study, data were collected from five Kebeles of the Gudeya Bila district, which contains a total of 21 Kebeles, out of which 19 Kebeles are rural and 2 are urban Kebeles. Multistage sampling methods were employed to select 5 kebeles from rural kebeles of the Gudeya Bila district. First using stratification divides the Kebeles into the three agro climates based on agroecology, these are; highland Kebeles (5), lowland Kebeles (7), and mid-altitude Kebeles (10). Taking into account the resource available, from 19 maize crop-producing rural kebeles of Gudeya Bila district; 5 kebeles (Tuluu chalii, Abayi Dalle, Gute chancho, Haro, and Gonkaija) were selected based on their agro-ecological zone compared to the remaining kebeles of the Gudeya Bila district. Finally, respondents from each kebeles were selected by using a simple random sampling method. Proportional sampling methods were employed to determine the number of respondents from each Kebeles. The sample size was determined by using Cochran's sample size determination formula(1963).

$$n = \frac{Z^2 p(1-p)}{e^2} = \frac{(1.96)^2\,(0.85(1-0.85))}{(0.07)^2} = 100$$

Where: N_i is the total number of observations in i^{th} kebele; n is the total number of households in one kebele; N is the total number of households in five Kebeles; N_S is the total number of sample size; e is the level of precision(7%) and z is level of confidence for 95% is (1.96).

Table 1: Distribution of sample size by kebele

Kebele	Number of households (N_i)	Total Sample (n_i)
Tuluu Chalii ($Kebele_1$)	3011	15
Abayi Dalle ($Kebele_2$)	4780	23
Gute chancho ($Kebele_3$)	4860	24
Haro ($Kebele_4$)	4434	21
Gonka ija ($Kebele_5$)	3520	17
Total	**20,605**	**100**

n_i= total number of households selected from kebele I (I = 1, 2, 3, 4,5); N_i= total number of households in kebele i.

2.3 Data Collection

Both primary and secondary sources of data were employed. Cross-sectional data were collected from the survey of randomly selected smallholder rural farm households. For primary data collection personal observation, Interview method, schedules method, Questionnaires method, and other methods were employed. Both quantitative and qualitative information was collected. The data collection included households' demographic, socioeconomic and environmental characteristics. Secondary information like population number, agricultural inputs, and outputs, farm use pattern, rainfall amounts, temperature, agroecology, etc were also collected. The survey was carried out in May and June 2018/19.

2.4 Method of data analysis

To analyze the collected data both descriptive methods and an econometrics model were applied. Descriptive methods to analyze the data use: mean, variance, table, chart, graph, and percentage to describe given data. In addition, inferential statistics (such as chi-square and t-tests) were employed to provide further insights on factors affecting rural smallholder farm household maize crop productivity. Specifically, we use chi-square tests for identifying qualitative factors affecting rural smallholder farm households' maize crop productivity whereas the t-test selected quantitative factors that affect rural smallholder farmers' maize crop productivity. The ordinary least square (OLS) estimation technique was applied to differentiate the determinants of maize crop productivity. This study, study has been tried to measure the productivity of maize crops by using independent variables such as Age (AGE), Family Size (FS), Farm Size (FL), Improved Seed (IMSD), Fertilizer (FER), Credit (CR), Education Level (EDU), Price Output (PO), Acidity of Farm Land (FAC) and Oxen (OX). The maize crops productivity model includes these independent variables in the form of a multiple linear regression function:

$$MP = F\{IMSD, FL, FER, EDU, AGE, CR, PO, FAC, FS, OX, SX)$$

$$lnmp = B_0 + B_1 IMSD + B_2 FL + B_3 FER + B_4 EDU + B_5 AGE + B_6 CR + B_7 PO + B_8 FAC + B_9 FS + B_{10} OX + B_{11} SX + Ui$$

Where, MP is the dependent variable, maize productivity, B_o is the constant term, B_i is the coefficient of explanatory variables, AGE is age household head, FS is family size household head, FL is farmland size household head, IMSD is improved maize seed, FER is fertilizer, CR is credit, EDU is education level household head, PO is the price of output, FAC is farmland acidity, OX is numbers of oxen, SX is the sex of household head and U_i is the residual term.

Table 2: Summary of hypothesized independent variables and their expected signs

Definition	Type	Expected sign
Farm size (FL)	Continuous	+
Fertilizer (FER)	Continuous	+
Educational status (EDU)	Continuous	+
Age (AGE)	Continuous	+
Family size (FS)	Continuous	+
Oxen (OX)	Continuous	+
Improved maize seed (IMSD)	Dummy	+
Credit (CR)	Dummy	+
Price of output (PO)	Dummy	+
The acidity of farmland (FAC)	Dummy	-
Sex (SX)	Dummy	+

2.5 Econometric Tests and Analysis of Data

Multicollinearity test: Explain the relation of explanatory variables with each other that arises due to the presence of a perfect linear relationship among explanatory variables. Since the presence of multicollinearity affects the OLS estimators and makes them inconsistence, the problem of multicollinearity must be tested. This test shows the testing of the interdependence of explanatory variables; which can be examined by the variance Inflating factor (VIF). As a rule of thumb when the mean of VIF is greater than 10 accept the alternative hypothesis that means there is multicollinearity, when the mean of VIF or (1/VIF) is less than 10, fail to reject the null hypothesis thus, no multicollinearity **(Gujarati, 2004)**.

Heteroscedasticity Test: The assumption states that the variation of each random term around its zero mean is not constant and changes as the explanatory variable changes regardless of the sample size that whether it increases, decreases, or remains constant, but does not mean that it affects the unbiasedness and consistency properties of OLS estimators rather it results in the variance of coefficient of OLS to be incorrect and inefficient. This is the test of the variance of the disturbance term under classical linear regression model assumptions errors are homoscedasticity or constant variance. The nature of the variance of the error term is judged by the Breusch-pagan test. H0: Constant variance and Ha: no Constant variance or heteroscedasticity. The decision rule is that, if the p-value is sufficiently small, that is, we reject the null hypothesis of homoscedasticity or constant variance. If the p-value is greater than 5% reject the alternative hypothesis; that is no constant variance (Gujarati, 2004).

Normality Test: The model assumes that the random variable u has a normal distribution. Symbolically: $u \sim N(0, \delta^2 U)$, which reads as u is normally distributed around zero mean and constant variance $\delta^2 u$. This means that small values of u's have a higher probability to be observed than large values. This assumption is necessary for constructing confidence intervals. If the assumption of normality is violated, the estimates of parameters are still unbiased but the statistical reliability by the classical tests of significance of the parameters cannot be assessed because these tests are based on the assumption of normal distribution of u. Hypothesis: HO: $B_i = 0$ is the error term that follows a normal distribution; H1: $B_i \neq 0$ is the error term that does not follow a normal distribution.

Omitted variable test: This model is the test of model specification. In this test whether the model has omitted variable or not performed. The decision is, that if the p-value is higher, the model has no omitted variable or no specification problem. Otherwise, the model has a specification problem if the p-value is lower. If we are missing variables in our model, that variable is correlated with the included repressors' and the omitted variable is a determinant of the dependent variable, then our regression coefficients are inconsistent (STOCK and Watson, 2003). H0: The model has no omitted variable; H1: The model has omitted variable. The nature of omitted variable in this model is judged by the Ramsey test by using the decision rules. If p- the value is high, accept the null hypothesis of no omitted variable otherwise accept that alternative hypothesis that says there is omitted variable.

The goodness of fit of the model: The goodness of fit of the model is measured by the coefficient of determination, which measures the percentage of the total variation in the independent variable. Therefore output, in this case, is explained by the regression model. Since the research uses multiple linear regression model analysis, adjusted R-squared is taken into account to measure the explanatory power of independence.

3. Data analysis and Discussion

3.1 Description of maize crop productivity

According to table (3) below, out of the total sample size of 20,605(100%), about 15,660 (79%) of the respondents are male-headed households; on the other hand, the shares of female household heads are 4945 (21%). It indicates that the responsibility of the male to participate in agricultural activities is more in number compared to females. This shows that an imbalance was exist between males and females not unique in social activity and female participation in agriculture was less than males in the study area

Table 3: Sex of household head

Sex	Frequency	Percent
Male	15,666	79%
Female	4,945	21%
Total	**20,605**	**100%**

Source: own computation based on data (2019)

As it can be shown in table (4) below, in the marital status analysis of the dimension of respondents, the majority of respondents, about 10,303 (50%), are married followed by unmarried 4945 (24%), widowed 3297 (16%) and divorced were 2060 (6%). Generally, the most of respondents are married.

Table 4: Marital status of household headed

Marital status	Frequency	Percent
Married	10,303	50%
Unmarried	4,945	24%
Widowed	3297	16%
Divorced	2060	6%
Total	**20,605**	**100%**

Source: own computation based on data (2019)

According to table (5) below, the study indicates that the majority of the respondents 8860 (43%) are in the age group between 30-40, only 618 (3%) are in the age group 20-30, 7830 (38%) are in the age group between 40-50 and 3297 (16%) are in the age group above 50 Years of age. Based on this table (5), the age structure of respondents implies that most of the respondents are in the productive age groups.

Table 5: Age of household head

Age	Frequency	Percent
20 – 30	618	3%
30 – 40	8860	43%
40 – 50	7830	38%
Above 50	3297	16%
Total	**20,605**	**100%**

Source: own computation based on data (2019)

As we have seen that from the table (6) below, 10,096 (49%) of respondents were (5-8) their family number without children and elders in agricultural activities, and also 7,830 (38%) and 2,679 (13%) of respondents implemented their agricultural work with 1-4 and above the eight family members respectively. Table (6) shows that the respondents have a large family size; a less percentage in agricultural activities. Because some of their family members were children and some of them were students. However, it is known that labor is the most important factor of production to enhance production and rising productivity.

Table 6: Family size of household headed

Family size	Frequency	Percent
1-4	7,830	38%
5-8	10,096	49%
Above 8	2,679	13%
Total	**20,605**	**100%**

Source: own computation based on data (2019)

The below table (7) shows that 1855 (9%) of the respondents are those who are illiterate whereas the Grade 1^{st} -4^{th} covers 4121 (20%), grade 5^{th}-8^{th} is 8448 (41%), grade 9^{th} -12^{th} covers 5563 (27%) and above the grade 12^{th} covers 618 (3%) clearly from this it is possible to observe that the majority of the respondents are literate and there are a few respondents above grade 12.

Table 7: Educational back ground of respondents based on education status

Education status	Frequency	Percent
Illiterate	1,855	9%
Grade 1-4	4121	20%
Grade 5-8	8,448	41%
Grade 9-12	5,563	27%
Above grade 12	618	3%
Total	**20,605**	**100%**

Source: own computation based on data (2019)

The below table (8) indicates that the majority of the respondents 14, 217(69%) of respondents' farmland is acidic, while 6388 (31%) of the respondents said that their land is nonacidic. This implies that in the study area soil acidity is prevalent and negatively affects maize output and becomes one of the main factors that reduce the productivity of maize in this study area.

Table 8: Sex of household head

Soil acidity	Frequency	Percent
Yes	14,217	69%
No	6,388	31%
Total	**20,605**	**100%**

Source: own computation based on data (2019)

As the survey indicated the farmers in the study area used both fertilizer and Improved seed. This was from the 20605 (100%) total respondents 19,163 (93%) of households used the fertilizer while the other 1,442 (7%) does not use the fertilizer. Of 93% of the respondent that used fertilizer 7,624 (37%) used less than 100kg per hector, 7,006 (34%) of them used 100kg -200kg per hectare and 4533 (22%) of them were used above 200kg per hectare of fertilizer during 2008/09 cropping season. Therefore, the farmers in the study area adopted fertilizer. The other is the data indicate that the using seed was from total respondents 18,544 (90%) of the respondents are using improved seeds and the other 2061 (10%) are not using improved seed. Generally, the below table (9) shows that, in the study, area farmers used both fertilizer and improved seed and the number of fertilizer and improved users was very high relative to not users in the study area. Therefore the use of fertilizer and improved seed increases the output of the maize productivity compared to not use.

Table 9: Distribution of fertilizer and the improved seed of farmer

Distribution of fertilizer (Use or Not use) Kg/ hector	Frequency	Percent
Use of fertilizer of farmer		
50-100kg	7,624	37%
100kg-200kg	7,006	34%
>200kg	4533	22%
Total	19,163	93%
Not use of fertilizer	1442	7%
Total	**20,605**	**100%**
Use of improved seed of farmer	18,544	90%
Use of improved seed of farmer	2061	10%
Total	**20,605**	**100%**

Source: own computation based on data (2019)

The result of this survey data in the table (10), indicates that from the total respondents about 5357 (26%) respondent does not get enough credit access from organizations, while the other respondents 15,248 (74%) of them get credit access from different organizations. Based on this result the farmers who get enough credit access from different organizations are expected to have the confidence to purchase agricultural input from the government and private organizations to improve their productivity.

Table 10: Distribution of respondents by access to credit

Access to credit	Frequency	Percent
Yes	15,248	74%
No	5357	26%
Total	**20,605**	**100%**

Source: own computation based on data (2019)

From the below table (11), the landholding size in ha in the study area of 10,921 (53%) of respondents had between (0.5-2) ha of land size, 5975(29%) of respondents had 2- 4ha of land size and 3709 (18%) respondents have more than 4ha. This implied that all respondents had their land which means about 20,605 (100%) respondents have their land, which has a positive contribution to maize productivity.

Table 11: The distribution of farm size in hectares of household

Distribution farmland size	Frequency	Percent
0.5 - 2 hect	10,921	53%
2-4 hect	5975	29%
Above 4	3709	18%
Total	**20,605**	**100%**

Source: own computation based on data (2019)

From the below table (12), we understand that 4945 (24%) of the respondents said that the market price for their output is fair, while 15,630 (76%) of the respondents said that they sold their product at an unfair price. This hurts the productivity of farmers hence it discourages farmers' work effort.

Table 12: Responses of farmers about their maize output price

Maize output price	Frequency	Percent
Yes	4945	24%
No	15,630	76%
Total	**20,605**	**100%**

Source: own computation based on data (2019)

3.2 Econometric results and interpretation

This section tried to analyze factor that determines maize productivity in the Gudeya bila district. The OLS regression analysis was employed for assessing the determinants of maize crop productivity. Before going to estimate the specified model, it is important to undertake different tests on whether the basic assumption of the model is met or not.

Test for multicollinearity: To test the existence or non-existence of multi-collinear problem in continuous explanatory variables variance inflation factor (VIF) techniques was employed. As is observed from the regression result the mean value of VIF is 5.07 which is less than 10, thus there is no multicollinearity. The research concluded that there were no problems of multicollinearity between the explanatory variables.

Test for Heteroscedasticity: To check this test, the researchers used the testing method developed by Breuschpogan. The decision rule is if the p-value of the Breuschpogan test is greater than the chosen significance levels i.e. 5% which indicates no problem of heteroscedasticity. Thus, the result indicates that Prob chi2 of 34.92% is greater than significance levels, and the study fails to reject the null hypothesis this shows the same variance among error terms i.e homoscedasticity.

Test for model specification: This test indicates that the model has no problem with an omitted variable since the test was failed to reject the null hypothesis. Prob> F is 0.0811% which is greater than 5%, thus the model has no omitted variables.

Test for normality distribution of error terms: The below result shows that the Prob>chi2=0.5333 which is greater than 0.05 and implies that the error term follows a normal distribution. So we fail to reject the null hypothesis which says the error term follows a normal distribution.

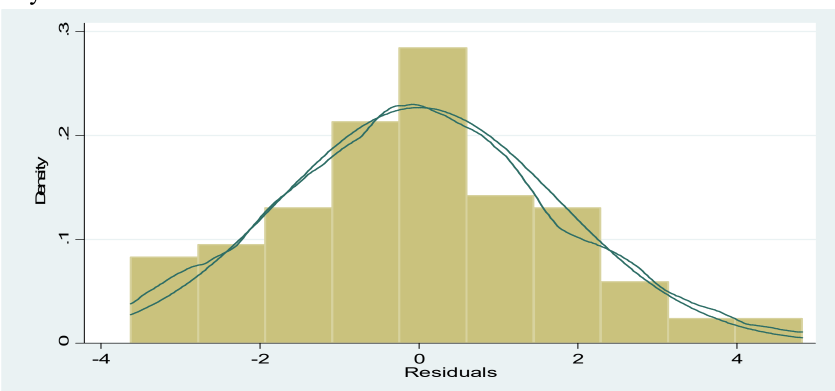

Figure 1: Source; STATA12 from own survey, 2019

3.3 Results of the regression analysis

This section presents the findings from the econometric results on the determinants of maize productivity. Table (13), below shows that coefficient, standard errors, t-values, and p-values for explanatory variables and R-square, adjuster R-square, standard error of the regression, F-statistics, prob (F-statistics) for the regression, and a number of observations included in the study are presented.

Table 13: Estimation results of regression analysis

Variable	Robust Coefficient	Std. Err	T	P>│z│	[95% Conf. Interval]	
SX	7.326117***	1.099123	6.60	0.000	5.142183	9.510052
FL	2.77091***	0.56898	4.88	0.000	1.64654	3.907642
FER	0.0538989***	0.0084595	6.37	0.000	0.03709	0.0707078
EDU	0.3689722	0.128298	2.88	0.005	0.1140469	0.6238976
AGE	- 0.0252927	0.0182698	- 1.38	0.170	-0.06615944	0.11009
CR	0.545916	0.6759926	0.81	0.421	0.7971914	1.889175
PO	2.758202	0.9684767	2.85	0.005	0.8338599	4.682545
FAC	-3.103979	0.7614797	-4.08	0.000	- 4.617023	1.590936
AS	0.3965278	0.999378	1.98	0.050	0.0007444	0.7938
OX	0.9047396	0.249131	3.63	0.000	0.4097222	1.399757
Cons	13.02052	1.448872	8.99	0.000	10.14164	15.8994
	Number of obs = 100			R – squared = - 0.9885		
	F(10, 89) 763.14			Adjested R square = 0.9872		
	Prob 0.000			**P < 0.01, **P < 0.05 and * P <0.10		

Source: own computation based on data (2019). Inferential statistics (such as chi-square and t-tests) were employed to provide further insights into factors affecting households' adoption decisions.

From the above table (13), the R-square and adjusted R-square of the model is 0.9885 and 0.9870 respectively. The total variation in the dependent variable that can be explained by the independent variable is 98.85%. In this model, 98.85% of the performance of the explanatory variable in this model explained the variation of the dependent variable, and the remaining 1.15% is explained by other variables not included in the model. Thus these variables collectively have good explanatory variables of maize productivity in the Oromia region, particularly in Gudeya Bila woreda. The null hypothesis of F. statistic (the overall test of significance of the model) that the R^2 is equal to zero is rejected at a 1% level of significance as the p-value was sufficiently low. F value of 0.000 indicates strong statistical significance, which enhanced the reliability and validity of the model.

LnCCP= 13.07+7.31 imsd+2.779fams+0.54fe+0.3689edu+0.395fs+0.3689age-3.10acidity+0.544cr+0.905ox+2.76pop
S = (1.448) (1.099) (0.568) (0.0084) (0.128) (0.199) (0.018) (0.761) (0.676) (0.025) (0.968)

The Improved seed: The regression result shows that improved seeds are positively influenced agricultural production and productivity. The elasticity or responsiveness of yield concerning improved seed is 7.31. This shows that other things remain constant, as the use of improved seed increases by one kilogram, the yield of smallholder farmers increases by 73.1%. The improved seed was positively significant at 1% the level.

The farm size: The regression result shows that the smallholder farm size positively influences maize output. The elasticity or responsiveness of output concerning farm size is 2.78. This shows that other things remain constant, as a one-hectare change in land size, leads to on average about a 27.8% increase in the maize output of farmers. It is statistically significant at a 1 percent level of significance.

The Fertilizer: The coefficient of fertilizers was found to be positively significant at a 1% level of significance. This shows that other things are constant, as the use of a one-kilogram increase in fertilizer use will lead to a 5% increase in maize output.

The number of Oxen: The coefficient of oxen was found to be positively significant at a 5% level. This means that when the numbers of oxen increase by one output of farmers will increase by 9% other things remain constant. In most parts of Ethiopia, farmers use oxen for plowing land. As result, it needs many numbers of oxen to tillage lands again and again. Therefore maize production and several oxen have direct relationships.

The education: The coefficient of education was found to be positively significant at the 5% level. This means that as the year of schooling increases by one year, farmers' maize productivity increases by 3.7% other things remain constant.

The farmland acidity: The coefficient of farmland acidity was found to be negatively significant 1% level and the coefficient is 3.1. This means that as the land of farmers is acidic, maize productivity decrease by 30.1% than farmers whose land is nonacidic, other things remain constant.

The price of output: The responsiveness of maize productivity concerning maize price is 2.762. This shows that other things remain constant, a 1 unit(birr) change in or increase in the price of maize leads to, the productivity of maize increase by 27.62%. As farmers get a fair price for their output farmers' work incentive to increase and their work effort also increase that leading to increasing maize productivity. The other is that as farmers get fair prices for their products they can buy different inputs that can increase their productivity.

4. Conclusions and Recommendations

Agriculture is the main economic activity in Ethiopia like in many developing countries. Even though agriculture is the backbone of their economy, it has not been able to satisfy the food requirements of their people. In line with this, the main objective of this study is to examine the performance and determinants of maize production and productivity in the case of the Gudeya bila district. To examine this problem cross-sectional data was collected. The paper has employed both descriptive and econometrics statistics to analyze the stated objectives. The descriptive result shows the socio-economic, institutional, and demographic characteristics of respondents by using percentages. For econometric analysis, the ordinary least square model was employed to identify the determinants of maize productivity in five randomly selected Kebeles in the GudeyaBila district. The dependent variable was being maize productivity which was regressed against the ten explanatory variables. The study found that the independent variables like an improved seed, farm size, fertilizer, education, credit, price of output, number of oxen, and family size were positively affecting the productivity of the maize in the study area. Whereas the variables age and acidity were negatively affected the productivity in the study area. From the explanatory variables improved seed, farm size, and fertilizer, positively and significantly affect productivity at 1%, while, education and number of oxen at 5% and price of output and family size at 10% level of significance. Generally, the sample respondents were asked to mention the major problem that faced farmers' agricultural input supply, and the research concluded that the availability of inputs such as improved seed, fertilizer, and nonacidic farm, were important for expanding the maize crop productivity in the study area.

This deals with some recommendations drawn based on the results of the study in which the smallholder farmers of districts and the government should focus to promote maize productivity. Modern agricultural inputs such as fertilizer, and improved seeds are more effective to increase maize output when they are combined with other complementary inputs. Thus, the government should facilitate the supply of these agricultural inputs. Government should have to improve the marketing system of the area because most of the smallholder farmers in the study area complain that their maize output price is not fair, hence this will reduce their work effort that leading to a reduction in maize output. As soil acidity affects plant growth by reducing nutrient availability such as calcium and magnesium supply and uptake of phosphorous as well due to its fixation. The government thus should provide lime to farmers as liming soil acidity, particularly on maize has the principal contribution of improving crop responses to fertilizers by improving nutrient availability. In this study, the education is statistically significant, as the research strongly believes education increases the productivity of the cereal crops, and the significance of the education in the study area for maize and other cereal crop production should be more encouraged by the government and the community should be aware of the importance of education. Credit facilities are an integral part of agricultural development, by which people can buy different agricultural inputs. Thus government should have to provide farmers with to access credit services and follow its purpose means what farmers do with this credit.

References

Abdullahi, A. (2012). Comparative Economic Analysis of Rice Production by Adopters and Non-Adopters of improved varieties among farmers in Paikoro Local Government Area of Niger State. Nigerian Journal of Basic and Applied Science.

Ajah J. I and Nmadu J. N. (2012). Farmers' Perception Of Problems Influencing Maize Storage In Abuja, Nigeria. Journal of Applied Agricultural Research 5(2): 89-94.

Asfaw, A., Lemenih, M., Kassa, H. and Ewnetu, Z. (2013). Importance, Determinants and Gender Dimensions of Forest Income in Eastern Highlands of Ethiopia: The Case of Communities around Jelo Afromontane Forest. Forest Policy and Economics, 28, 1-7.

Belay, K. and Degnet, A. (2004). *Challenges Facing Agricultural Extension Agents: A Case Study from South-western Ethiopia. African Development Bank, Blackwell Publishing Ltd, Oxford, UK.*

Endrias, G., Ayalneh, B., Belay, K. and Eyasu, E. (2012). Technical Efficiency of Small Holder Maize Producers in Ethiopia: The Case of Wolaita and Gamo Gofa Zones; EEA, Hawassa Chapter.

FAO. (2012). The State of Food Insecurity in the World. Economic growth is necessary but not sufficient to accelerate the reduction of hunger and malnutrition. FAO, Rome, Italy.

Gujarati. (2004). *Basic Econometrics. 4th Ed. The Mcgraw−Hill Companies. 1003p.*

Hailu, B. (2008). Adoption of Improved Teff and Wheat Production Technologies in Crop and Livestock Mixed Systems in Northern and Western Shewa Zones of Ethiopia. University of Pretoria, Pretoria.

JAMES H. STOCK and Mark W. Watson. (2003). Forecasting Output and Inflation: The Role of Asset Price. Journal of Economic Literature Vol. XLI (September 2003) pp. 788-829.

Oladeebo, J. O. (2004). Resource-Use Efficiency of Small and Large Scale Farmer in South-Western Nigeria: Implication for Food Security. International Journal of Food and Agricultural Research 1 (12) 227-235.

Rashid, S., and S. Lemma. (2010). Strategic Grain Reserve in Ethiopia: Institutional Design and Operational Performance. IFPRI Discussion Paper 1054. Washington, D.C.: International Food Policy Research

Institute.
Saari, S. (2011). Production and Productivity as Sources of Well-being. MIDO OY.
World Bank. (2008). *Agriculture Development Report 2008: Agriculture for Development.The World Bank. Washington, DC, USA.*