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Technical Efficiency of Smallholder Faba Bean Farmers: The Case of lemu District, Oromia Regional State, Ethiopia

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ABSTRACT

This study was conducted to assess the technical efficiency of faba bean production in lemu district of Oromia region, Ethiopia. Both primary and secondary data sources were used in this study. The primary data pertaining to farm production, input usage, and socioeconomic and institutional factors were collected during 2014 cropping season through a structured questionnaire from randomly selected 181 faba bean farmers. The stochastic frontier and translog functional form with a one-step approach were employed to assess efficiency and factors affecting efficiency in faba bean production. The maximum likelihood estimates for the inefficiency parameter depicted that there is inefficiency (100%) and most farmers in the study area were not efficient suggesting that efficiency improvement is one of the possible paths for increasing agricultural production with available inputs and technology. The study finds that faba bean output responds positively to increase area planted and the use of labour .The mean technical efficiencies were found to be 69 percent for faba bean production. The result implies that it is possible to increase faba bean yield up to 31 percent through better use of existing resources and technology. The technical efficiency analysis also showed that about 60 percent of the farmers were above the average and 38 percent were below the average of mean technical efficiency. The production efficiency of faba bean farming was determined by education, livestock holding, distance to all-weather roads, distance to faba bean plot and slop negatively. Age, extension contact and family size were positively affect inefficiency of faba bean farmers. The results highlight the need for

government and private sector assistance in improving efficiency by promoting access to productive resources and ensuring better and more reliable agricultural extension services and training specific to faba bean production.

INTRODUCTION

Consequently, agriculture is the basis of the Ethiopian economy. It accounts for about 80% of the population in the rural areas derives its livelihood from agriculture; the sector accounts for 43% of national GDP; and it is the source of 70% of the country's export earnings, 80% of the labor force employment and about 70% of the raw materials for domestic industries [1].

Ethiopia's agriculture, despite its significance and the country's rich and diversified climate, altitude, soil and water resources, remains backward and undeveloped. It is characterized by low productivity, smallholder subsistence farming, and instability of production mainly related with rain fed farming and traditional and primitive production system. As a result the country has been a scene of poverty and persistent food insecurity.Although the contribution of agriculture has decreasing slowly, still it is the predominant sector of the national economy. That is why the country is following Agricultural Development-Led Industrialization (ADLI) strategy with the Government's overarching policy in response to Ethiopia's food security and agricultural productivity challenge. The strategy promotes the use of labor-intensive methods to increase output and productivity by applying chemical inputs, diversifying production, utilizing improved agricultural technologies.

Pulse crops represent an important component of agricultural food crops consumed in developing countries and are considered a vital crop for achieving food and nutritional security for both poor producers and consumers. As a matter of fact, in dietary terms, Pulse complement cereal crops as a source of protein and minerals while ergonomically they serve as rotation crop with cereals, reducing soil pathogens and supplying nitrogen to the cereal crop (Beebe, no date). In Ethiopia pulses rank second in terms of production volume and cultivated land out of the total grain production and cultivated land [2]. Pulses are produced mainly by subsistence farmers usually under rain fed condition. According to Ethiopian Statistical Agency annual report of 2014/15, the share of Pulses production was around 9.88 %. In the same period, pulses occupied around 12.74% of total cultivated area.

Efficiency is a very important factor of productivity growth, especially in developing agricultural economies where resources are meager and opportunities for developing and adopting better technologies are dwindling [3]. Such economies can benefit greatly by determining the extent to which it is possible to raise productivity or increase efficiency, at the existing resource base or technology. Each type of inefficiency is costly to a firm or production unit (e.g., a farm household), in the sense that, inefficiency causes a reduction in profit below the maximum value attainable.

Recently, Ethiopia's agricultural strategy is focusing on placing major effort to support the intensification of farm products both for domestic and export markets by small and large farms through technology development and dissemination, commercialization and linking with markets. It is assumed that productivity of smallholder farmers can be increased in short period of time by utilizing smallholders' labor, land and agricultural technologies. Because, in economics these production resources are scarce and technologies are time demanding, it might be better to think about the efficiency of smallholder farmers to boost their agricultural outputs at a given level of inputs and/or without wasting these precious resources. Efficient utilization depends on managerial ability of entrepreneurs-farmer, firm, etc. In fact, some studies have been conducted to analyze efficiency performance of farmers in Ethiopia. However, in reality it is difficult to compare the efficiency level of farmers from one study to another due to variations in choosing input variables. This necessitates the measurement of efficiency at local level using most commonly used input variables so that appropriate policy recommendations could be made. So this study attempts to assess technical efficiency of farmers and identifies the socio-economic variables affecting efficiency.

MATERIAL AND METHODS

Description of the study areathe study area was located at 60 km south west of Addis in zone of Oromia National Regional State. It is one of the most potential zones identified for faba bean production. lemu is one of the 12 districts which is located at 8.48º latitude and 38.68 º longitudes and cover an area of 59,905 km^2 altitudinal variations which ranges from an altitude of 1850 to 2900 m.a.s.l.

Data Sources and Sampling Procedure: - both primary and secondary data were used. The different inputs used in the production of faba bean in 2014/15 production year and the corresponding output as well as other agronomic data were collected from 181 selected sample households using a structured questionnaire. Primary data were also supplemented with secondary data. Information on demographic, agro-ecological conditions, institutional, social and economic information were obtained from published and unpublished sources. The data was cross-sectional and quantitative in nature; on inputs used output gained, and farm and household level characteristics.

Qualitative data on selected factors influencing productivity and efficiency of farmers was also collected from key informants.This district was purposively selected because of its high potential in faba bean production. It consist of 31 Farmer Associations out of which 27 (14 from high land and 13 from mid land) of them were engaged in faba bean production during 2014/15 cropping season. It was from these FAs that the six (three from high land and three from mid land) sampled kebeles were selected.Different literatures have shown that there are several approaches to determine the sample size. To determine the sample size, this study has been adopted a sample size determination formula of Statistical. That is a step by step approach where first an initial sample size is calculated, and then it is adjusted for the population, design effect and the response rate. Based on this, the required sample size is determined as follows:

Initial sample size

$$n_1 = \frac{z^2 \, p\hat{}(1-p\hat{})}{e^2} = 96$$

Where

z = is desired level of confidence (at 95%) = 1.96

p hat = is precision of an estimated proportion, assumed to be = 0.5 and e = is required margin of error = 0.1

2. Sample size adjusted for the size of the population (usually for small and medium)

$$n_2 = n_1 \frac{N}{N+n_1} = 97$$

Where

N = is the target population (2,610)

3. Sample size adjusted for design effect (deff> 1), assumed to be =1.76

N_3= deff*n_2 =171

4. Final sample size adjusted for response rate (r) = 95% was assumed= 181

Accordingly 49, 12, 43, 48, 13 and 16 sample farmers (a total of 181 sample farmers) were selected from ElalaSeden, KusayeBoda, Elala Wako, TahaGola, KarsaWarko and BayeGiche PAs, respectively.

Data Analysis: Before doing analysis, the collected data were entered to the computer and data cleaning was done using SPSS software. Based on the objective of the study, the data set was analyzed using descriptive statistics and econometric models. So as to capture effects of these errors, this study used stochastic frontier model. Descriptive statistics was used to describe some important characteristics of the sample farm households and draw a general picture of the study area.

It includes the application of ratios, percentages, means, and standard deviations along with the minimum and maximum values, t-test, chi-square tests and graphs in the process of comparing or presenting socioeconomic and farm level characteristics of faba bean producer farmers.

The general stochastic frontier production function for the cross-section data, which was considered in this study, is defined by

$$Y_i = exp\ (x_i;\beta + v_i - u_i) \quad \text{-----} \quad (1)$$

Where Y_i = denotes the output for the i^{th} sample farm of faba bean, X_i represents a (1 x K) vector whose values are functions of inputs and explanatory variables for the i^{th} farm, $f(x,\beta)$ is an appropriate production function like Cobb Douglas or Translog, β is the coefficient vector (K x 1) of unknown parameters to be estimated, V_is are assumed to be independent and identically distributed random errors which have normal distribution with mean zero and unknown variables

In other words, the basis of a frontier function can be illustrated with a farm using n inputs for faba bean ($X_1, X_2, \ldots, X_n$) to produce output Y of faba bean. Efficient transformation of inputs into output is characterized by the production function $f(X_i)$, which shows the maximum output obtainable from various input vectors. The stochastic frontier production function assumes the presence of technical inefficiency of production. Hence, the function is defined as:

$$Y_i = f(X_i, \beta) + \varepsilon_i \; ; \forall \; i = 1,2, - - - n_{=181} \text{ -- } 2$$

Where ε_i is the error term that is composed of two elements, that is $\varepsilon_i = V_i - U_i$.

Daniel et al;[5] and Amaza et al. [6] and the approach describes technical efficiency as the ratio of the observed output to the frontier output, that means the technical efficiency of an individual farmer or farm is defined as the ratio of observed output and the corresponding frontier output, given the state of available technology, and specified as ,

$TE = \underline{F(x_i;\beta).\exp(v_i-u_i)} = \exp(-u_i)$

$F(x_i;\beta).\exp(v_i)$

Where $F(x_i;\beta).\exp(v_i-u_i)$ is the observed output (Y) and $F(x_i\beta).\exp(v_i)$ is the frontier output (Y*). V_i is the error term permits random variations in output due to factor outside the control of the farmer like weather and diseases as well as measurement error in the in the output variable, and is assumed to be independently, identically and normal distributed with mean zero and constant variance (σ^2_v) ; i.e.~ $N(o,\sigma^2_v)$.

U_is are non-negative random variables independently and identically distributed as (σ^2_u) , i.e.,

$u_i \sim N(\mu_i, u^2_u)$, but if $u_i = 0$, the assumed distribution is half-normal. Where $\mu_i = z_i\delta$ Where

Z_{it} is a (1 x M) vector of explanatory variables associated with the technical inefficiency effects in the i^{th} time period

δ is an (M x 1) vector of unknown parameter to be estimated.For this study, the single stage maximum likelihood estimation method is used in estimating the technical efficiency levels faba bean farmers and the effect of inefficiency determinants simultaneously. This estimation procedure guarantee that the assumption of independent distribution of the inefficiency error term is not violated. The maximum likelihood estimation the stochastic frontier model yields the estimate for beta(β), sigma squared (σ^2) and gamma(γ), and are variance parameters; γ measure the total variation of observed output from its frontier output. We use the parameterization following Battese and Cora [7] and give as, $\sigma^2 = \sigma^2_{v} + \sigma^2_{u}$ and $\gamma = \sigma^2_u / (\sigma^2_v + \sigma^2_u)$, where the gamma lies between zero and one ($0 \leq \gamma \leq 1$). If the value is close to zero, then the deviations are as a result of random factors and /or if the value is very close to 1, then the deviation are as a result of inefficiency factors from the frontier. Following Aigner et al. [8], the translong production function has been used recently by many studies to estimate technical inefficiency (for Therefore, the translog production function stated below in is used for the study for its flexibility for which it places no restriction unlike the cobb-douglas production function.

$$\text{Ln } Y_{ij} = \beta_{0i} + \beta_{1LnX1ij} + \beta_2 \text{ Ln}X_{2ij} + \beta_3 \text{Ln}X_{3ij} + \beta_4 \text{Ln}X_{4ij} + \beta_5 \text{Ln}X_{5ij} + Vij - Uij$$

Where, i = 1, 2 …n =181, x= vector of five input variables the subscripts I and j refer to the i^{th}farmer and j^{th} observation respectively. Based on the above model, a stochastic frontier model for faba bean farmer is given by:

$$\text{Ln (output)}_{i} = \beta_0 + \beta_1 \ln(\text{Area}) + \beta_2 \ln(\text{seed}) + \beta_3 \ln(\text{fert}) + \beta_4 \ln(\text{lab}) + \beta_5 \ln(\text{oxndays}) + v_i + u_i$$

Hypothesis testing

In spite of the magnitude and significance of the variable performance, γ, it is important to explain the various null hypotheses employed in this study. Three hypotheses were tested to test the adequacy of the specified model used in this study, the presence of inefficiency and exogenous variables to explain inefficiency among smallholder faba bean producer (Table 1). The generalized likelihood ratio statistics was used to test the hypothesis. It is specified as:

$$LR (\lambda) = -2 [\{\ln L(H0)\} - \{\ln L(H1)\}]$$

Where L(H0) and L(H1) are the values of likelihood functions derived from restricted (null) and unrestricted (alternative) hypothesis. This has a chi-square distribution with degree of freedom equal to the difference between the number of estimated parameters under H_1 and $H_{0.}$ Yet, where the test involves a γ, then the mixed chi-square distribution is used. The H_0 is rejected when the estimated chi-square is greater than the critical (Table 1). The result of the hypothesis tested is presented in the result discussion section of this study.

Table 1 hypothesis taste

Restrictions	Description
1. H0: $\beta ij = 0$ H1: $\beta ij \neq 0$	Coefficient of the second-order variables in the traslog model are zero (Cobb-Douglas) Coefficients of the second-order variables in the translog model are different from zero.
2. H0: $\gamma = \delta 0 = \delta 1 =--- = \delta 15 = 0$ H1: $\gamma > 0$, $\delta i \neq 0$, i=0,1,---15	Inefficiency effects are absent from the model (all farms are fully efficient) Inefficiency effects are present in the model (all farms are not fully efficient)
3. H0: $\delta 1 =--- = \delta 15 = 0$ H1: $\delta 1 =--- = \delta 15 \neq 0$	There are no farm specific factors on technical inefficiency There are farm specific factors on technical inefficiency.

It is assumed that some farmers produce on the frontier and others do not. Therefore, the need arises to find out factors causing technical inefficiency. The technical inefficiency model has been developed for this study to concentrate on this important issue. The technical inefficiency effects model incorporates farm and farmers' specific characteristics, institutional and other environmental factors. The aforementioned variables included in the model are explained in detail below with their expected effects on technical inefficiency.

RESULTS AND DISCUSSION

Demographic and household characteristics The result of descriptive statistics like mean, minimum, maximum and standard deviation values for continuous variables; frequencies and per cents for discrete variables were discussed in this part'.

Age Age is one of the important factors which determine management experience of farmers. So it is plausible to discuss age structure of farmers within the sample. The average age of the household head was 43 year with a range of 20 to 80 years. Most of the households (67.4%) are in the range of 31 to 55(Table 2). This shows that the majority of the household heads were able to work full adult workload. Table 2.Age group of household heads

Age groups	Percent of HH heads
16-30	14.4
31-55	67.4
>55	18.2
Total	100.0

Source: Own computation (2014)

Age structure of household members also has implication on farm economy and agricultural productivity. Because availability of work force, behavior of consumption and other socioeconomic factors in the agricultural society might be determined by age. The age structures of the surveyed households member result indicate that 48.95% of the population were economically active i.e. 16 – 55 years, whereas 47.07 % were under age of 16 and 3.98% are above 55 (Table 3.). This figure shows that every economically active person in the house hold had to support more than one economically inactive person.

Household size Total number of individuals and their composition within household determine availability of labour power needed in farm production. In this study the survey result revealed that the average family size was 6.7 per household with a minimum of 1 and maximum of 14 persons and a standard deviation of 2.54. This average household size is very large as compared to average adult equivalency of 4.99. This indicates that there is highest dependency ratio. This family size coupled with small farm land size and backward production system, it will be difficult for the farmer to sustain its family. It would be difficult to send his children to school and afford health expenses. When we compare the sex of the family member, 52.5 % were male and 47.5 were female.

Table 3. Age structure of household members of the sample households

Age group	Percent
≤ 7	17.64
8 – 15	29.43
16 – 30	28.46
31 – 55	20.49
> 55	3.98
Total	100

Source: Own computation (2014)

Education Education improves managerial skills and an intention to adopt new technologies. Educated farmer is also willing to employ experimentation on his/her plots. The education level of the farm society has implication on agricultural production. Among the total 1055 family members of sample households who are above or equal to the age of 7 years, 77.44% are literate in qualitative sense as they can at least read and write and most of who learned through formal education (Table 4.). Among 181 sample household heads, 74.52% have attended formal education while 13.26% of the sample household heads are illiterate others 86.74% are literate.

Table 4.Educational status of family member (age ≥7)

Education level	Family members	Percent
Illiterate	238	22.56
Religious and Adult education	78	7.39
Primary education (1-4 grades)	330	31.28
Elementary education (5-8 grades)	272	25.78
Secondary education (9-12)	115	10.90
Higher education >12	22	2.09
Total	1055	100

Source: Own computation (2014)

Livestock productionin the study area, livestock production is source of cash next to crop production. Farmers sell poultry and ruminants in order to fulfill their immediate cash demand and rear them for home consumption. They use horses and donkeys for transportation and ox is merely their source of draught power. Animal dung is used to maintain fertility of land, as energy source for cooking and as a source of income. The average livestock holding for sample households was estimated to 8.3 TLU with a minimum value of 0 and a maximum value of 26.7 (Table 5). From a total of 181 farmers only 2.21% own no oxen and about 14.36% of farmers in the sample have a single ox. About 43.65% of them have one pair of oxen, about 11.05% of them have 3 oxen each, about 21.55% of them have two pair of oxen and the rest 7.18 % of the households have more than two pair of oxen. As long as oxen is the only source of draught power, farmers with one ox plough their land by making pair of oxen with other farmers who own only one ox. Farmers with no ox plough their farm by exchanging labour force or cash for oxen power.

Table 5.Ownership of livestock by sample farmers in the production year (2014/15)

	No	Minimum	Maximum	Mean	Std.Deviation
Cow	181	0	11	1.81	1.61
Breeding buls	181	0	4	0.52	0.85
Oxen	181	0	12	2.69	1.62

Heifer	181	0	5	0.89	0.99
Calves	181	0	14	1.15	1.40
Sheep	181	0	30	2.50	3.87
Goat	181	0	40	2.86	5.08
Poultry	181	0	40	5.43	7.25
Donkey	181	0	5	1.55	1.04
Hourse	181	0	4	0.36	0.68
Mule	181	0	1	0.07	0.25
TLU	181	0	26.70	8.27	4.05

Major crops grownA mixed crop-livestock farming system is practiced in the district. The cropping system is dominated by wheat, teff, barley, faba bean and chick pea production. Wheat production is used mainly for home consumption and commercial purpose and it is a dominant crop produced in the district. Farmers in the study area produced faba bean for different purposes.

Table 6. Purpose of faba bean production.

Parameters	Frequency	Percent
Crop income	11	6.08
Family consumption	31	17.13
Profit	6	3.31
Diversifying	8	4.42
Crop income and profit	24	13.26
Crop income and family consumption	35	19.34
Crop income, family consumption and diversifying	61	33.70
Crop income, family consumption, profit and diversifying	5	2.76

4.1.2. Plot level characteristics

Farm size Land is crucial source of agricultural production on which the livelihood of the rural Households depend. There are no communal or state farms in the study area. Pasture land and forestry are public resources. During the crop production year (2014/15), most of the sample household head (85.78%) operated on their own land (Table 7). In the production year, about 9.31% of sample farmers rented land by paying an average of 4017.68 birr/ha which ranged from 1000 up to 12,000 birr/ha. The rent varied based on fertility of and. For medium fertile soil the rental value was on average 2865.19

birr/ha and for least fertile land the rental value was on average 1960.22. Share cropping was not practiced by most farmers. From the total sample farmers, only 4.9% of them produced faba bean crop by sharing land with others.

In the study area the fertility status of land operated by sample households, 52.45% of land is categorized as highly fertile, 36.76% medium fertile and 10.78 % least fertile respectively. Farmers usually maintain the land fertility by practicing crop rotation pattern, cereals-pulse-cereals, and applying fertilizer and compost.

In the study area the sample household had an average farm size of 2.71 ha with a range of 0.38 ha to 15.75 ha with a standard deviation of 2.21 during 2014 cropping season. The average size of faba bean planted area was 0.47 ha with a standard deviation of 0.88. Plot level data was collected from 204 faba bean plots. The maximum plot area recorded was 3.75 ha. From the total 204 faba bean plots, about 85.78% of them were own plots and 9.31% of plots were rented in cash, 4.9% of the total plot area were sharecropped.

Table 7.Descriptive statistics of land holding by source and fertility (ha/household) in 2014/2015

	Frequency	Percent
Owned land	175	85.78
Rented in	19	9.31
Shared in	10	4.99
Total land	204	100
Fertility status of total land operated		
High fertile	107	52.45
Medium fertile	75	36.77
Poor in fertility	22	10.78
Total land	204	100

Use of agricultural inputs The major inputs applied in faba bean production includes oxen days for land preparation and planting, seed, labor used from land preparation to harvesting and threshing, land and fertilizers (inorganic and or manure).

It is evident from (Table 8.) that there was a wide variation in both the input use and crop yields harvested as shown by the large values of standard deviations. Such difference in the level of input use indicates that available resources were not utilized efficiently. The average number of oxen days for land preparation and planting to one hectare of faba bean was 16.47 with a small standard deviation 11.33 respectively. The quantity of seed determines population of plants in any field crops and therefore, it directly affects yield per hectare. The average quantities of seed used on faba bean farms in the study area were 205 kg/ha with standard deviations of 30.58.

LabourHuman labour required for management and production of crops and animals is supplied almost entirely by members of the household. About 79.419% of labour force required for faba bean production was provided by members of the household. Farmers also deploy hired laborer at a minimum of wage rate 20 and maximum of 100 ETB birr with average wage rate of 49 ETB birr per day during peak season of agricultural production, i.e. weeding, harvesting and threshing. There is also other type of labour resource management like labour exchange arrangements such as '*Debo'* or '*jigi*' especially during seasons where there is shortage of labor.Faba bean production involves intensive use of labor and in various farming practices like land preparation, weeding, harvesting and threshing. The average number of labor days consumed per ha for faba bean production was 92.29 man-days. In the study area most of the households used family labor, while some of them used hired labor to undertake different farm activities. In the past farmers mainly used hand weeding to control faba bean weed infestation and required more labor. The weeding frequency of the study revealed that the minimum of weeding was 0 and the maximum was 5 with an average of 1.53 and a standard deviation of 0.75 respectively.

As illustrated in Table 9, average oxen-days used in the production of faba bean was estimated at 16.47 with a range of 2.0 to 80.77 oxen days per hectare.

Table 9. Labour use for faba bean production per hectare by sample households in 2014/2015

	no	Minimum	Maximum	Mean	Stddevation
Labour (man-days)	204	10.97	344.8	90.85	67.44
Own labour	204	0.63	131.25	24.98	17.41
Hired labour	204	0	105	5.76	11.27
Oxen days	204	2.0	80.77	16.47	11.33

Seed In the study area, farmers sow both local and improved seeds. As it can be seen from table 10, about 47.06% of farmers sow improved seed of faba bean. From the total faba bean sampled farmers 50% % of them sowed local seed and 2.94% of them sow both local and improved seeds. This indicates that almost half of the sample farmers utilize improved variety. The amount of seed used per ha also has important implication on productivity. The minimum amount of seed used by sampled farmers was 100 kg per hectare and the maximum was 320 kg/ha .Farmers sow an average of 205.29 kg of faba bean per ha and this level is in the recommendation of extension package program i.e. from 200 – 300 kg depending on the seed size of the variety.

In the study area farmers accessed seeds from different sources. The main source of seed for planting faba bean was farmer's own saved seed (56.6) followed by government package (15.1%), local traders (14.1%) and others (Table 10.).

Table 10.Utilization of improved, local and source of seed by sample farmers and plots number in the production year (2014/2015)

	Frequency	Percent
Improved seed	96	47.06
Local seed	102	50.00
Improved and local seed	6	2.94
Total	204	100
Source of seed		
Own seed	116	56.6
Government package	31	15.1
Local traders	29	14.1
Agro-dealers	1	0.5
Model farmers	8	3.9
Neighbor farmers	6	2.9
Cooperatives	3	1.5
Research center	4	2.0
Market	3	1.5
Parent	1	0.5
Exchange from farmers	2	1.0

Total	204	100

Although, farmers were asked whether they grow local faba bean variety for the last five years; 86.7% of them were responding that they were grown local faba bean variety for the last five years and 13.3% of them were responding that they did not plant local faba bean variety. Similar questions also asked about the growing of improved faba bean varieties, out of 181 respondents 59.5% were responding that they grow improved faba bean varieties and 40.3% were not grow improved faba bean varieties in the study area. The improved faba bean varieties used in the study area were Degagwhich is commonly used before 1990. Then after, variety Wolki, motiand other varieties were distributed in a limited amount in the area (Table 11).

Table 11. Descriptive statistics of faba bean varieties grown in the district

Name of variety	Frequency	Percent
Degaga	63	30.9
Wolki	11	5.4
Moti	14	6.9
Gebelcho	4	2.0
Tumsa	1	0.5
Hachalu	3	1.5
CS 20 DK	2	1.0
Local faba bean	103	50.5
Improved but name not known	3	1.5
Total	204	100

Commercial inputs Faba bean is a crop enriched with protein, therefore, may correct important amino aciddeficiencies of cereals when sowed in rotation with *teff*, wheat and barley. It is grown inrotation with cereals to break cereal disease cycles and to fix atmospheric nitrogen, thusreducing the demand of other cereal crops for nitrogen fertilizers.

In the study area, the other important input used for faba bean production is inorganic fertilizer (DAP and UREA) and organic fertilizer (manure/compost). According to the findings from the group and individual (key-informant) discussions, most farmers do have demand to utilize fertilizer for production of faba bean. Most of the time, they use fertilizer if the land is low fertile or if cereals are sown subsequently without sowing any pulse in between and if it is for the first time that pulse is sown on the land. When we specifically consider total sample faba bean plots, fertilizer was applied on 76.96 percent of them. As illustrated by table 12, the average usage of fertilizer on faba bean field is 103.28 kg/ha (Dap and UREA). Some farmers also reported that they applied manure and or compost on their plot of land especially fields which are found near to their homestead as a supplement for the inorganic fertilizer. In addition to this Very few farmers responded that they treat faba bean seed with bio-fertilizer during planting. Most of the time, they sow faba bean to break the cereal pattern and to fix nitrogen. Farmers within the sample framework follow the right, cereals-pulse-cereals cropping to maintain fertility of land.

In the study area, aphids and African boll worm are the most important types of insects affecting growth of faba bean. During high infestation of insect pests, farmers used primicarb (primor) 50% WP EC to control aphids and Endo Sulphane to control African boll worm.

Land preparation and planting Farmers sow faba bean after they plow land for an average of 2.53 times. About 27.9% of farmers sow faba bean after they plow land three times. And about 22.5, 27.9, and 21.6% of farmers plow their land for one, for two and more than three times for sowing. Hence, farmers weed their land after four and six weeks of sowing. The level of yield of faba bean might be determined by how good the farmer manages weed before sowing. Therefore, farmers weed their land within the interval between consecutive ploughs. Faba bean also has to be weeded two times; the first hand weeding is after 30 days of sowing and the second hand weeding is after six weeks of sowing. However, if the farmer leaves the plot until faba bean is flowering, it will result in yield reduction.

Production and productivity When the respondents were asked about the purpose of faba bean production, most of them answered that they produce faba bean for different uses: 33% of their total harvest is for income, family consumption and diversification; 19.3% of them were used for income and family consumption; 14.4% of them were used for family consumption; and they used about 13.3% of the yield for income and profit. By- product of faba bean is also used for animal feed.

In the production year of 2014/15, the sample farmers harvested faba bean within a range of 0.1 qt/ha to 72.00 qt/ha with an average of 19.34 qt/ha, this is greater than the national average which is 18.93 qt/ha. Yield per hectare of faba bean may affected by socio economic and institutional factors.

Access to public services and social networks in each of the peasant associations, there are three development workers and one supervisor for two PAs. These extension workers provide advice for farmers on different crop technologies and livestock production practices. Extension service creates an impact on agriculture by disseminating new technologies to farmers thereby increasing agricultural production and productivity, second by improving human capital and managerial skill of farmers to advance their efficiency level. In other words, it is assumed that an increase in the number of extension contacts enhances farmers' access to crop related information and improved technological packages. Those farmers' located far from DA centers are advised less frequently due to less accessibility of roads. Many farmers contacted individually and in group discussions argued that extension contact has significant and positive effect on the crop productivity. From the total sample farmers, 2.8% of the household head did not get advice from extension agent, about 42% of them stated that they got advice from extension workers for less than 12 times a year, 16% of them told that they got advice from extension workers. And about 39.2% of them stated that they get advice for more than 12 days per year. On average yearly extension contact of the farmers is about 17.64 days with a minimum of 0 days and a maximum of 120 days with a standard deviation of 20.36. The DA gives theoretical knowledge as well as shows the importance of technologies by means of demonstration sites.

Credit Accessibility of credit may facilitate the dissemination and promotion of fertilizer, improved varieties, insecticides and farming practices in agricultural production. The survey result showed that out of 181 respondents, about 50.3% of them had an access to credit facility the remaining 49.7% of them did not have any access to credit facility. Moreover over, even if they have access to credit, most of them were not borrowed money from different sources.

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Table 1. The number of farmers borrowed (yes) and not borrowed (no) money from different institutions.

Sources		Frequency	Per cent
Relatives and friends	No yes	172 9	95 5
Informal saving and credit group	No Yes	177 4	97.8 2.2
Money lenders	No yes	176 5	97.2 2.8
Government credit schemes	No yes	146 35	80.7 19.3
NGOs/Church	No Yes	178 3	98.3 1.7
Bank or micro finance	No Yes	156 25	86.2 13.8

Table 14.Maximum likelihood estimates for parameters of stochastic frontier production function inefficiency effects model for faba bean grower in lemu district

Variable	parameters	coefficient	t-ratio
Constant (β0)	β_0	6.35***	16.11
Ln (Area)[A]	β_1	13.29***	14.13
Ln (Seed)[S]	β_2	-17.55	-18.70
Ln (Fertilizer)[F]	β_3	-20.99	-25.88
Ln (labor) [L]	β_4	27.21***	28.94
Ln (Oxen)[O]	β_5	-8.97	-95.41
Ln $(A)^2$	β_6	50.89***	69.35
Ln $(S)^2$	β_7	23.68***	32.70
Ln $(F)^2$	β_8	11.16***	19.00
Ln $(L)^2$	β_9	44.36***	60.54
Ln $(O)^2$	β_{10}	-18.67	-25.53

Ln (A) Ln (S)	β_{11}	-11.42	-12.90
Ln (A) Ln (F)	β_{12}	14.60***	16.79
Ln (A) Ln (L)	β_{13}	-61.32	-69.10
Ln (A) Ln (O)	β_{14}	-73.74	-83.13
Ln (S) Ln (F)	β_{15}	-53.02	-74.78
Ln (S) Ln (L)	β_{16}	-19.56	-22.13
Ln (S) Ln (O)	β17	64.70***	73.25
Ln (F) Ln (L)	β18	-10.66	-12.67
Ln (F) Ln (O)	β19	14.37***	17.69
Ln (L) Ln (O)	β_{20}	24.77***	27.95

Table 15. Technical efficiency of sample farmers producing Faba bean

Description	Household head level estimates
Mean	0.69
Minimum	0.13
Maximum	0.91
Standard deviation	0.16

Source: Own Computation Model Output (2014).

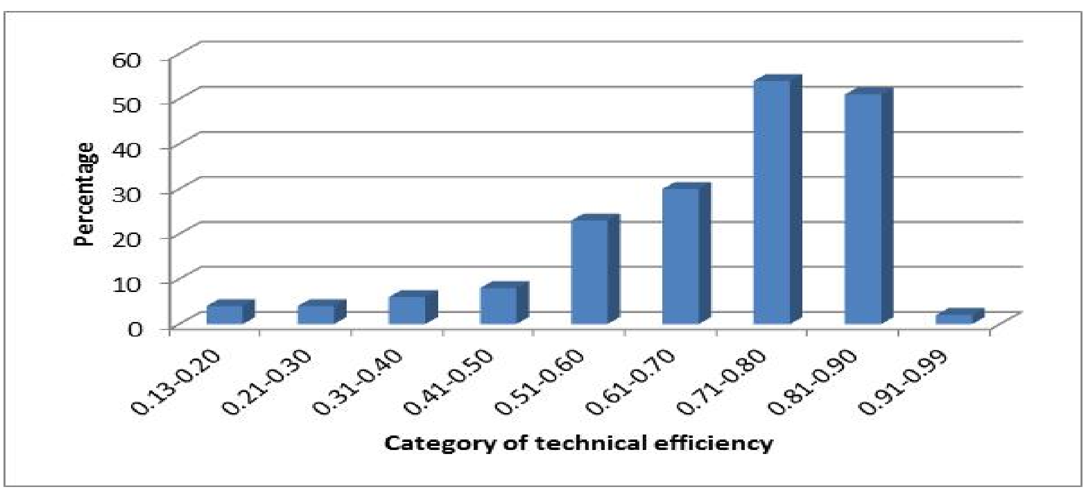

Figure 1. Distribution of technical efficiency of sample farmers

In summary to increase faba bean farming efficiency, efforts need to be invested in improving farmers' education through enhancing the universal primary education and training farmers about specific crop production packages practically as well as theoretically which are being implemented in local communities.

CONCLUSION AND RECOMMENDATIONS

This study was designed to analyze technical efficiency of faba bean smallholder growers in South west Shewa zone of Oromia Regional State, lemu district. Cross-sectional data collected from sample farmers in ElalaSeden, KusayeBoda, Elala Wako, TahaGola, KarsaWarko and BayeGiche peasant associations were used.

The study used the farm-level data collected from a total of 181 faba bean producer and estimated the stochastic frontier production function (SFPF) by incorporating inefficiency effects. We find that SFPF best fits the data better than the Cobb-Douglas production function. Moreover, the traditional average response function is not an adequate representation of faba bean farm level data for 2014 cropping season.

The result of study showed that area of faba bean, seed, fertilizer, labour and oxen days are the major factors associated with change in faba bean output. The effect of land area allocated to faba bean production and human labour on output is positive and the coefficient is statistically significant at 1% to improve faba bean productivity. The quantity of seed and fertilizer applied and oxen days used have negatively associated on faba bean output, and statistically non-significant. The interactions of land and fertilizer, seed and oxen days, fertilizer and oxen days had also a significant and positive effect to improve the yields of faba bean.

The results of efficiency analysis show that the mean technical efficiencies were found to be 69% with minimum 13% and maximum of 91%. This indicated that about 60% of farmers in the study area were efficient and produced above the average efficiency level while 40% of the farmers were inefficient and producing below the average efficiency level, suggesting that efficiency improvement is one of the possible opportunities for increasing faba bean production with available input resources and technology. Thus, an average farmer is producing 31% less than the achievable potential output. The sources of inefficiency were estimated using the δ - coefficients. Inefficiency factors arethose relating to farmers' demographic, socio- economic, institutional and plot specificfactors. These include the farmers' level of education, distance to extension service, distance to input market, distance to output market, extension contact, household size, member to a group, training, credit accessibility, livestock holding distance to weather road distance of plots from home, slop and soil fertility. Among the variables considered education, training, livestock holding, distance to all weather roads, distance to plot from home, and slop are insignificant to determine inefficiency of farmers. To the contrary, positive and significant coefficients of age, extension contact and household size indicate that inefficiency of farmers would be determined positively as the level of these factors increase.

Therecommendation/policy implication of this study is that technical efficiency in smallholder faba bean production could be increased by 31% on average through better use of available resources, especially area of faba bean land and labour given the current state of technology. Thus, government or other concerned bodies in the developmental activities working with the view to increase production efficiency of farmers in the study district should work on improving productivity of faba bean farmers by giving especial emphasis for significant factors of production and inefficiency.

In conclusion, the existence of inefficiency in faba bean production along with major inefficiency variables indicate that there is a room for improving efficiency and increase faba bean production using the readily available resources and technology. Hence, integrated developmental efforts that will decrease the existing level of inefficiency will have significance importance in improving faba bean production and productivity.

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