The Effect of Farmers Education on Farm Productivity: Evidence from Small-Scale Maize Producing Farmers in North Bench District, Bench Maji Zone

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ABSTRACT

The objective of this study is to examine the effect of farmer education on farm productivity. Cross-sectional data has been collected from 200 maize producing farmers. Descriptive statistics and Cobb-Douglas production function model was used. The main finding of the study is higher education contributes to high productivity. Thus, formal schooling opens the mind of farmers in adoption of new farm technology, non-formal education propose farmer to better method of farming, and informal education maintain the farmer on changing ideas each other. Therefore, to increase their productivity the farmers should be required skills and knowledge in modern farming and be able to know the use of modern farm inputs.

Keyword: Cobb-Douglas production function model, Education, productivity
Introduction

Background of the Study

In developing countries, agricultural growth is important for poverty reduction because most of people derive their livelihood from agricultural production. Thus, the means of making better agricultural production widely acknowledged as the main strategy for poverty escaping poverty trap (Otsuka and Larson, 2013). Sumner (2012), note that Sub Saharan regions accounts for approximately 26 percent of 1.2 billion people in extreme poverty who live on less than $1.25 per day and 83 percent of the population who are extremely poor in SSA survive in rural areas. Moreover, the severe problem is productivity is not significantly increased over the decades and its output has not kept speed with population growth (Teklewold, H., et al, 2013). On the face of it, improving the agricultural technology as a means of increasing farm productivity seems a crucial strategy.

According to Ani (2007), improving the farmer’s ability for rising agricultural productivity is a prerequisite for social and economic development for rural areas. This is because agriculture forms the bedrock of economic activities in the rural area. Obviously, development, food security and poverty mitigation will not be truly achieved without rapid agricultural growth in developing country. Assisting the rural poor to enhance their livelihoods and food security in a sustainable manner is therefore a great challenge. Broadly put, increases in agricultural productivity are central to growth, income distribution, improved food security and alleviation of poverty in rural Africa (FAO, 2002).

Schult (1961) and Becker (1962) have been the main advocates of human capital as determinant of economic growth. Schultz identified the accumulation of human capital as the main factor clearing up the difference between growth and accumulation of physical capital. According to his view, human capital is the capital good whose value depends on five main categories of investments in human beings: 1) Health, including nutrition, 2) migration, enhancing job opportunities, 3) on the Job training, 4) formal education, 5) study programs for adults, such as extension service in agriculture.

Education has been recognized to be a leading device for shaping people’s life and making life important, even at adult age. It makes sense that there exist a positive relationship between education and human continued existence (Ani, 2007). Therefore, education becomes an appropriate way for agricultural development process and productivity of farmers. The farmer’s ability to deal with the disequilibria induced by technological differences over time improves with education (Luh, 2009).

Hanushek, et al., (2007) point out three mechanisms through which education may affect economic growth. First, education can increase the human capital (quality of labor) of the labor force, increasing labor productivity and thus transitional growth toward a higher equilibrium level of output (augmented neoclassical growth theories) (Mankiew, et al., 1992). Second, education can increase the innovative capacity of the economy, which encourages economic growth (endogenous growth model) (Romar, P, 1990), and (Aghion, P and Peter Hiwitt, 1998)). Third, education can make possible the diffusion and transmission of knowledge needed to understand and process new information, which again promotes economic growth, (Nelson, R and Phelps, E, 1966) and (Benhabib, J and Spiegal, M, 1994).

Highest agricultural productivity depends primarily on the education of the rural farmers to understand and accept the complex scientific changes that are difficult for the uneducated rural farmer. Hence, we cannot increase the productivity of the rural farmer without the provision of adult education (Onwubuya, E., 2005). Education may enhance farm productivity directly by improving the quality of labour, by increasing the ability to adjust to disequilibria through its effect upon the adoption of innovations and in a rapidly changing technological or economic environment.
Thus, as educational level of farmers increases, the output increases having highest yields in agricultural productivity. Extension service is one of the non-formal educations that have greater impact on farmer productivity. non-formal education gives the farmer better skills on that they train for particular task and better methods of farming, as well as offer them for innovation, ideas and permits the farmers to share experience with each other (Oduro, et al., 2014). Agricultural extension service have been recognized as a complementary input for increasing farm productivity and it is connect the gap between the level of available technology and the technology adopted by farmers (Adhikari, 2016).

Asfaw & Admassie (2004) study notes those Ethiopian farmers have faced frequently varying input and output price under the new government. In addition, erratic weather, pests and crop disease all contribute to an environment in which farmers must adapt frequently in order to survive. As a result, there may be an efficiency advantage for farmers who are better prepared to predict and cope with disequilibria. Thus, even in the absence of innovation, farm productivity may be enhanced by investments in education. Since farming methods in Ethiopia are largely traditional, there appears to be little economic justification for Ethiopian farm households to invest in education. However, new, higher yield crop varieties are available in some areas, and some farmers in many areas have adopted certain modern inputs, primarily chemical fertilizers. As technological innovations spread more widely within the country, the importance of formal schooling to farm production ought to become more apparent.

In the perspective of north bench district, most of the farmers were illiterate and there is low participation rate of farmers in education. The various interrelationships between education (schooing), and farms productivity in North Bench district is not well known because of there is no empirical studies that have been conducted in this direction. This trend can be attributed to the qualitative nature of most of the human capital variables that affect agricultural farm productivity. This paper aim is to identify the benefits of formal schooling and non-formal education on agricultural productivity of small-scale rural maize producing farmers in North Bench district, Bench Maji Zone.

Problem statement
An improvement in farm human capital through farmer education is important for enhancing farm productivity. In order to increase productivity there is a need of knowledge and skill of farmers in farm production. Moreover, it is better to the farmers when they produce with modern and improved technology. Therefore, in this regarded the farmers education plays a greater role by providing them skill and knowledge about their production. Therefore, Investing in human capital is necessary for raising farm productivity, which is a key to the improvement of living standards of farmers. However, in North Bench district most of the farmers were not attend the formal schooling as well as low attention to extension workers. More than 94.3 % of the population who lives in rural areas, their livelihood depends on agricultural product (Agricultural & Natural resource office of district, 2017). Production in North Bench District is distinguished by low yield as well as returns to farm labor and lands are low. This low level of productivity is arising due to several factors, among which the small size of farm-holdings, use of traditional farming system and low educational level and training. Thus, to identify the direction of human capital that will important for increasing farmer’s productivities, it is significantly essential to investigate the effect of farmer’s education on the farm productivity in the North Bench District.
So far, the relationship among farm productivity, and education and extension training is not well known because of there are no empirical studies that have been conducted in this way. In addition, there is little evidence in the area to suggest that the agriculture sector’s low
education level is what affects its contribution to GDP. Thus, this study aims that to identify the possible benefits of schooling for households engaged in agricultural production and to quantify the effects of education on productivity of maize-producing farmers in North Bench District, Bench Maji Zone.

**Objective of the study**

The overall objective of study is to examine the effect of farmer education on farm productivity of small-scale maize producing farmers in North Bench District, Bench Maji zone.

The specific objectives of the study include:

- To analyze factor affecting agricultural productivity of maize production in the study area;
- To estimate the impact of education and agricultural extension service on farmers productivity in the study area;
- To identify the possible benefit of formal and non-formal education for farm productivity in study area;
- To provide recommendation that will inform policy on the relationship between farmer education and farm productivity.

**Related reviewed literature**

**Education and Economic growth.**

Education is widely believed as an important role in economic growth. At aggregate level, there are strong theoretical reasons for linking the expansion of education to higher rates of economic growth. Solow(1956), argue that changes in national income are determined by changes in country’s stock of physical and human capital. The new economic growth theories that are discover by Romer (1986) and Lucas ( 1988) confirm the human development that deriving force of all economic growth is people. In that theory increasing productivity is not in an exogenous factor but in endogenous, those related to the behavior of people responsible for accumulation of productive and knowledge. According to Panin (1999) the human capital model shows how education allows the whole production process to benefit from positive externalities. Educated people use capital more efficiently, so it turns into more productive. They are more likely to innovate, thus, to develop a new and better form of production. Moreover, they spread the benefit to their co-workers. Who learn from them are become more productive. Thus, raising the level of education can rise in the efficiencies of all factor of production (Panin, 1999).There is long run relationship between education and real GDP per capita (Nowak.A, 2016).

Education as an investment in human capital has been considered as a growth factor to increase labor productivity, reduce income inequality and poverty (Amin & Awung, 2005). Arrow (1973) also reports that the productivity – adding human capital theory suggested that education adds to individual productivity and that leads to increase the market value of his/her labor. Education is broadly expend as the act of acquiring knowledge, skills, values, attitudes and best practices (Asenso-Okyere,et,al, 2000). Education is also the source of technical knowhow and improvement on technical knowledge and, enhanced labor efficiency (Diwan, 1971). Economic benefit of schooling includes the potential to obtain employment or to generate income through self-employment, using skills learned in school (Knight, 2003) . According to Asenso (2000), education can be divided into two-border categories namely formal and informal education. Formal education has been recognized as the most effective way to develop the human potential. It represents that all forms of education that requires people to acquire skills through planned system or institution recognized by minister of education. Therefore, that formal education is divided as basic (primary and junior secondary), secondary, and tertiary education. Whereas, informal education largely deal with the education of adults or people not through the means that are rigid and do not follow formal class room education end in the award of
certificate or degrees. To a large degree, informal means of education are aimed at making people either functionally literate or enable them acquire some skill or vocation. There are different informal education such as Adult education (non-formal education), artisanal training (apprenticeship), and extension education (Asenso-Okyere, et al, 2000).

Weir (1999) point out that formal schooling not important only after new technologies have been adopted but education may also helps farmers to decide early adopter of innovation and the extent to which innovation will be used. There are at least three reasons for this event. First, those with schooling tend to be more prosperous and less in danger of starvation even if a potential innovation is unsuccessful. Second, educated farmers may be more likely to be contact by agricultural extension workers looking for model farmers to test innovations. Finally, literate farmers are better ability to acquire information about possible innovation and make rational progress of the risks involved in trying new inputs, crops or methods.

Understanding the impact of education on economic performance of a country requires taking in to account the specific institutional arrangement that comprise the structure of incentives and restriction at a certain moment. Education can encourage economic growth if it imitate positively on the individual income and the economy productivity (Marius. C, 2013). Future growth and social welfare will depend on knowledge intensive industries and services. Human capital is factor of production accumulated by the individual through education and it is causes the higher production (Dumciuvienė, 2015).

Education, particularly primary and lower secondary education contributes to poverty reduction by increasing the productivity of the poor labor (Lockheed., et., 1980; Moock, 1994; Philips, 1994; Villaume, 1977; world bank ,1995). As stated by Singh., et., al.,( 1986), education should result in an economies growing demand for flexible workers who can willingly to acquire new skills to support the sustained expansion of knowledge in the nation. In addition, higher education contributes to self-sustaining growth through the impact of graduates on the spread of knowledge (Becker, 1964). Workers that are more educated can know to deal more effectively with rapidly changing environments (Schultz, 1971, 1975; Mincer, 1974; World Bank 1991). Moreover, schooling may speed the modification in use of new technologies (Huffman W. E., 1974). Most empirical studies Lockheed, Jamison and Lau, 1980; Moock, 1981; Philips, 1994; Weir, 1999) on the impact of farmer’s education on farm productivity have recognized that primary education is very important in increasing productivity.

Education has also been identified as a driver of improved demographic and health outcomes, contributing to decreases in infant mortality and fertility over the second half of the 20th and early 21st centuries (Gakidou, 2010) , and (Barro, 2015). Education plays a central and significant role in economic growth. The higher is the quality of the education, the greater impact of education on the economic growth (Sylvie. K, 2017). According to the World Bank (2001), education is central to its strategies for helping the counters’ to reduce poverty and improves their living standard through sustainable growth and investment in people.

Education directly affects the economic growth insofar as it is essential to improve human capital. An economy’s production capacity depends on different factors. These include physical capital, technology and the numbers of workers, as well as their quality. This quality is largely determined by human capital (the stock of knowledge, skills and habit). Thus, an increase in the workers educational level improves in their human capital and increasing the productivity of this workers and the economy’s output (Canals, 2017). The primary device through which to increase human capital is education.
There are two different perspectives on education: one perspective views education as human capital development for economic growth and the other views it as a mechanism for social quality (Byrd, 2016). Human capital is like any other type of capital that can be invested in education and training to enhance benefits for an improvement in the quality and level of production. Therefore, human capital is most important factor in economic growth and social change (Todaro, 2015). The tertiary education is important for growth in countries above the certain technology level which themselves are innovation producers whereas lower level of education are important for countries which can only copy and imitate technological leaders (Ljungberg, J., & Nilsson, A., 2009).

**Effect of Education on farmers productivity**

Agricultural education is the type of education that leads to achievement of practical skills and assist farmers in obtaining and developing skills that would be ultimately transferred to job opportunity in the society (Odoro, O., 2015). The productive value of education has two main effects on agriculture: “worker effect” and “allocative effect” (Welch, F, 1970). Worker effect means the farmers with more education are produce more output from a given level of input. It is seen as increased output per a unit change in education keeping all other factors constant. Hence, worker effect means additional output gain from a unit change in the education. Whereas, with allocative effect, a worker is able to acquire information about cost and characteristics of input and interpret the information to make decision that will enhance output. In his study conducted in Nepal, India (Pudasaini, 1983), discover that the allocative effect of education on productivity is more important than worker effect indicating that key way that education influences agricultural productivity is by improving the ability of farmers to take decision concerning the selection of input and combination of input for better output. He declares that there are three main ways through which education enhances agricultural productivity: Improvement in farmer’s skills, enhancement of farmers’ ability to utilize farm input, and improvement in managerial ability of the farmers.

The effect of education on agricultural productivity can also be described as cognitive and non-cognitive as point out by (Appleton, S., & Balihuta, A., 1996). A cognitive effect of education comprises basic literacy and numeracy that farmers achieve from education. Literacy enables farmers to read and understand information on inputs such as chemical fertilizers and pesticides among others. Numeracy allows for calculation of the right quantity of inputs to be combined to get the desired output. Similarly, Asadullah, M & Rahman, S, (2005) research conducted on 141 villages consisting of rice farmers with in Bangladesh, found out that schooling has positive effects on agriculture due to the skills of literacy and numeracy that give the farmers better understanding into agricultural issues. Concerning non-cognitive effects, there is a change in the attitude of farmers who attend school and this is because of discipline of formal schooling in terms of punctuality, teamwork, correctness, adhering to schedules and so on. on the other hand, non-cognitive effect on agriculture has not been widely studied and the inference of its effect on agricultural productivity are few as it is assumed that change in farmer’s behavior as a result of education make them more susceptible to new ideas and modern practices. Education influences agricultural productivity either directly or indirectly. Indirectly, with the skills derived from education, farmers are able to engage in activities in the non-farm sector that serves as alternative source of income for agricultural activities (Appleton, S., & Balihuta, A., 1996; Lele, 1999).

The better educated farmer is quicker to observe profitable new process and product since the expected payoff from innovation is likely to be greater and the risk likely to be smaller (Nelson, R & Phelps, E, 1966). Lele (1990) has observed that an improvement in farm human
capital through farmer education is essential for increasing agricultural productivity. Farmers who have acquired high education are likely to implement new technologies past than others are with low educational levels, and use inputs that make them more productive. Alene (2007) presents that effect of education on productivity enhancing is positively under improved technology. Another important point is education effect is different on technology adopters and non-adopters (Alene, 2007).

The low earning from farms are partly the result of their relatively low level of human capital endowment and partly of labor market discrimination. Therefore, Education is critical for economic growth and poverty reduction and if the nation is to achieve high productivity and incomes from small and medium scale farms and eventually alleviate poverty, then the relationship between human capital development and productivity in agriculture should be explored fully (World Bank, 1995). Education is significant input in agricultural production and important input when the firm engaged in activities that involve more complex decision-making (Gallacher, 2001). Knowledge and skills delivery could be an integral part in farmer’s capacity to generate higher growth in agricultural productivity (Betz, 2009).

The returns to education differ with the level of education and the type of education. A regards educational level, there are mixed evidence from literature as to whether primary or secondary education has most returns to agriculture but despite that it is generally agreed that returns on tertiary education is very minimal or non – existence (Appleton, S., & Balihuta, A., 1996; Asadullah, M & Rahman, S, 2005; Reimers,et.al, 2012). Lockheed., et, al., (1980), argues that primary schooling is more crucial then secondary schooling for agricultural productivity because it gives farmer basic numercy and literacy. It was relized in their reschre that an additional year of primary scooeling increase agricultural productivity by 7.4% which has supported by Appleton, S., & Balihuta, A.,( 1996) who gatherd that four years of primary schooling rasied productivity by 7% while completing primary schooling increase crop production by 13%. Pudasaini (1983) also stated that as education level increase the the rate of productivity declines hence there is diminishing marginal productivity with regards to education. However ,these statements have been opposed by recent studies conducted by Reimers & Klasen (2012) on the sample of 95 developing, who discovered that returns to secondary education exceeds that of exceed that of primary education because it is not only the ability to read and write that gives higer agricultural productivity but ability to do critical thinking in addition to application of knowldage gained. Secondary education can be side to enhance the allocative effect of education on agricultural productivity in addition to indirectly contributing to productivity by providing a means to obtain non farm income that can be used in the acquisition of inputs (weir, 1999). Education is highly correlated with productivity . Specifically, workers with formal education are more productive than those with no formal education (Jones, 2001). education affects workers’ productivity by enhancing individuals’ ability to learn from experience (Marconi, 2012).

The role of education in farm production is improve the ability to learn tecnologies and to provide the productive capacity. To accumulate expertise in techenologies is determined by the schooling of the agent that runs it (Mateos, 2017). The farmers increasing their productivity potential by developing and refining their capabilies thourgh education. The more they know about the farming, the more valuable productivity gain (Radcliffe, 2018). Agricultural Education is significantly related to agricultural output. There is statistically difference between income and output of farmers with education and without education. Therefore the farmers ‘should be encouraged to participate in adult education schemes using incentives and agricultural policy should be in cycle on the farmer education (Okpachu, A. et,al, 2014)
Methodology

Description of the Study Area

North Bench District is one from the 10 districts in Bench Maji Zone, SNNPs regional state, located in southwestern part of Ethiopia. Based on the 2007 census conducted by the central statistical agency (CSA), the District has total population of 116,892 of whom men are 579,32 and women are 58,960. The Woreda located about 537 km southwest of the Addis Ababa. It is the largest district in the zone with an area of 393km² and cultivable land of 92,165 hectar. The woreda has located a latitude and longitude of 6.91⁰-7.2⁰ N latitude & 35.53⁰-35.75⁰ E longitude, and the elevation of the district ranges between 1001–2500m.a.s.l. The agro-climatic conditions of the district are conducive for the production of various types of crops. Maize occupied the largest cultivated area out of the crops grown in the district.

Types, Sources and Methods of Data Collection

In conducting the study primary data was collected from farmers in the selected Keble in the district basically on the production level, farm size, farm inputs and equipment used, educational level, farming experience, gender, age, secondary occupation, and exposure to extension service. Semi-Structured questionnaire was administered, and an interview has conducted for selected farmers in order to collect relevant data. Furthermore, secondary data were gathered from the agricultural and natural resource office of the district in order to gather detail information on the interview questions.

Sample Size and Sampling Techniques

The respondent for this study has been selected by using multi-stage sampling methods. The first stage involves purposively selecting two Keble from thirty-one Keble in the North Bench district because in which high number of maize producing farmers were exists. In the second stage, sample size of 200 maize producing farmers was randomly selected from the selected Keble from the total population of 1553 farmers. According to Catherine Dawson (2009), the correct sample size in the study is depending
on the nature of population and the purpose of the study. Although there are no general rules, the sample size usually depends on the population to be sampled. Regarding to sample size determination for the study among different methods, the one that has developed by Carvalho (2005) is used.

Table 3.1. Sample size Determination.

<table>
<thead>
<tr>
<th>Population size</th>
<th>Sample size</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Low</td>
</tr>
<tr>
<td>51-90</td>
<td>5</td>
</tr>
<tr>
<td>91-150</td>
<td>8</td>
</tr>
<tr>
<td>151-280</td>
<td>13</td>
</tr>
<tr>
<td>281-500</td>
<td>20</td>
</tr>
<tr>
<td>501-1200</td>
<td>32</td>
</tr>
<tr>
<td>1201-3200</td>
<td>60</td>
</tr>
<tr>
<td>3201-10,000</td>
<td>80</td>
</tr>
<tr>
<td>10001-35,000</td>
<td>126</td>
</tr>
<tr>
<td>35,000-150,000</td>
<td>200</td>
</tr>
</tbody>
</table>

Source: (Carvalho, 2005).

These samples were selected from each Keble using relatively proportionate allocation in relation to the percentage of total population. The two selected Keble was Seritin, and Tissue. 896 and 657 total number of populations is maize producing farmers in Seritin and Tissue Keble respectively (Agriculture, and Rural Development office, 2018).

Table 3.2. Number of sample from each Keble.

<table>
<thead>
<tr>
<th>Name of each Keble</th>
<th>Number of total population in the Keble (maize producing farmers)</th>
<th>Covering % in sample</th>
<th>No. of sample household taken</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seritin</td>
<td>896</td>
<td>57.70%</td>
<td>115</td>
</tr>
<tr>
<td>Tissue</td>
<td>657</td>
<td>42.30%</td>
<td>85</td>
</tr>
<tr>
<td>Total</td>
<td>1553</td>
<td>100%</td>
<td>200</td>
</tr>
</tbody>
</table>

Source: From list of household heads from each, selected Keble (2017/18) and Sample size proportionately computed from the given total households of each kebele.
Method of Data Analysis

The collected data has been analyzed with STATA software. This software was used to generate correlation coefficients, cross tabulation of variables, frequencies, and tables to show clearly findings identified. Descriptive statistics and econometric models were used to analyze the data collected from households.

Descriptive Method

Descriptive statistics, such as means, percentage and frequency counts, and standard deviation on the socio-economic characteristics of the respondent such as gender, age, year of formal education, farming experience, secondary occupation were used in the study. The results were then interpreted by writing description about the quantitative data. The information collected from open-ended questions was analyzed using narrative techniques.

Empirical Model

The study has employs the traditional Cobb-Douglas production function model based on the agricultural productivity as the dependent variable. The literature available on the various theories used to explain the effect of education on the farm productivity has mostly focus on the theory of the firm where education is built-in with Cobb-Douglas production function (Weir, 1999; Lockheed et.al, 1980; Edwin, 2001; Oduro, 2015; Murhi, 2017). Most of the study using the Cobb-Douglas production function approach state that the functional form of Cobb-Douglas model is assumes homogeneity, unitary elasticity of substitition between input and output. And also it is among the best well known production function utilized in applied production and productivity analysis. OLS regression analysis is used to determine the factors that critically infulance the productivity by specifying the model with education and without education of the farmers as input of the production in this study. The literature on the the effect of education on agricultural productivity is divided in to two camps: frontier versus non-frontier (direct method) for estimating the production function. This study uses non-frontier technique to estimate the coefficient on years of schooling in a Modified Cobb-Douglas (C-D) production function. The study estimates only the “worker effect” of education. Estimating the “allocative effect” was not possible because of in measuring the allocative effect of schooling, the dependent variable must be total farm output aggregated over at least two crops, since no account is taken of allocation of inputs across competing uses in the case of only one output (weir, 1999). Thus, the study focuses only on one crop what we call maize product The worker effect of schooling refers to the increase in farm output that is due to the direct change of education, holding other inputs constant ( Chaudhri, 1979; Welch 1970).

By considering all this, to measure the worker effect of schooling, Cobb-Douglas production functions by taking the semi-log linear form used as the follows:-

\[
\ln Y_i = \beta_0 + \beta_1 \ln L_i + \beta_2 \ln N_i + \beta_3 \ln F_i + \beta_4 \ln OX_i + \gamma E_i + \phi \sum Z_i + \alpha \sum X_i + \epsilon_i
\]  

(3.1)

Where, \( \ln Y_i \) is the natural logarithm of farm yields’ in maize production for household \( i \);

\( \ln L_i \) is the natural logarithm of available cultivable land for household \( i \);

\( \ln N_i \) is the natural logarithm of the number of adult household members who work on the farm in household \( i \);

\( \ln F_i \) is the natural logarithm of the quantity of fertilizer used by household \( i \);

\( \ln OX_i \) is the natural logarithm of the number of bulls and oxen owned by household \( i \); \( E_i \) is a variable(s) representing education for household \( i \); \( Z_i \) is other household characteristics of household \( i \); \( X_i \) is other farm characteristics such as land quality for household \( i \) and \( \epsilon_i \) is a stochastic error term.

Definitions of variables and hypothesis setting

Hypothesized variables expected to influence maize productivity in the study area are explained in the following way:
Dependent variable:

Level of maize yields: It is a continuous variable, which represents dependent variable; the amount of maize actually produced by household in the year 2017/18, which is measured in quintals of maize per hectare.

Independent Variables
The following explanatory variables were hypothesized to influence the productivity of maize producing farmers.

Land under cultivation of maize product (Li):
This variable is a continuous variable measured in terms of a number of hectares allocated to Maize output. It implies the sum of own cultivated land, rented in land and land held through the share cropping agreement during the survey period by the household head. Those who have large farm size can expand production by exploiting economies of scale, higher input usage, tend to the traditional distribution method by adopting row planting method which is applicable for increasing productivity (Endrias, 2013). Thus, it is expected that positively affect the household level of maize productivity. This is because producers who own large land area holding can produce more than producers who own less area.

Adult Household member (Ni):
This variable is a continuous explanatory variable and refers to the number of active family labour in the household. Labour is among critical variable in influencing the decision of household in farm production (Geremew, 2012). In this study, we consider that active family members who participate on agricultural activity in household. Thus, the variable is expected that the positively effect upon the productivity of maize producing farmers. This is because maize production in the area is labour intensive, thus need high labour and in this rural area there is no market for labour or if any deficient.

Amount of Fertilizer used (Fi)
This variable is continuous measured in numbers. It is the quantity of fertilizer used in 2017/18 for Maize production by household head. The farmers who participate on the purchase of chemical fertilizer are more productive than without fertilizer (Oduro,O, 2015). Thus, Fertilizer use is normally expected to boost production and the possibility of households to engage in output markets, since it is positive effect on farm productivity.

Number of Oxen owned (OXi):
It is continues variable measured in number. It is the amount of livestock used for farming (used as capital) in rural area. Agricultural production is directly influenced by the owner ship of oxen (Beyene, 2015). Therefore, it is expected that the larger the number of oxen the household has, the more the agricultural productivity will be. This is because as the number of oxen increases the farmer’s ability to plough more land will also increase.

Education level of household head(Ei):
It is categorical variables measured in number of years of schooling. It have four categories, household with no schooling, household having one to four schooling, having five to eight schooling and household having nine to twelve schooling. The educated farmers are believed to acquire, analyze and evaluate information on different agricultural input, market opportunities that potentially could increase farm productivity than illiterate farmers (Abdurohman, 2018). Therefore, it is expected that positive relationship between education level of household and farm productivity.

Extension service:
This is dummy variable that takes a value of one if the household head has expose to extension service and zero if the household have no extension contact. Extension service brings in farmers on training and better methods of farming (Hanushek,et.al., 2007). Farmers that have frequent contact with extension Agents will have better access to information and could adopt better technology that would increase their production and productivity. Thus, it is expect that extension service is positive effect on
volume of maize productivity through its encouragement of production.

**Access to credit:**
This is a dummy variable that takes the value “1” when the household have an access to credit and “0” have no access to credit. Credit helps farmer’s worker to improve the productivity of their land. There is a need for money for to adopt new technologies such as yield increasing inputs. Input deliverance should be combined with credit provision in order to reduce the working capital constraint to adopting new inputs for farm households (Ellis, 2004). This variable is expected that influence the maize productivity positively on the assumption that access to credit improves the monetary capacity of maize producing farmers to buy modern inputs, thereby increasing production.

**Sex of the household head:** This is dummy variable that takes a value of one if the household head is male and zero if the household is female. Both men and women take part in crop production and management. The result expected that the proportion of male-headed households is quite higher than that of female-headed households in participating in maize production.

**Age of household head**
This variable is continuous variable and defined as the number of years of household head age. In this study, it is believe that as age increase farmers would obtain knowledge and experience from side to side continues learning which helps them to actively participate on maize production. Thus, in this study this variable is used as the proxy for farmer’s experience in farming of maize output.

**Environmental factor**
According to Odulaja,(1996), the environmental factors including rainfall, soil type, humidity, temperature, erosion, and vegetation, which are location specific. In this study, land fertility (overall) and nature of land (land sloping) are used to represent the environment factors. The variable land fertility is measured as one if the overall land the household possessed is fertile and zero if it is of poor fertility. Farmers who have many design of land gave the overall fertility of their land. Whereas, the nature of the land farmers owned is continues variable, and it is assumed that household with the land slope of plain have high productivity.

**Statistical and specification test**
In order to test the violation on least square estimator, the entire hypostasized explanatory variables were checked for the existence of statistical problem. There are different methods that are suggested for detecting the existence the multicolliniarity problem between the model explanatory variable. Among this methods, variance inflation- factor (VIF) techniques are the most common used and is used in the current study to detect the multi- collinarity among continuous explanatory variable (Gujarati, 2004). According to Gujarati (2004) VIF shows how the variance is inflated by the presence of multicollinarity. Mathematically, for explanatory variable \(x_i\) can be computed as

\[
\text{VIF} (x_i) = \frac{1}{1-R^2}
\]

where the \(R^2\) is the coefficient of correlation among explanatory variable.

According to Gujarati (2004), the larger the value of VIF indicates the more the colliniriaty among expalanatory. As the rule of thumb , if the VIF of the variable exceed 10 , which will happen if the \(R^2\) exceed 0.90 the variable said to highly collinear.

Alternatively, we can use the inverse of VIF \((1/\text{VIF})\) called Tolearance (TOL) as measure of multicolineraty. The closer is the TOL of one explanatory variable to zero, the greater the collinareity of that variable with other regressor. On the other hand, the TOL of \(X_i\) is closer to 1, the greater the evidence that \(X_i\) is not collinear with other regerssor (Gujarati, 2004).

The other problem is the problem of non - constant variance what we call Heteroscedasticity. The occurrence of
Heteroscedasticity causes the OLS estimator to be vague and their estimated standard error deviation is biased. Heteroscedasticity was tested in all regression estimation by performing the Breusch-pagan test to find out if the disturbance term varies systematically with one or more explanatory variable. The dependent and other independent variables were transformed into logarithmic form and OLS was used estimate the parameter coefficients. They study reports OLS based on Heteroscedasticity - consistent standard and covariance. One way of dealing with Heteroscedasticity is to use the variable that is causing the Heteroscedasticity or other greater variability with the disturbance term as a weight variable in the weighted least square (WLS) estimation. Omitted variable biased was tested by OV test. See all the result in the Annex I.

Results
To achieve the understanding on the effect farmer education on the farm productivity of small-scale farmer's, survey was conducted from 200 small-scale rural maize producing farmers in North Bench district in 2018/19. This chapter present and discuss main findings of the study from the survey. The researcher organized the analysis in to two parts: descriptive analysis part and empirical analysis parts. To empirical analysis the study, first employ the Cobb-Douglas production function to estimate the effect of input and household characteristics on the value of maize output. To achieve it second objective, educational level of household head is set up as an additional factor of production to find out the return to education in North Bench district, Bench Maji zone.

Descriptive results and demographic characteristics of farmers
This section provides the descriptive analysis on the household head of maize producing farmers in the North Bench District. The section describe the sex, farm experience in maize production, whether they had schooling before or not, land ownership, and exposure to extension service, and the utilization of chemical fertilizer and improved seed.

The result showed that the majority of the respondents were male (66 %,) while the remaining 34 % were female, this implies that majority of the farmers on maize production are males. At least 30.5 % of the surveyed farmers were above 10 years farm experience in maize production, with 38% in the group of 7-10 years farm experiences and 25% having 4-6 year experience. The small percentages i.e. 6.5% of respondents were with less than 3 years experience in maize production. It is believed that they gain experience as they stay on the farm for long. The percentage of maize producing farmers who respond as attending formal schooling was 68.5%.

31.5 % of the sampled farmers were not attending the formal school. This shows most of the maize farmer in the district were not up to basic education. Survey result indicates that 78 % of respondents own land. That means, 22 % of sample farmer did not possess their own land. The farmers who have not own land were produce by renting the land from the relatives and crop sharing with the owner of land. More than 76.5 percent of the maize producing farmers said they has farm assistance from the extension worker and only 23.5 percent of the respondent have no access to contact extension worker. The average number of contacts for all household was 1.54 times per year. This revealed that the individual based number of visits the extension agent to solve the specific problem of farmer was minimal. Extension services provide to improving the farm productivity through informal education of farmers; thus, it needs the intervention of government as well as calls for a careful look of policy makers.

Empirical result
Table 4.1 shows the data to be used in the production function estimation. Means are expressed for sub sample of observations used in the econometrics analysis. The data estimate
the relationship between farmer education and farm productivity are from the survey that is drawn from the small-scale rural maize-producing farmers in the North Bench District, Bench Maji zone. The dependent variable is the natural log the value of maize output in quintal per hectare of land under cultivation. Several of the farm variables is explained in logarithmic form such as cultivated land area under maize production, quantity of fertilizer used, number of oxen the farmers have, and adult members of household.

The land area cultivated is measured in hectare. The mean farm size for maize is 1.8 hectare. Age is used as the proxy variable for farm experience. Land quality and slope are the proxy of the environmental factor. The education of the maize producing farmers in North Bench district is very low. The average year of schooling of the household head of the maize producing farmers in the district is 5.13. This mean value indicate that the farmers sampled has been less than primary education on average. Different level of schooling has different effect up on the productivity, a set of dummy variables representing different level of schooling is used as measure of education in other specification of the estimated functions. The coefficient on the dummy variable 0-1 represents the percentage increase in output due to having that level of schooling, as compared with that of no schooling and others level completed.

Table 4.1. Variable definition and its mean value

<table>
<thead>
<tr>
<th>Variable name</th>
<th>Definition</th>
<th>Mean</th>
<th>Std.err</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dependent variable:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ln- maize yields</td>
<td>natural log of value of maize (per hectare)</td>
<td>1.63</td>
<td>0.03</td>
</tr>
<tr>
<td><strong>Farm and household variable:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ln- Li</td>
<td>Natural log cultivated land area under maize production</td>
<td>0.5</td>
<td>0.04</td>
</tr>
<tr>
<td>Ln Ni</td>
<td>Natural log of adult member of household</td>
<td>0.65</td>
<td>0.031</td>
</tr>
<tr>
<td>Ln Fi</td>
<td>Natural log of the amount of fertilizer used</td>
<td>0.64</td>
<td>0.035</td>
</tr>
<tr>
<td>Ln oxi</td>
<td>Natural log of number of oxen household have</td>
<td>0.7</td>
<td>0.02</td>
</tr>
<tr>
<td>Nature of land</td>
<td>Slop of land for the production of maize</td>
<td>1.99</td>
<td>0.08</td>
</tr>
<tr>
<td>Age- HHH</td>
<td>Age of household (years)</td>
<td>37.5</td>
<td>0.05</td>
</tr>
<tr>
<td>Fertility of land</td>
<td>Dummy 1 if the land is fertile</td>
<td>0.44</td>
<td>0.035</td>
</tr>
<tr>
<td>Sex</td>
<td>Dummy: 1 if the household head is male</td>
<td>0.72</td>
<td>0.03</td>
</tr>
<tr>
<td>Secondary occupation</td>
<td>Dummy: 1 if the household head is primly farmers</td>
<td>1.75</td>
<td>0.04</td>
</tr>
<tr>
<td>Credit access</td>
<td>Dummy: 1 if the household have credit access</td>
<td>0.4</td>
<td>0.35</td>
</tr>
<tr>
<td><strong>Education variable:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Edu-HHH-F</td>
<td>Years of schooling of household head- farmers</td>
<td>5.13</td>
<td>0.07</td>
</tr>
<tr>
<td>Edupri</td>
<td>Dummy: 1 if household head has 1 to 4 schooling</td>
<td>0.38</td>
<td>0.034</td>
</tr>
<tr>
<td>Edumid</td>
<td>Dummy: 1 if household head has 5 to 8 schooling</td>
<td>0.16</td>
<td>0.026</td>
</tr>
<tr>
<td>Edusec</td>
<td>Dummy: 1 if household head has 9 to 12 schooling</td>
<td>0.14</td>
<td>0.024</td>
</tr>
</tbody>
</table>
Effect of farmer education on farm productivity

This section focuses on the effect of farmer education on the farm productivity. We used education as input of production in our regression, thus the regression is with education variable. The OLS regression and weighted least square estimation were used for the analysis. The weighted least square estimation in table 4.2 revealed that better results with respect to F- statistics, $R^2$ and significance level of estimated coefficient as compare with OLS regression.

The estimation in table 4.2 show that the formal year of schooling attended by household head of maize producing farmers as input of maize production and extension service dummy 1-0 as well as learn from relatives, which represents non formal education and informal schooling. Educational accomplishment variables may now introduced to consider the effect on the farm productivity.

The output elasticity of land size, credit access, number of oxen, nature of land, and sex dummy is positive and statistically insignificant effect at up on the productivity whereas adult household member is negative and insignificant on farm productivity if the specified the regression include the years of schooling completed in both equation. The coefficient on the adult household member is rejecting the null hypothesis, this is may be because of those adult members are not devoting their time to support their family or they have may be with another occupation.

The household composition variable age of the household head has positive and significant effect on the maize output in both OLS and WLS at 5% and 1% level of significance respectively. Age is proxy of experience of farmers in this analysis. Thus, the older farmers are more experienced in producing maize than the younger farmer. When the age of the farmers increase by one the farmer’s productivity was increase by 0.05%, keeping other thing remain constant.

The usage of fertilizer is positive and significant effect on the maize output at 1% level of significance on OLS regression. One percent increases in the use of modern chemical fertilizer increases the output of maize by 0.17 percent keeping other variable remaining constant. Similarly, the output elasticity of fertilizer is positive (0.19%) and significant at 1% level of significance on WLS estimation.

The environmental factors land fertility is positive and significant effect at 5 % level of significance on both equations. The result revealed that a one unit improvement in the land quality increase the maize productivity by 0.066%.

<table>
<thead>
<tr>
<th>Variable</th>
<th>OLS coefficient</th>
<th>t-ratio</th>
<th>WLS estimation</th>
<th>t-ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>0.577</td>
<td>2.82</td>
<td>-0.680</td>
<td>-0.31</td>
</tr>
<tr>
<td>Ln- Li</td>
<td>0.053</td>
<td>1.14</td>
<td>0.048</td>
<td>0.24</td>
</tr>
</tbody>
</table>

Source: survey results, 2018/19
Estimated coefficient of formal years of schooling completed by household head farmers is positive; hence, the return to schooling is positively related with the farmer productivity. The worker effect of schooling is measured by the coefficient on schooling where all other input is included. The worker effect of an additional year of schooling of household head farmer is positive and statistically significant in both OLS and WLS. The OLS estimation that are reported with the t-statistics based on Heteroscedasticity – consistent standard error, had a much lower coefficient of 1 to 4 years of schooling completed by household head. As shown in the table 4.2. above the result indicate that maize farm productivity increase by 0.17% when household head farmers completed the 1 to 4 schooling as contrast with the farmers who had not attend any schooling, keeping other thing remain constant. Estimated coefficient of 1 to 4 schooling is positive and statistically significant effect upon maize output at 5% level of significance. Effect of education dummy variable for maize farmers with 5 to 8 schooling is positive and statistically significant effect at 1% level of significance. The result reveled that maize farmers who had completed the 5 to 8 schooling were more productive and output per hectare increase by 0.32% then the no schooling maize farmers. The effect of education dummy variable 9 to 12 schooling completed is positive and significant effect up on the maize output at 1% level of significance. Maize productivity of farmers is increase by 0.47% when the household head completed 9 to 12 schooling as contrasted to farmers who had not attend the formal schooling with keeping other variable remain constant. In WLS estimation, estimated coefficient of education dummy variable for maize farmers with all formal schooling is positive and significant effect at 1% level of significance. The maize productivity is increased by 0.23% when the household head farmer completed 1 to 4 schooling as compared to one who had has no receive formal schooling with all other input remain constant. The famers who had completed 5 to 8 schooling had more productive...
and output per hectare increase by 0.30% as compare to the farmer who had no schooling. The farmers who receive 9 to 12 schooling has much more productive by 0.45% than with not schooling farmers.

In summary, farmers who completed the formal schooling have greatly enhanced their farm ability and skill to identify things differently from those with no schooling. The maize producing farmers with the primary schooling is lower productive than with secondary schooling completion. In other words, the return to secondary education is higher than primary schooling. This indicate that secondary education gives the farmers better ability to think critically and take decision that have positive effect in the face other challenges such as weather condition and insufficient funds for input, and hired labour. This opposes the finding of Kurosaki and Khan (2004), the effect of primary education on crop productivity is significant but additional gain from higher education is very small.

The overall effect of various level educations can be seen as an additional one to four schooling, five to eight schooling and nine to twelve education leads to increase productivity with secondary education. The return to farmer education is strongly positive, for each schooling stage, what we observe. More over the better-educated farmer is more likely to use the new technology and near to modernization. The finding match that the return to secondary education is higher than primary education because the ability of farmers to make better decision or choice about combination of input to obtain maximum output is with higher education (Reimers, 2012). Furthermore, other studies on the return to education, Onphanhdhala and Suruga (2007) found that an additional year of schooling would increase the productivity by 5.2%. Education has positive effect on the adoption of innovation, which has the important factor of the rural development (Okpachu, 2013). Non-formal education will take in concern extension service and adult literacy class. The effect of adult literacy on agricultural productivity cannot be examined because adult literacy classes were not available on selected sample Keble in the district. The focus of this section is only on extension service. It is widely accepted that agricultural extension service plays a crucial role for productivity progress. They are crucial for facilitating the spreading of new agricultural technology, their learning and adoption by farmers. According to the farmers, some of the service delivered includes the provision of knowledge on: line planting, pests and disease control, farm management, fertilizer application, harvesting, good farming practice, how to save, and provision of inputs. The OLS coefficient shows extension service is positive and insignificant effect on maize productivity. Farm productivity is increased by 0.04 percent when the farmer has extension service contact than where there is no extension contact. In equation two, the extension service is positive and significant effect at 10% level of significances. This result suggest that the farmers require counseling and other service to actively participation on the production of the maize, thus the farmers who live near to extension service center are more probable to participate in the production of maize, other thing remain constant. This result is in line with the finding of Elias et al., (2015) extension service is the influencing factor in order to enhance the farmer’s productivity and it increases the farmer’s ability to adopt the new technology as well as modernization.

Informal education used in this study describes the "locality effect" of education whereby farmers split ideas among each other related to their production. Due to the traditional nature of the farm technology in rural Ethiopia, most of the farmers in district were acquire the new technology from their relatives as well as learning by doing. The base of the researcher to account learn from relatives is based on participation of farmers in farm based group. The other variable that is learning by doing is accounted based on their participation on the
field learning. The lower coverage of extension service supplied in the district contributes to the increase in distribution of knowledge among the farmers because that is the voluntarily available source of knowledge in the area. Actually, the negative coefficient on the dummy learn from relatives indicates that the farmers who focus more on the relative were less productive. Whereas, the positive coefficient of learning by doing in both equation indicates the farmers who spend their more time to field learning farm method may have more likely to produce than who have not on the field learning. Thus, farmers in the area raise their productivity with the practice of field learning with high yield maize output. Farmers in north bench district copy their neighbors in deciding to adopt new technology. This evidence suggests that if educated farmers are more likely to adopt modern techniques, uneducated neighbors may imitate from them. This imply that, along with own farm education, the education of neighboring farmers and field learning should enter in to household head farm production. The current finding is consistence with the finding of Odouori et.al. (2015) due to the lower exposure of extension service the farmers share their knowledge on how to control pests and diseases, type and quality seeds to use for planting, farming practice, harvesting, and marketing among each other’s.

**Percentage gain per year of education.**

The study computed the percentage increase in output value for one additional year of education of farmers. The percentage increase is obtained by computing the ratio of the output value when the level of education is \( \frac{1}{2} \) years greater than \( E \), to the value when it is \( \frac{1}{2} \) less, subtracting one and multiplying by 100. The percentage increase in output is estimated by using the formula in equation 4.1

\[
\%\, \text{increase \ in \ output} = \left( e^{\frac{a}{N}} - 1 \right) \times 100
\]

Where, \( a \) is the estimated coefficient of education, \( e \) is the natural exponential, \( N \) is the years of education in the level specified by the dummy variable indicator.

The effect of one year additional schooling is 4.87 percent when the farmer attends 1 to 4 schooling. Similarly, 9.33 % and 15% change in output when the household attend 5 to 8 and 9 to 12 schooling. See the result in annex III.

\(^2\)The result in equation 4.1 is approving from the method developed by Lockheed., et, al (1980). Using their method of computing the percentage increase in output due to an adding one extra year of schooling by calculating the ratio of cereal crop production when education is 0.5 year higher than average to cereal crop production when education is 0.5 year below average education.

**Conclusion and Recommendation**

**Conclusion**

The educational level of agricultural farmers has an influence on agricultural productivity. Education can be improving the quality of farmer labour by enabling them to produce more with their available stock of production factors. Moreover, it can help farmers to choose way that is more effective to production by adopting new technology and increase the efficiency of the resource allocation. Thus, more rapid the flow of new input, the greater will be the productivity disparity associated with additional education.

In order to understand the effect of farmer education on the farm productivity, this study estimated and quantifies the contribution of formal schooling attended, exposure to extension service, and learns from relatives on the maize productivity of farmers. Cobb-Douglas production function has specified with education variable as input of production. Due to Heteroskedasticity problem, the study employs the weighted least squares method in estimation this is because the Heteroskedasticity causes the OLS estimator inefficient. However, the OLS estimation results are reported after the transformation.

The maize farmer’s education as measured by the formal years of schooling completed by the household head had significant and positive
effect on the farm productivity. The farmers who schooling the 1 to 4 education has lower productive then 5 to 8 schooling, similarly, 5 to 8 schooling farmers were low productive than 9 to 12 schooling farmers. The result exposed that the additional year of schooling causes high productivity. Thus, education contributes to agriculture not only direct effect rather through the input selection and allocation. The education improves the farmer’s ability, enabling them to select improved inputs and optimally allot existing and new inputs among competing uses. On the other hand, it enhances their decision-making ability manly by increasing their ability to allocate the existing farm resources. Educated farmer were use more improved inputs and carry out the large-scale operation than their counterpart. This suggests that the education contributes more to productivity in modernizing agriculture then in traditional agriculture. However, this does not mean that the traditional farmer fail to use education in production process, rather that education has a higher payoff in modernizing agriculture because it work together with larger quantities of other inputs and bigger farm operation in such agriculture than traditional one. Thus, education is the key factors that determine agricultural production in adopting inputs in general and management ability in particular.

**Recommendation**

Maize is one of the important crops in agricultural sector of Ethiopia. However, smallholder farmer dominates the production of maize. Therefore, to promote and encourage smallholder farmers in the production of maize needs a number of improvements. Based up on the finding of the study, the following point need to be considered as possible recommendations:

- Inclusion of education at the core of rural development and food security agenda focusing on expanding access to education and improving school attendance of farmers in the districts, and finding the appropriate ways to integrate agriculture in the basic education curriculum.
- Government investment in agriculture should be guide towards the provision of better extension service. The minister of agriculture should transfer more extension agents to the districts and provide them with motor bicycle to facilitate easy movement among the Keble’s. In addition, various farmers also confused to utilize the extension service offered; hence, extension agents should be trained to practice evidence based teaching. Moreover, the individual in the communities who are appreciated and agreed by the communities members can be trained and used as monitor to farmers accordingly they can be link the farmers and extension agents.
- Sampled farmers complained about the continues increase in the price of fertilizer and the low access to credit in the district. Thus, providing the access to credit and subsidize the fertilizer to unable farmers’ is one of the possible solutions. This is because the fertilizer and credit are the key factor in influencing the farmer’s decision to participate on maize production.
- Focus on the way by which knowledge of farmers can be improved. The way through which this can be done is through adult literacy classes. In addition, the non-formal section of the education director can be train basic schoolteachers and other literacy in the district to grasp the classes and tech the illiterates. The minister of agriculture should consider the subsidization of inputs and equipment used for agricultural reason. Moreover, the district chief leader should make the roads leading to farming areas are frequently graded and bridge built over the river to enable easy movement of product from the farm to the markets.
- It is suitable to conclude that the farmers can achieve productivity if the farmers with certain level of education are assisted to increase their efficiency in production. Thus to increase their productivity the farmers in district should have required skills and knowledge in modern farming method and be
able to know simple instruction on the use of modern farm inputs.

Reference


42. okpachu, a. et al. (2014). The impact of education on agricultural productivity of small scale rural female maize farmers in potiskum. *International Journal of Research in Agriculture and Food Sciences*.


https://escipub.com/american-journal-of-design/
ANNEX I: Tests for Multicollinearity and Model specification

<table>
<thead>
<tr>
<th>Variable</th>
<th>VIF</th>
<th>1/VIF</th>
</tr>
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<tbody>
<tr>
<td>lnL1</td>
<td>1.72</td>
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<tr>
<td>lnFi</td>
<td>1.55</td>
<td>0.64502</td>
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<td>Education</td>
<td>1.39</td>
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<td>lnOXi</td>
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<td>lnNi</td>
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<td>Age</td>
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<tr>
<td>natureofland</td>
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<tr>
<td>Mean VIF</td>
<td>1.29</td>
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</tr>
</tbody>
</table>

a. Multicollinearity Model specification

Annex II: Econometrics results

Table 4.1. Variable definition and its mean value

<table>
<thead>
<tr>
<th>Variable name</th>
<th>Definition</th>
<th>Mean</th>
<th>Std.err</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dependent variable:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ln- maize yields</td>
<td>Natural log of value of maize (per hectare)</td>
<td>1.63</td>
<td>0.03</td>
</tr>
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<td>Natural log of adult member of household</td>
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<td>Natural log of the amount of fertilizer used</td>
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<td>0.035</td>
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<td>Ln oxi</td>
<td>Natural log of number of oxen household have</td>
<td>0.7</td>
<td>0.02</td>
</tr>
<tr>
<td>Nature of land</td>
<td>Slope of land for the production of maize</td>
<td>1.99</td>
<td>0.08</td>
</tr>
<tr>
<td>Age- HHH</td>
<td>Age of household (years)</td>
<td>37.5</td>
<td>0.05</td>
</tr>
<tr>
<td>Fertility of land</td>
<td>Dummy 1 if the land is fertile</td>
<td>0.44</td>
<td>0.035</td>
</tr>
<tr>
<td>Sex</td>
<td>Dummy: 1 if the household head is male</td>
<td>0.72</td>
<td>0.03</td>
</tr>
<tr>
<td>Secondary occupation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Credit access</td>
<td>Dummy: 1 if the household have credit access</td>
<td>0.4</td>
<td>0.35</td>
</tr>
<tr>
<td>Education variable:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Edu-HHH-F</td>
<td>Years of schooling of household head- farmers</td>
<td>5.13</td>
<td>0.07</td>
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<td>Dummy: 1 if household head has 1 to 4 schooling</td>
<td>0.38</td>
<td>0.034</td>
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<td>Dummy: 1 if household head has 5 to 8 schooling</td>
<td>0.16</td>
<td>0.026</td>
</tr>
<tr>
<td>Edusec</td>
<td>Dummy: 1 if household head has 9 to 12 schooling</td>
<td>0.14</td>
<td>0.024</td>
</tr>
<tr>
<td>Extservi</td>
<td>Dummy: 1 if the household head has extension contact</td>
<td>0.32</td>
<td>0.033</td>
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<td>Larnrelatives</td>
<td>Dummy: 1 if the household head has learn from relatives</td>
<td>0.8</td>
<td>0.02</td>
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</tbody>
</table>
Source: survey results, 2018/19

OLS regression

<table>
<thead>
<tr>
<th>Educational variable</th>
<th>Percentage increase in output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary (1 to 4 schooling)</td>
<td>4.87</td>
</tr>
<tr>
<td>Middle (5 to 8 schooling)</td>
<td>9.33</td>
</tr>
<tr>
<td>Secondary (9 to 12 schooling)</td>
<td>15</td>
</tr>
</tbody>
</table>

Source: author computation from survey (2018/19), using the formula developed by Lockheed (1980)

- Result is based on equation 4.1

WLS estimation

Annex III

Table 4.3. The percentage increase in output related with an extra year of schooling of household head farmer.