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Factors that affecting the Level of Technical efficiency of Haricot Bean Producing for Smallholder Farmers in Bosat district, East Shoa Zone, Oromia National Regional State, Ethiopia

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Haricot bean is one of the most important pulse crop and it is considered as the main cash crop and the least expensive source of protein for the farmers in Ethiopia, but its production and productivity is low. So this study aimed to analyze the level of technical efficiency by smallholder farmers in Boset district of Oromia National state of Ethiopia. Three stage sampling technique was employed to select 149 sample farmers who were interviewed using a structured questionnaire and cross sectional data collected in 2018/2019 production year. Both primary and secondary data were used for this study. Cobb-Douglas stochastic frontier with a one-step approach used to estimate levels of the technical efficiency. The maximum likelihood parameter estimates showed that haricot bean output was positive and significantly influenced by land, NPSB fertilizer, oxen and labor in man-days. The mean technical efficiency of farmers in the production of haricot bean was 81.4%. This showed that there exists a possibility to increase the level of haricot bean output by 18.6% through efficiently utilizing the existing resources. Hence, the government should provide necessary the attention of policy makers to improve agricultural production should not revolve solely around the introduction and dissemination of new technology to increase yield, but also more attention should be given to improve the existing level of efficiency.

Key words: Haricot-bean, Stochastic-Frontier, Technical Efficiency.

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INTRODUCTION

Agriculture is a dominant sector of the Ethiopian economy, which makes a great share contribution to the Gross Domestic Product (GDP), employment and foreign exchange earnings. The importance of agriculture in Ethiopia is evidenced by its share in GDP (40%), employment generation (85%), the share of export (77%) (EATA, 2017). Ethiopia is known as the homeland of several crop plants. It is ranked 13th among pulse producing countries in the World (FAO, 2015). So, pulse crops are important components of crop production in Ethiopia smallholder's agriculture, providing an economic advantage to small farm holders as an alternative source of protein and other nutrients, cash income that seeks to address food security (Alemneh *et al*., 2017).In addition, they have been used for many years in crop rotation practices, since they have the capacity to improve the fertility status of the soil through biological nitrogen fixation (Derese, 2012). Pulses had cultivated and consumed in large quantities in Ethiopia for many years and also it covered about 12.61% (1.6 million hectares(ha)) of the grain crop area and 9.73% to production (about 29.8 million quintals(qt) in 2017/18 production season (CSA, 2018).

Among pulse crop the current productivity level of haricot bean falls significantly below the demonstrated potential. The current national, regional and zonal productivity of haricot bean was (17, 18.3 and 16.6) qt/ha respectively (CSA, 2018). This implies that the productivity of haricot bean in East Shoa was below the average productivity of the country and the region. Moreover, the productivity of haricot bean in the study area was 13.5qt/ha (BDANRO, 2018) which is below the average productivity of haricot bean in Ethiopia (17 qt/ha), Oromia (18.3 qt/ha and East Shoa (16.6qt/ha). This shows the existence of inefficiency in the study area.

Kusse *et al*. (2018) conducted the study to analyze the technical efficiency of sorghum production by smallholder farmers in Konso district, Southern Ethiopia. The study used stochastic production frontier model. The estimated stochastic production frontier model indicated that input variables such as land size, fertilizer (urea and dap), human labor, oxen power and chemicals (herbicides or pesticides) found to be important factors in increasing the level of sorghum output in the study area. The result further revealed significant differences in technical efficiency among sorghum producers in the study area. The discrepancy ratio, which measures the relative deviation of output from the frontier level due to inefficiency, was about 90%. The estimated mean levels of technical efficiency of the sample households were about 69%, which shows the existence of a possibility to increase the level of sorghum output by about 31% by efficient use of the existing resources. Among the household specific socio-economic and institutional factors hypothesized to affect the level of technical inefficiency, age, education level, family size, off/non-farm activities, extension contact, livestock holding, plots distance and soil fertility status were found to be significant in determining the level of technical inefficiency of sorghum production in the study area

Another study Getachow (2018) done on the technical efficiency of barley production of smallholder farmers in the meket district, Amhara National State, Ethiopia. The trans-log functional form of the production function simultaneously with the single stage estimation approach was used to estimate the production of barley output and technical inefficiency factors. The estimated mean levels of technical efficiency of the sample farmers were about 70.9%, which revealed that, the presence of a room to increase their technical efficiency level on average by 29.1% with the existing resources. So, additional study was important to fulfill the information gap in this area. Therefore, the objective of the study is to measure the level of technical efficiency of haricot bean producing farmers in the study area.

METHODOLOGY

Description of Study Area

This study was conducted at Boset district, East Shoa Zone, Oromia National Regional State, Ethiopia. The district is located at 125 km from the capital city of Ethiopia, Addis Ababa and 25 km away from Adama (East Shoa zone) in east direction. It also located between the coordinates 8039'59.99'' N latitude and 39029'59.99'' E longitude and at an altitude range of 900-1500 m.a.s.l (meter above sea level). The minimum and maximum annual rainfall of the area is 750 and 850 mm respectively. On the other hand the minimum and maximum temperature is 11℃ and 27℃ respectively. The dominant soil types in the district are Andosols, Fluvisols, Combisols and Luvisols. The total area coverage of the district is 151,406 ha. Out of this 28.7% (43,457 ha 39,668.53) is cultivated land, 30% (45421.98) is pasture land, 6.33% (23,922.24) forest and the remaining 3.57 %(42,393.86) is bare land or uncultivated. Boset is bordered on the north east by Minjar shonkara of Amara regional national state, on East by Fantale,on the South East by Jegu distict of Arsi zone, on the West Adama district. For the administrative purpose the district has 11 urban and 33 rural kebeles source from Boset district Administrative office (BDAO, 2018).

Boset district has total household number 22,170 of this 18,999 men headed households and 3,171 are women headed households. The estimated total population of the district is 217,132 of this 118,676 were men and 98,456 were women while the population density of the districtwas1.02 persons per km^2 (BDAO, 2018). The major crops grown in thedistrict are *teff*, haricot bean, maize, and sorghum. The area coverage of haricot bean is 8152ha with production of 110,052 qt which is produced by10, 986 farmers in 2018/19 production year. The number of livestock in the study areawere;cattle(24,346), sheep(64,833),goat (189,516),Horses (1050), Mules (253), camels (28980), poultries (110,307) and honey bee colonies (475) Source from Boset District Livestock and Fish Development Office (BDLFDO, 2018).

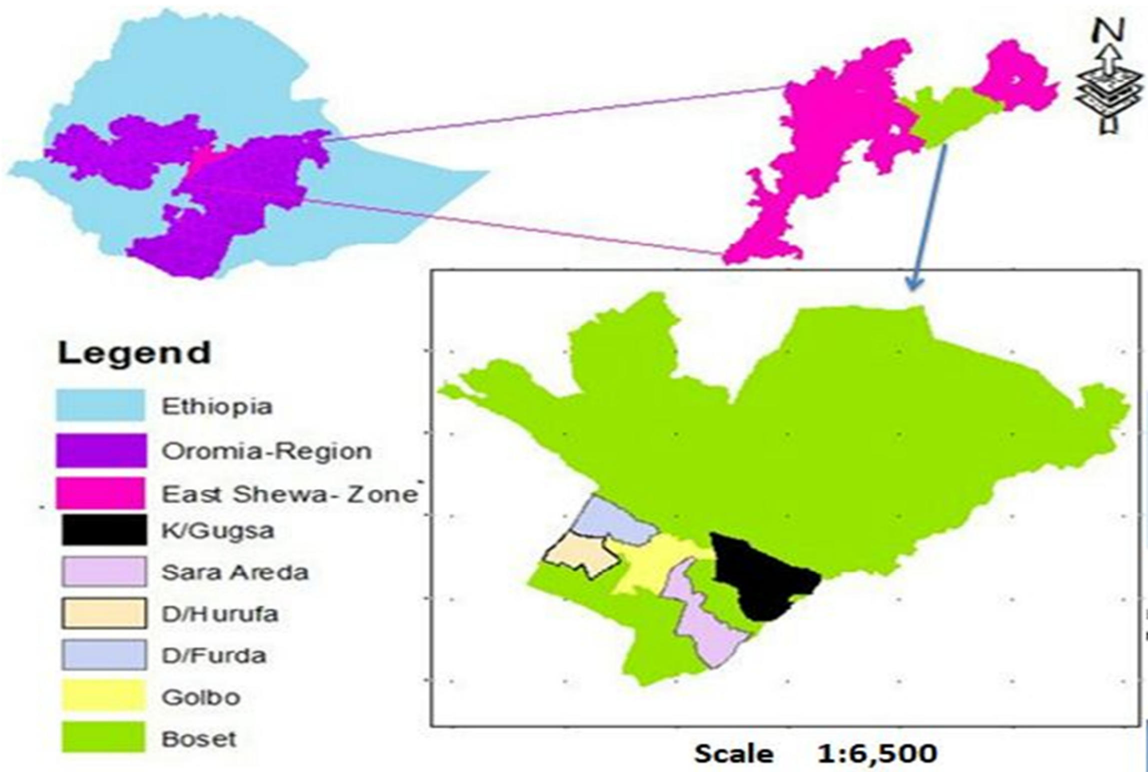

Figure 1: Map of the study area
Source: GIS (2019)

Data Source, Types and Methods of Data Collection

Source of Data

Primary data were collected from 2018/19 production year using personally administered structured questionnaires and through observation method. The data included information on haricot bean farming operations such as: type, amount and source of inputs, input utilization and cost of inputs (input prices), farm and off-farm activities, access to credit and extension system etc. were collected from the respondents. In general, household demographic, socioeconomic, and institutional and farm characteristics was collected from the respondents. Data was gathered from secondary data, that is, existing scholarly literatures from journals, research papers, websites, books and reports. The data included: measurement of efficiency and Stochastic frontier or, formerly studied research findings on technical efficiency, country's statistical report, different research reports on haricot bean strategic plans, promotion brochures, crop variety register etc. In this study both primary data and secondary data were used. The primary data was collected for the 2018/19 production year through interviewing individual farm households by using structured questionnaires and well-trained enumerators.

Sampling Techniques and Sample Size Determination

For this study, three stage sampling techniques were applied in order to select sample households. In the first stage, out of 33 rural kebeles administration in Boset district 12 haricot bean producing kebeles were purposively selected. In the second stage, out of 12*kebeles,* five kebeles were selected randomly. In the third stage, 149 sample haricot bean producing farmers were selected from the total households of five kebeles by using simple random sampling technique based on probability proportional to size based on the list of the name of households obtained from the kebele development agent office those grew haricot bean during 2018/2019 production year. The population is homogeneous in the agro ecology and production system, sothe sample size was computed according to the following formula developed by Yamane (1967).

$$n = \frac{N}{1+N(e^2)} = \frac{3425}{1+3425((0.08)^2)} = 149 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 1$$

Where: n is sample size; N is the total number of haricot bean producers in the sampled *kebeles* (3425) and e is the desired level of precision. By taking e as 8%, because of limit of financial, time and difficulty to manage large sample size.

Table 1: Number of sample farmers selected per each kebele

Name of selected *kebeles*	Total producers	The Proportion of sampled household	Number of HH Selected
Dongore Hurufa	780	0.23	34
Dongore Furda	670	0.19	29
Golbo	710	0.21	31
Sara Arada	650	0.19	28
Konbe Gugsa	615	0.18	27
Total	3425	1	149

Source: BDANRO and own computation (2019)

Methods of Data Analysis

Descriptive statistics

Descriptive statistics include means or averages, frequency distributions, percentages, standard deviations along with the minimum and maximum was used in analyzing the socioeconomic characteristics of the farmers, input and output variables and problems encountered by Haricot bean farmers in the study area. In sum, it is used to present a detailed summary of net farm income, output and input variables involved in the frontier production function for individual farmers.

Econometric analysis

Model specification for TE measurement

The stochastic frontier functional approach requires a priori specification of the production function to estimate the level of efficiency. Among the possible algebraic forms, Cobb-Douglas and trans- log functions were the most popularly used models in the most empirical studies of agricultural production analysis. Some researcher argues that Cobb-Douglas functional form has advantages over the other functional forms in that it provides a comparison between adequate fit of the data and computational feasibility. It is also convenient in interpreting elasticity of production and it is very parsimonious with respect to degrees of freedom and it is convenient in interpreting elasticity of production.

In addition, the Cobb-Douglas production function is attractive due to its simplicity and because of the logarithmic nature of the production function that makes econometric estimation of the parameters a simple matter. Translog production function is more complicated to estimate the parameters having serious estimation problems. One of the estimation problems is as the number of variable inputs increases, the number of parameters to be estimated increases rapidly. Another problem is the additional terms require cross products of input variables, thus making a serious multicollinearity problem (Coelli, 1995). Furthermore, the majority of empirical studies done on TE in Ethiopia analyzed using Cobb-Douglas frontier function (Beyan *et al*. 2013; Solomon, 2014; Asafa, 2016; Ahimad *et al*., 2018, Kusse *et al.,* 2018 and Mogos, 2018).This study also tested whether to employ Cobb-Douglas or Translog production functional form and the test result revealed that, Cobb-Douglas production functional form best fits the data.

Thus, Cobb-Douglas frontier function was specified as follows:

$$Y_i = AX_1{}^{\beta 1}X_2{}^{\beta 2}..X_n^{\beta n} \quad \ldots\ldots\ldots 2$$

The linear form of Cobb-Douglas production functions for this study defined as:

$$\ln(Y_i) = \beta o + \sum_{i=1}^{5} \beta_i\, lnX_i + \varepsilon_i \ldots\ldots\ldots 3$$

$$lnY_i = \beta_o + \beta_1 lnX_1 + \beta_2 lnX_2 + \beta_3 lnX_3 + \beta_4 lnX_4 + \beta_5 lnX_5 + \varepsilon_i \ldots\ldots\ldots 4$$

Where: *Ln is* represents natural logarithm, the subscript i represents ith sampled farmer; $Y_i$is amount of haricot bean produced for ith farmers expressed in qt per year; $X_1$is land allocated to Haricot bean production (ha) by a given household;$X_2$is human labor used by a given household in haricot bean production (man days);$X_3$is total amount of Nitrogen Phosphors sulfur Boron(NPSB)fertilizers applied in haricot bean by a household in kg;$X_4$is amount of haricot bean seed sown on ploughed area measured in kg;$X_5$is the total number of oxen power used for haricot bean production in oxen day;$\beta_o$is interception; $\beta_1 - \beta_5$are parameters to be estimated and represents elasticity of production and $\epsilon_i$is the error term of the model consisting of two components Vi and $U_{i.}$

$$\varepsilon_i = Vi - Ui, Ui > 0 \ldots\ldots\ldots 5$$

V_i is a symmetric error term that captures deviations of actual production from the frontier because of favorable or unfavorable factors beyond the control of the producers such as drought, weather, luck, measurement error. The frontier production function is said to be stochastic because of this error term and producers can produce beyond the frontier when the value of V_i is positive and large U_i shows the inefficiency of farmers from factors under their control such as technical and economic inefficiency, the will and effort of the farmers, and possibility of defective and damaged products. Accordingly, individual farmer technical efficiency is predicted from estimated stochastic production frontiers. The measure of production efficiency relative to the production frontier is the ratio of the observed output to the corresponding maximum output given the available technology and it is defined as:

$$TE = \frac{Y_i}{Y_i^*} = \exp(-U_i) \ldots\ldots\ldots 6$$

Where:TE is technical efficiency ofithhousehold in haricot bean production;Y_i isthe actual output of ithhousehold in haricot bean production and Yi* is the frontier output of ithhousehold in haricot bean production and takes the value with in interval (0, 1) and 1 indicates a fully efficient farm.

Definition of Variables and Hypothesis

Dependent variables

Output: It is defined as the actual quantity of haricot bean produced and measured in qt during the 2018/19 production year by sample households. This is a dependent variable of the production function taken as a continuous variable.

Independent variables

Input: Defined as the total inputs used by sample household in the production of haricot bean in 2018/19 production year. These refer to explanatory variables (independents) that were used in the estimation of production function taken as a continuous variable.

Quantity of seed used (X1): It is the total amount of haricot bean seed applied during 2018/19 production season measured in kilogram. Seed is one of the most and important factor of production. The quantity of seed applied has a positive and significant influence on haricot bean yield, which indicates that the higher seed rate would result in high haricot bean yield except where there is overcrowding leading to competition of available nutrients that is consequently lead to lower yields (Hassen *et al*., 2015).The application of seed is hypothesized to have a positive effect on haricot bean yield.

Fertilizer (X2): It is the quantity of chemical fertilizer (NPSB) applied in a given production season measured in kilogram. The application of chemical fertilizer had a positive influence on productivity, which depicts that farmers who apply higher rates of chemical fertilizer receive higher yields (Endrias *et al*., 2013). The variable was expected to have a positive effect on haricot bean production.

Land (X3): It is the area of land devoted to haricot bean production by sampled household during 2018/2019 which is measured in ha. The size of land allocated for a given crop has an influence on the total output of that crop. The land plays an important role in farming because it has a positive and significant influence on haricot bean yield indicating that an increase in one ha of land can result in an increase in the total production of haricot bean (Tamirat, 2017). In this study, the variable was expected to have a positive effect on haricot bean output.

Labor (X4): This represents the total labor (family, exchange and hired) utilized in various farm activities (plough, sowing and fertilizer application, weeding, harvesting and threshing).Thus, labor inputs for major activities were converted into man-equivalent. The man-equivalent was computed by taking into account the age and sex of the laborer and using standard conversion factor reported by Strock *et al*. (1991) as indicated in Appendix Table 1. Then the total man-equivalent used by each sample farmer was included in the production function by converting into man-days. It was measured in man-days (MDs) where eight hours is equivalent to one man-day. In this study it was hypothesized to influence haricot bean output positively.

Oxen power (Z5): It is a total amount of oxen power used by the i^{th} household from land preparation up to sowing. Given small-scale farmers and less mechanized farming practice in the study area, oxen power is among major inputs of production. Hence, oxen power were measured using the total amount of oxen days allocated for ploughing activities of haricot bean production in 2018/19 year. It is a continuous variable whichis measured in pair of oxen per day (one pair oxen-day is equivalent to eight working hours). In this study the variable was hypothesized to have a positive effect on haricot bean output.

RESULTS AND DISCUSSIONS

Descriptive Results

Major crops grown by sampled household.

The major crops grown in the sampled *kebeles* are maize*,* haricot bean, sorghum and *teff*. The sample households, on average, allocated 0.77ha, 0.75ha, 0.125ha and 0.14 ha for maize, haricot bean, sorghum and *teff* in 2018/19 production year (Table 2).Among these crops, haricot bean was the second dominant crop in terms of area coverage. It accounted for 42% of total cultivated land.

Table 2: Farm allocation for different crops (ha) by sample household farmers

Variable	Mean	Std. Dev.	Min	Max	Total area	Percent
Haricot bean	0.75	0.51	0.12	2.5	111.75	42
Maize	0.77	0.52	0.13	2.56	114.41	43
Teff	0.12	0.08	0.02	0.42	18.62	7
Sorghum	0.14	0.09	0.02	0.48	21.28	8

Source: Own survey (2019)

Econometric Results

Selection of functional form and hypotheses tested

The attractive feature of Stochastic Production Function (SPF) model is that, it is possible to test various hypotheses using maximum likelihood ratio test, which were not possible in non-parametric models Accordingly three hypotheses were tested, to select thecorrect functional form for the given data set, for the existence of inefficiency and for variables that explain the difference in efficiency (Greene, 2003).

The first null hypothesis tested was, test for the selection of the appropriate functional form for the data; Cobb-Douglas versus Translog production function. In order to choose between the two alternative functional forms that can better fit to the survey data collected, the null hypothesis that all the interaction and square terms are all equal to zero (H_0:β_{ij}= 0), *i.e.* Cobb-Douglas frontier functional specification, is tested against the alternative hypothesis that these coefficients are different from zero (H_1: $\beta_{ij}\neq$ 0). The test was made based on the value of likelihood ratio (LR) statistics, which can be computed from the log likelihood value obtained from estimation of Cobb-Douglas and Translog functional specifications using equation (6). Then, this computed value is compared with the upper 10% critical value of the $\chi 2$ at the degree of freedom(df) equals to the difference between the numbers of explanatory variables used in the two functional forms (in this case df = 15). For the haricot bean producer respondents, the estimated log likelihood values of the Cobb-Douglas and Translog production functions were -25.414 and -11.307, respectively.

The computed values LR = -2 [(-25.414) – (-11.307)] =27.9and compared with the critical value of χ^2 at the 10 % level of significance with fifteen df which was 30.58. Therefore, since the calculated value of LR statistic is less than the critical value of χ^2 the null hypothesis was failed to reject indicating that the best functional form for the data was Cobb-Douglas production function which shows the nonexistence of interaction effect of input variables used in the production function.

After the appropriate production function is selected, the next step is a test for adequacy of representing the data using SPF over the traditional mean response function which is Ordinary Least Square (OLS). This hypothesis was tested using the generalized likelihood ratio test based on the log likelihood function under OLS estimation and final maximum likelihood estimation. This null hypothesis also used to test for the existence of the inefficiency component of the composed error term of the Stochastic Frontier Model at one time. If the null hypothesis$H_0: \gamma = 0$ is accepted against alternative hypothesis$H_1: \gamma \neq 0$, then the SPF is identical to OLS specification indicating that there is no inefficiency problem within the haricot bean output of sampled farmers. The generalized log-likelihood ratio (LR) statistics, was used to test the validity of the SPF over the OLSmodel. Under the null hypothesis(H_0), the value of the restricted log-likelihood function for the OLS production function is -57.43, while under the alternative hypothesis(H_1), for the stochastic Cobb-Douglas function, the value of the unrestricted log likelihood function is 25.41. The generalized likelihood ratio statistics, LR= -2 [(-57.43 – (-25.41)] =64.04. The critical value of χ^2at one degree of freedom and 1% significance level is 6.63. Therefore, LR test of $\gamma = 0$ provide a statistic of 64.04 for haricot bean production; which was significantly higher than the critical value of value of χ^2 for the upper 1% at one degree of freedom (6.63). Thus, the null hypothesis was not accepted. This indicates that the SPF was an adequate representation of the data, given the corresponding OLS production function. Hence, a stochastic frontier approach best fits the data under consideration. Consequently, the null hypothesis that haricot bean producing farmers in the area were fully efficient was rejected indicating the existence of considerable inefficiency among haricot bean producing farmers in the study area.

The third null hypothesis are explored that the explanatory variables associated with inefficiency effects are all zero (Ho: $\delta_1 = \delta_2 = ... = \delta_{12} = 0$) was also tested. To test this hypothesis likewise, LR (the inefficiency effect) was calculated using the value of the Log-Likelihood function under the SPF model (a model without explanatory variables of inefficiency effects: H0) and the full frontier model (a model with explanatory variables that are supposed to determine inefficiency of each: H1). The calculated value LR = -2 (-25.414314 - 13.079) = 76.98 is greater than the critical value of 24.72 at 11 degrees of freedom. The values of LR implying that, the null hypothesis (H_0) that the explanatory variables are simultaneously equal to zero was rejected at the 1% significance level. Hence, these variables simultaneously explain the sources of efficiency differences among the sample farmers in their categories.

Table 3: Generalized likelihood-ratio test of hypotheses for parameters of SPF

Null hypotheses	LR statistic	Critical value χ2	df	Decision
H0: β_{ij}=0	27.9	30.58.	15	Accepted
H0: γ =0	64	6.63	1	Reject
H0: $U_i=\delta_0=\delta_1...=\delta_{12}=0$	76.98	24.72	11	Reject

Source: Own Survey result (2019)

Maximum likelihood estimation of parameters

Technical efficiency analysis

The maximum-likelihood estimates of parameters of the stochastic production frontier and inefficiency effect models as described with equations 5 and 6 were obtained after treating the dataset with STATA version 13.1. A stochastic production frontier model permits to consider production of haricot bean in the study area with Cobb-Douglas stochastic production was tested and found to be best to fit the data and was used to estimate efficiency of farmers and to identify factors determining the inefficiencies in farming system. Estimation of parameters was carried out with a one-stage procedure under the assumption of half-normal distribution of the error terms. This approach leads us to the final estimates of parameters of the five explanatory variables of the frontier function; and twelve explanatory variables which influence the mean efficiency of haricot bean producers.

Table 4: Maximum-likelihood estimates of the frontier model

Variable	Parameter	Coefficient	Std.error	Z-value
Cons	β_0	0.977 ***	0.383	2.54
InNPSB fertilizer	β_1	0.120 **	0.056	2.1
Lnseed	β_2	0.078	0.075	1.04
Lnland	β_3	0.688 ***	0.091	7.51
Lnoxen	β_4	0.119 **	0.048	2.45
Lnlabor	β_5	0.151 ***	0.052	2.89
$\sigma^2 = \sigma_v^2 + \sigma_u^2$		0.182	.035	
$\lambda = \sigma_u / \sigma_v$		2.179	.079	
Gamma(γ)	0.826			
Returns to scale	1.155			

&* shows significant at 5% and 1% respectively
Source: Own computation model output (2019).

The maximum-likelihood estimates of the parameters of the frontier production function presented in Table 4.All the coefficients of production function variables were positive. The result of the Cobb-Douglas stochastic production frontier showed coefficients of land and labor force were positive and significant at 1% significance level and coefficients of NPSB fertilizer and oxen power were also positive and significantly at 5% significance level. Contrary to these the coefficients of quantity of seed used was statistically insignificant but with the expected sign.

Among the total five variables considered in the production function, four (land, labor, NPSB fertilizer and oxen) had significant effect in explaining the variation in haricot bean production among farmers. One of the appealing features of the Cobb-Douglas functional form is the direct interpretation of its parametric coefficients as a partial elasticity of production with respect to the input used. This attribute allows one to evaluate the potential effects of changes in the amount of each input on the output.

The coefficient of labor availability was found to be positive and significant in the technical efficiency. The calculated coefficient of labor was 0.151 which indicate that as the labor increase by 1% output of haricot bean increase by 0.151% assuming other factors remains constant. This implies that technical efficiency increase with the increase in labor availability. Hence the farmers who had more available labor were better managers; therefore, they produced closer to their production frontier which was similar with Endrias *et al.* (2011), Wondimu and Hassen (2014) and Wudineh*et al*. (2017).

NPSB fertilizer is an important factor for haricot bean production and it is measured in terms of quantity in kg. The coefficient of NPSB fertilizer used for haricot bean has expected positive sign with an elasticity of 0.120 and is statistically significant at 5%. This implies that as NPSB fertilizer increased by 1% haricot bean output would increase by 0.120% other factors remains constant.

Oxen power also found to be an important variable for haricot bean production and was again with statistically significant at 5% level of significance. The positive coefficient shows that an increase in the number of oxen day by 1% will tend to increase haricot bean yield by 0.119%; other variable in the model remain consistent. The finding is consistent with the finding of Bekele (2013) and Fetagn (2017) who argue that presumably farmers increase oxen days per ha will increase output significantly.

Technical efficiency scores and their distribution

The main objective of this study was to measure the levels of technical efficiency of haricot bean producing farmers in Boset district. From the analysis of the survey data, the mean TE of the sampled haricot bean producer households in 2018/19 production year was 81.4 with minimum and maximum efficiency levels of about 21.4 and 99.9% with a standard deviation of 15.8% respectively. This shows that there is a wide disparity among haricot beans producer farmers in their level of technical efficiency which in turn indicates that, there exists a room for improving the existing level of haricot beans production through enhancing the level of farmers ‘technical efficiency. The mean level of technical efficiency further tells us that the level of haricot beans output of the sample respondents can be increased on average by about 18.56% if appropriate measures are taken to improve the level of efficiency of haricot beans growing farmers. In other words, there is a possibility to increase yield of haricot bean by about 18.6% using the resources at their disposal in an efficient manner without introducing any other improved (external)inputs and practices.

One way of looking at frequency distribution of the individual efficiency values is taking the mean efficiency as a milestone. According to Stevenson (1980), grouping can be done based on the relative performance of each sample farmer in relation to the mean performance level and the corresponding standard deviation. Hence, three sample farmers categorical groups can be identified as the less efficient, average and more efficient farmers based on their technical efficiency scores. In this respect, farmers are considered as averagely efficient if they were operating in the range of mean efficiency plus or minus one standard deviation, and less efficient or more efficient farmers if they used to operate below or above the average efficiency range, respectively.

Table 5: Frequency distribution of sample farmers by Efficiency groups

Variable	Mean	Std. Dev.	Min	Max
TE	0.814	0.158	0.214	0.999
Efficiency group	Score	Frequency		Percent
Less efficient	< 0.65	27		18.12
Average efficient	0.65-0.97	96		64.43
more efficient	> 0.973	26		17.45

Source: Own computation model output (2019)

As shown in Table 5 technical efficiency scores and their distribution, about 18.12% of the sample households were categorized into less efficient. On average the households in this cluster have a room to enhance their haricot bean output at least by 35%. While 64.43 % and 17.1% of the sample households were categorized into average and more efficient, respectively. This indicates that most of the sample farmers were grouped into average efficient or operate between 0.65 and 0.97 of the technical efficiency scores.

CONCLUSION AND RECOMMENDATION

The main objective of this study was measuring efficiency level of haricot bean farmers, identifying those factors which affect technical efficiency of haricot bean production in Boset district of Oromia National Regional State. Data were collected for the 2018/19 production season by interviewing a total of 149 sample haricot bean producing farmers using a structured questionnaire that encompasses question related to demographic characteristics, inputs and output, institutional and farm specific characteristics. Three-stage sampling technique was employed for selecting the respondents. Data were analyzed using both descriptive statistics and econometric model. The estimated stochastic production frontier model indicated that area of haricot bean, fertilizers, labor and oxen power were significant factors of haricot bean output. The positive coefficient of these parameters indicates that increased use of these inputs will increase the production level to a higher extent. The technical efficiency level of farmers in haricot bean production was ranging from 21.4% to 99.9%. The mean technical efficiency level of 81.6 % indicates that production can be increased by18.4% of the potential in those farmers who grow haricot bean through better use of the available resources, given the current state of technologies. The result of the study provides information and got some policy recommendations to policymakers and extension workers on how to improve farm technical efficiency of the households can be increased by 18.6% through better allocation of the available resources, especially land, NPSB fertilizers labor and oxen power. Thus, government or other concerned bodies in the developmental activities, working with the view to boost production efficiency of households in the study area should work on improving productivity of households by giving especial emphasis for significant factors of production and inefficiency.

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