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Determinants of Productivity and Profitability Performance of Smallholder Common Bean Producers in Central Rift Valley of Ethiopia

Abebe TESHOME[1]
Yared DERIBE[2]
Mekonnen SIME[3]

Abstract

The Central Rift Valley of Ethiopia is known for its potential in production and marketing of common bean. However, there is inadequate information on determinants of productivity and profitability performances of smallholder common bean producers. Hence, this study was designed with the aim generating adequate information on the area. The study involves the cross-sectional household survey of 172 common bean producers in Shalla and Boset districts. Farm size, household size and non-farm income have a significant negative effect on the productivity of smallholder common bean producers. Whereas, experience, group membership, type of common bean produced and credit utilization have significant positive influence. A unit percent increase in farm size of smallholder common bean producers would decrease the probability of their profitability by 11 percent. On other hand, a unit percent increase in Tropical Livestock Unit and farming experience increase their probability of profitability by 4.7 and 26 percent, respectively.

***Keywords**: Common bean, Smallholder, Tropical Livestock Unit, Profitability*
***JEL Classification**: D24, D2*

Etiyopya Merkezi Rift Vadisinde Küçük Ölçekli Fasulye Üreticilerinin Verimlilik ve Karlılık Performansının Belirleyicileri

Özet

Etiyopya'nın merkezi Rift Vadisi, yaygın fasulye üretimi ve pazarlamasındaki potansiyeli ile bilinir. Fakat küçük ölçekli fasulye üreticilerinin verimlilik ve karlılık performansının belirleyicileri hakkında yetersiz bilgi bulunmaktadır. Buradan yola çıkarak, bu çalışma küçük ölçekli fasulye üreticilerinin verimlilik ve karlılık performansını etkileyen faktörleri araştırmak amacıyla tasarlanmıştır. Çalışma, Shalla ve Boset bölgelerinde fasulye yetiştiren 172 çiftçinin yatay kesit hanehalkı anketini içeriyordu. Araştırma sonuçları çiftlik büyüklüğünün, hanehalk büyüklüğünün ve çiftlik dışı gelirin küçük ölçekli yaygın fasulye üreticilerinin verimliliği üzerinde önemli olumsuz etkiye sahip olduğunu gösterir. Fakat deneyim, grup üyeliği, üretilen yaygın fasulye türü ve kredi kullanımının önemli pozitif etkiye sahip olduğu görülmüştür. Bu sonuçlara göre küçük ölçekli yaygın fasulye üreticilerinin çiftlik büyüklüklerinde yüzde birlik bir artış, karlılık olasılıklarını yüzde 11 azaltmaktadır. Diğer yandan, Tropikal Hayvancılık Birimi ve çiftçilik deneyiminde yüzde birlik artış, karlılık olasılıklarını sırasıyla yüzde 4,7 ve yüzde 26 artırmaktadır.

***Anahtar Kelimeler**: Fasulye, Küçük toprak sahibi, Tropikal Hayvancılık Birimi, Karlılık*
***JEL Sınıflandırması**: D24, D2*

[1] Associate Researcher, Department of Agricultural Economics, Ethiopian Institute of Agricultural Research, Addis Ababa, Ethiopia, abebegurmu3@gmail.com, orcid.org/0000-0001-5725-9011
[2] Associate Researcher, Department of Agricultural Economics, Ethiopian Institute of Agricultural Research, Addis Ababa, Ethiopia, yared.deribe@gmail.com, orcid.org/0000-0002-9053-7105
[3] Researcher Department of Agricultural Economics, Ethiopian Institute of Agricultural Research, Addis Ababa, Ethiopia, mekonnensm@yahoo.com, orcid.org/0000-0002-1161-8290

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1. Introduction

Pulses are important crops in agricultural production, and are major sources of protein for most of the developing countries in the world. Pulses are considered as an input-saving and resource-conserving crops because of their biological nitrogen fixing ability. Hence, they reduce the requirements of inorganic commercial fertilizer (FAO, 2014). Pulses are used as a source of income in addition to their uses as the main sources of protein in cereal based diets. Large quantities of the grain legumes (pulses) are sold in urban centers locally and exported in the form of green dried and processed forms (Devid, 2016).

Common bean is among important pulse crops which produced for direct consumption in the world. It is produced in regions with different cropping systems such as Latin America, Africa, Middle East, China, Europe, United States and Canada. Common bean is produced as subsistence crop throughout Sub-Saharan Africa region (Jones, 1999). The crop is grown widely and largely consumed in most parts of central, eastern and southern Africa. It is grown on about 4.5 million hectares of land annually by most of the resource poor farmers and it is preferred grain legume due to its early maturity (PABR, 2008). Common Bean is an important source of cash income for most of smallholder farmers in Africa and providing marketable product at the critical times when farmers have nothing to sell (Charles et al., 2004).

Common bean, known as haricot bean is an important crop to the Ethiopian national economy and to farmers as food and cash income. It used as an important source of foreign income for more than 50 years in Ethiopia (Ferris and Kaganzi, 2008). Common bean is ranked as the second largest pulse crop in the country in terms of production with share of 17 percent, next to Faba beans (Negash, 2007). Fast maturing characteristics of the crop enables the farm households to generate cash income that is required for purchase food and other household needs when other crops have not yet matured. Therefore, the crop is highly preferred in providing a quick cash for the risk prone farm households (Beshir and Nishikawa, 2012).

Common bean is grown widely in different parts of Ethiopia namely Oromia (East shoa, East Hararghe, West Hararghe and west Arsi zone) and SNNPR (Wolaita, Sidama, Gedeo, Alaba, Dauro and Guraghe zones). About 1,508,230.37 quintals of white bean and 3,374,971.33 quintals of red bean are produced on 88,302.71 and 200,334.52 hectares of land, respectively at the national level (CSA, 2018). About 318,085.99 quintals of white bean and 99,381.36 quintals of red bean are produced on 20, 289.93 and 5913.56 hectares of land, respectively in East shewa zone. 228,170.37 quintals of red beans are produced on 15,382.63 hectares of land in west Arsi zone in 2018/19 growing season (CSA, 2018).

Central Rift Valley Areas of Ethiopia is considered as the potential sources of common bean. The production of white bean type is common in the area. About 18% to 30% of farm land is allocated to common bean production and 86% of the product is sold in major common beans producing districts of the central rift valley areas (Atnaf et al., 2015). Nonetheless the immense potential of common bean

production in the area, no adequate information is available on factors determining the productivity and profitability performance of smallholder common bean producers. In Ethiopia, efforts for achieving accelerated and sustained economic growth are geared to sustainably increase the productivity of the agricultural sector by improving the role of farmers in attaining better food security and incomes (MoFED, 2010). In the attempt to enhance the growth and development concerns of the agricultural sector, there is a need to provide information on determinants of productivity along with the profitability of the major agricultural commodities. Identifying the determinants of productivity and profit accruing to bean producers is likely to provide important information that is essential for understanding the economics of bean production, policy formulation, improving bean production and productivity, and income of smallholder farm households. This research was therefore, intended to generate important information on determinants of productivity and profitability performance of smallholder common bean producers in central rift valley of Ethiopia on the basis of cross-sectional household survey conducted in 2018 in Shalla and Boset districts.

2. Literature Review

A number of socioeconomic and institutional factors have been identified to influence the profitability of agricultural production at the farm level. The study conducted by Sulumbe et al. (2010) on the profitability of cotton production under sole-cropping in Nigeria showed that family size, house holds' annual income and extension service were positively related to cotton output and profitability. According to Mulgeta (2011), household with large livestock holding can have an alternative cash sources which used to improve the productivity and profitability. Techane et al. (2002), reported that house households with larger tropical Livestock Unit have better economic strength to improve their farm profitability. The experience in crop production found to have an effect on the productivity and profitability status of smallholder farm households. According to Lawal et al. (2013) and Okoli et al. (2015) farming experience positively affected on farm productivity and profitability. Group membership is another important factor which determine the productivity and profitability of smallholder farmers. The research by Birachi et al. (2011) and Owuor et al. (2004) showed that group membership had a significant positive effect on output produced and farm profitability, since the farmers in group member can easily access extension services and agricultural inputs than being alone.

In a study conducted by Lowenberg-DeBoer and Ibro (2008) on the value chain of cow pea in Nigeria, it was found that businesses operating at a greater scale earned more per input. Neither experience nor education was found to be a strong predictor of profitability. However, this study focused on the traders with the exclusion of cow pea producers. Even though traders represent an important part of the cowpea supply chain, there is a need to determine the value accruing to producers of cow pea. According to the study conducted by Katungi et al. (2011) on cost benefit analysis of farmer-based common bean seed production in Kenya; it was found that the average variable cost of producing bean seed was US$ 388 per hectare and the

costs on items such as use of chemicals in seed treatment before storage, rouging and plant protection accounted for a smaller share (about5%) of the variable costs because most of the producers did not apply the practices. This study further suggests that farmer-based seed production enterprises were likely to be more sensitive to yield than price fluctuations. A 10% reduction in the price of seed reduced the profitability by about 1%, while a similar increase in yield increased profitability by 10%. This implies that huge change in price affect the profitability of farmer-based common bean seed production significantly; while a slight change in yield can have a significant impact on the enterprise profitability. However, the finding of this study is not comprehensive since it focuses only on common bean seed production profitability, while excluding most of the farmers engaged in common bean grain production. Hence, it is necessary to include common bean grain in the study in order to have good picture on common production profitability.

The research by Saimon (2016) on factors influencing on-farm common bean profitability of smallholder bean farmers in Babati District of Tanzania, shows that, age of respondents, gender of respondents, common bean yield, selling price, extension service, access to credit and off-farm income are factors determining common bean on-farm level gross margin (profit). According to this study unit increase in common bean yield led to an increase in profit margin by 0.29613 units at 1% level of significance. A unit increase in farm-gate price also led to an increase in the profit margin by 0.14054 units. This implies that a unit increase in selling price led to increased profit margin of smallholder farmers. In addition to this, the study results show that, access to credit had a positive effect on profit margin. A unit increase in the credit accessed by common bean producer causes profit margin to be increased by 0.32619 units at 10% level of significance. Credit facilitates the introduction of innovative agricultural technologies, ensures input and output marketing arrangements and enhance productivity and farm profitability. However, it is unclear as to whether the same factors apply to the central rift valley of Ethiopia. Therefore, there is a need to conduct a research to assess whether these factors of common bean productivity and profitability can be applied to the focus area of this study or not.

3. The Research Methods

3.1. Description of the Study Area

This study was conducted in central rift- valley region of Ethiopia, particularly in Shalla and Boset districts. Shalla is located in western Arsi zone of the central rift valley of Ethiopia. The zone is known by the production of different cereal crops like teff, barley, wheat, maize, sorghum and finger millet. Faba beans and common beans are among the pulse crops produced in the area. 542,621.05quintals of common bean was produced form 29,011.14 hectares of land in the zone during 2015/16 growing season (CSA, 2015/16). The district is situated about 270 km south west of Addis Ababa. The area is lowland with an altitude of 1550m above sea level, with latitude of 38° 27’10.9’’E and Longitude of 7°17’08.6’’N. The site has mean maximum temperature of 29.2°C and mean minimum temperature of 14.4°C. The soil texture is sandy loam and the site receives 763 mm mean annual

rainfall, but with much variation in distribution and amount of 70% which occurs between the months of May and September.

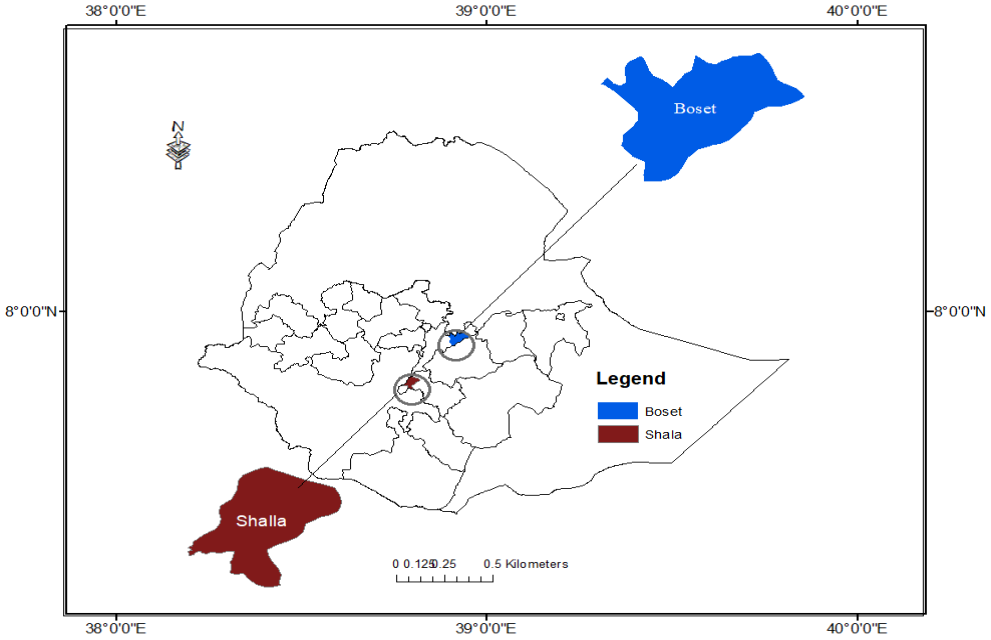

Figure 1. Map of the study area
Source: Own Computation

As indicated on the figure 1, Boset district found in east shoa zone of Oromia regional state within the central rift valley of Ethiopia. Different cereal crops like teff, barley, maize and wheat and pulse crops such as Faba beans, field peas, common beans, chick pea and lentils are commonly produced in the area. 103, 105.98 quintals of common bean were produced form 8,633.13 hectares of land in the zone during 2015/16 growing season (CSA, 2015/16). Boset district is located on the distance of 25 km from Adama and 125km from Addis Ababa in east shewa zone. The district is located between 1400m-2500m above the sea level and rests on area of 151,406 hectares. It gets 600-900mm annual rain fall on average. Agriculture is the main economic activity of this district in which most of farm households are engaged in the production of major cereal crops, pulses and horticultural products.

3.2. Sources of Data and Methods of Data Collection

Both primary and secondary data were collected to attain the research objectives. The main source of data for the research is cross sectional household survey of the common bean producers in the central rift valley region conducted in 2018. Hence, the smallholder farm households were the primary data source. Secondary data was obtained from various sources such as previous research findings, proceedings, journals and other sources which were relevant for this study.

Structured questionnaire was the primary data collection tool for the household survey. Enumerators were given training and briefings on the objective, contents of

the questionnaire and were also acquainted with the basic techniques of data gathering, interviewing and on how to approach farmers. Primary data was collected through face-to-face interview of the sample households using structured questionnaire which was filled up by recruited and trained enumerators under the close supervision of the researchers or supervisors.

3.3. Sampling Design and Sample Size

Major common bean producing areas were considered for the study. Purposive sampling technique was used to identify the major common bean growing areas in central rift valley of Ethiopia. Western Arsi and East Shewa zones of the Oromia regional state are the major common bean growing zones in central rift valley of Ethiopia from which major common bean producing districts were selected. Major common bean growing districts in these zones were selected purposively depending on the area coverage of common bean production. Accordingly, Shalla and Boset districts selected from the Western Arsi and East Shewa zone, respectively. Then the major common bean growing kebeles in each district were identified based on the area of common bean production. Based on the information from each district Agriculture and Rural Development Office, Awara Gama and Chefa Kerensa kebeles from shalla, and Sara Areda and Kachachule kebeles from Boset district were selected purposively for this study.

Simple random sampling technique was employed in order to draw common bean growing farm households. Total population of common bean growing farm households was identified in each kebeles. In the two districts, 1109 common bean producing smallholder farm households were identified of which 582 from shalla and 527 from Boset district. Proportionate sampling technique was employed to calculate or determine the number of common bean producers sampled or drawn in each district and kebele. According to Yamane (1967), the sample size determined as follows:

$$n = \frac{N}{1+N(e)^2} \quad (1)$$

Where n is the sample size, N is a target population of common bean producers, e is the level of precision. Based on this formula, the sample size of common bean producers for (N) =1109 at e = 0.07 is:

$$n = \frac{1109}{1+1109(0.07)^2} = 172 \quad (2)$$

Based on the proportional sampling technique, from the total sample of 172 smallholder farm households, 90 were selected from shalla district, out of this, 49 samples were taken from Chefa Kerensa whereas 41 samples were from Awara Gama Kebele. Similarly, out of 82 samples taken from Boset district of which 49 samples were taken from Sara Areda and 33 were from Kachachule kebele, were the sample sizes considered. Finally, the sample farm households were drawn randomly using simple random sampling technique.

3.4. Methods of Data Analysis

Descriptive statistics was used to describe the household information. Independent two sample t-test was also employed to examine the difference in productivity among the smallholder common bean producers. Econometric analysis (OLS) was used to estimate the factors influencing the productivity of smallholder common bean producers. Whereas, Binary logit model was employed to identify factors affecting relative likelihood of farmers' profitability in common bean production.

3.5. Model Specification

The method of Ordinary Least Square (OLS) was used to analyze factors affecting common bean productivity. According to (Wooldridge, 2012), OLS method is more amenable to ceteris paribus analysis because it allows us to explicitly control for many other factors that simultaneously affect the dependent variable. It allows many observed factors to affect the dependent variable thus allowing for much more flexibility. Hence, OLS method is appropriate to estimate the parameters of multiple linear regression model. Multiple regression equation, involving the use of ordinary least square (OLS) is used to examine the magnitude and direction of the effect of independent variables on the response variable. The multiple regression equation with four different functional forms stated as follows:

$$Y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \cdots \beta_k x_k + \mu_t \quad \textit{(Liner)} \quad (3)$$

$$Y = \beta_0 + \beta_1 lnx_1 + \beta_2 lnx_2 + \beta_3 lnx_3 + \cdots \beta_k lnx_k + \mu_t \quad \textit{(Semi-log)} \quad (4)$$

$$lnY = \beta_0 + \beta_1 lnx_1 + \beta_2 lnx_2 + \beta_3 lnx_3 + \cdots \beta_k lnx_k + \mu_t \quad \textit{(Double log)} \quad (5)$$

$$lnY = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \cdots \beta_k x_k + \mu_t \quad \textit{(Exponential)} \quad (6)$$

Where Y is dependent or response variable; productivity (production in quintal per hectare) in this case, Xs are explanatory variables affecting productivity of common bean production, β_0 is the constant or intercept, the betas i.e. β_1, β_2, β_3 ..... β_k represent the regression coefficients that show the partial effects of the corresponding explanatory variables and Ɛt represent an error term.

Binary logit model was employed to analyze factors affecting the farmers 'profitability performance (probability of smallholder common bean producers' profitability) in central rift valley of Ethiopia. According to Hosmer and Lemeshow (2000), logistic regression model is preferred when the outcome variable is dichotomous (binary). Agresti (2007) also stated that logistic regression is appropriate when dependent variable is binary and the independent variables are continuous and mix of categorical and continuous. Furthermore, logistic regression model was preferred, since it has simpler functional form than probit model (Guajarati and Sangeetha, 2007). Therefore, logistic regression model was employed in this study to envisage the relative likelihood of farmers' profitability in common bean production in central rift valley of Ethiopia.

Dependent variable takes the value of '1' if farmer is profitable (gain) in common bean production and '0' for failure (loss). The parameter (coefficient) of each independent variable was used to estimate the marginal effect of the corresponding

independent variables on the outcome variable. The marginal effect of each explanatory variable shows the extent and direction of the influence of each variable change on the response variable. The model was specified as follows:

$$Y = 1 \quad if\ NFI^* > 0 \tag{7}$$

$$Y = 0 \quad if\ NFI^* < 0 \tag{8}$$

Where NFI* represent the common bean Net Farm Income per hectare. Following Sadiq et al. (2013) and Ogisi et al. (2013), Net Farm Income was used as a proxy to determine the profitability status smallholder farmers. The data across all observations takes the value less than and greater than zero. Thus, the dependent variable takes the value of 1 if the farmer is profitable or gain (NFI >0). Y_i takes the value of 0 for loss. This indicates that the farmers fail to cover their cost of production, since the total revenue below the total cost of production (NFI<0). The fundamental equation of logistic regression was stated as follows.

The probability of the farmers to gain (have positive net margin) is given by:

$$P(Y = 1/X_i) = exp^{(X_iB+\mu)}/[1 + exp^{(X_iB+\mu}] \tag{9}$$

Similarly, the probability of the farmers to loss (have negative net margin) is represented as:

$$P(Y = 0/X_i) = 1 - \{[exp^{(X_iB+\mu)}]/[1 + exp^{(X_iB+\mu}]\} = 1/\,exp^{(X_iB+\mu)} \tag{10}$$

The logit regression equation reveals that when the value of each explanatory variable increased by one unit (percent), all other variables held constant, the odds ratio (probability ratio of **p/1-p**) given as:

$$P/1 - p = \{[exp^{(X_iB+\mu)}/1 + exp^{(X_iB+\mu)}]/[1/exp^{(X_iB+\mu}]\} = exp^{(X_iB+\mu)} \tag{11}$$

Hence, the logit transformation of the odds that the farmers are gain (have positive net margin) in their common bean production **(**$p(y=1/x_i)$**)** is expressed as:

$$Logit(Y_1) = ln\,[\,p\,(Y = 1)/\,(1 - P\,(Y = 1))] = \beta_0 + \beta_1 x_1 + \beta_2 x_2 +$$

$$\beta_3 x_3 + \cdots + \beta_k x_k + \mu_t \tag{12}$$

Where,

P(Y=1) is the probability of having positive net margin(gain) and 1-p(Y=1) the probability of having negative net margin(loss) of the i^{th} farmer.

Y=1 if the farmer is having positive net margin(gain) in common bean production and '0'otherwise.

β_0 = Intercept (constant)

$\beta_1, \beta_2, \beta_3 \ldots\ldots\ldots, \beta_k$ = coefficients indicating the marginal effect of the corresponding explanatory variables on net margin of smallholder common bean producers.

$X_1, X_2, X_3 \ldots, X_k$ = Explanatory variables assumed to affect the net margin of farmers in common bean production.

μ = Error (disturbance term)

Ln [P(Y=1)/ (1-P(Y=1))] = the natural logarithm ranges from negative infinity to positive infinity.

3.6. Fitness Tests for Different Functional Forms in Multiple Regression Model

In selecting the function that best fit to the data, different criterion like Akaike's Information Criteria, Bayesian Information criteria(BIC), the value of F-ratio and its p-value, the value of coefficient of determination(R^2) and the number of significant variables are used following (Guajarati and Sangeetha, 2007). The function with the lowest value of AIC, BIC and p-value; highest value of F-ratio and R^2, and with a higher number of significant variables is best fit to the data. The double log function was eventually selected since it fulfills most of the criterion relative to the rest three functional forms of the regression equation (See Appendix Table 1). On the other hand, this means the data was best fit to the regression equation in double log function. Hence, the regression model in double log function applied to analyze factors affecting the productivity of common bean production.

3.7. Regression Diagnostics in Multiple Regression

Shapiro-Wilk and Skewness/Kurtosis (sktest) were employed on error term to check the distribution of data. The tests were not significant at 5% level of significance. Hence, the data was normally distributed. The non-significant Breusch-Pagan test result shows that there was no heteroskedasticity problem in the data set. On the other hand, the Ramsey Regression Specification Error Test (RESET) employed to detect the presence of the problem of functional form misspecification. The insignificant test value shows that all of the independent variables are exogenous (no independent variable suffers from an endogeneity problem) and there is no omitted variable from the model while it significantly affects the dependent variable. Hence, the model is specified correctly. The Variance Inflation Factor of each explanatory variable was very small and less than 10.00 with the mean VIF of 1.32 (See appendix Table 2). Thus, there was no evidence of the presence of multicollinearity problem in the data set.

3.8. Regression Diagnostics in Logistic Regression

The existence of multicollinearity among independent variables for all continuous and discrete variables was checked before running the logistic regression. Variance Inflation Factor (VIF) and contingency coefficients were used to check the degree of correlation among the continuous and discrete independent variables, respectively. According to Gujarati (2004), the Variance Inflation Factor is used to check multicollinearity among continuous independent variables by which each continuous explanatory variable was regressed on all other continuous explanatory variables. As the rule of thumb, the VIF exceeds 10 shows high degree of correlation among the independent variables. The mean value of VIF for the

continuous explanatory variables included in the model was less than ten (Mean VIF = 1.064). This shows that multicollinearity was not a serious problem in the analysis (See Appendix Table 3). Contingency coefficient is a chi-square-based measure of correlation among the dummy explanatory variables. The value of contingency coefficient above 0.75 revealed a strong correlation among explanatory dummy variables (Healy, 1984). The contingency coefficients of all explanatory dummy variables considered in the model were less than 0.75 which implies that there was no serious multicollinearity problem among discrete explanatory variables (See Appendix Table 4). On the other way, the insignificant result of the Link test indicates that there was no model misspecification problem in the logistic regression analysis (Appendix Table 5).

4. Result and Discussion

4.1. Socioeconomic Characteristics of the Farm Households

The result of the descriptive analysis shown in Table 1 indicates that from the overall sample farm household in the study area, 75% were male-headed households whereas, 25% were female-headed households. From the total sample households, 58.7% have grown common beans during the production season. From the total of 172 sample smallholder common bean producers, most (66.3%) were lack the access to agricultural extension visit. Only small percentage (33.7%) of the total sample were accessed the agricultural extension visit. From this it is deduced that most of smallholder common bean producers lack access to agricultural extension visit. As shown in Table 1 below, Majority of the households in the study areas had no access to training on common bean production. Only 26.2% of the sample households have access to training on common bean production in 2009/10 growing season (Table 1).

Table 1. Socio Economic Characteristics of the Farm Households

Characteristics		Shalla		Boset		Total Number	(%)
		Number	(%)	Number	(%)		
Gender	Male	62	68.9	67	81.7	129	75
	Female	28	31.1	15	18.3	43	25
	Total	90	100	82	100	172	100
Extension Visit	Yes	30	33.3	28	34.1	58	33.7
	No	60	66.7	54	65.9	114	66.3
	Total	90	100	82	100	172	100
Land Ownership Under Bean	Own	47	52.2	54	65.9	101	58.7
	Not Own	43	47.8	28	34.1	71	41.3
	Total	90	100	82	100	172	100
Training Access	Yes	22	24.4	23	28.1	45	26.2
	No	68	75.6	59	71.9	127	73.8
	Total	90	100	82	100	172	100

4.2. Type of Common Bean Produced

Various varieties of common bean were produced in Central Rift Valley of Ethiopia. Naser, Awash-1, Awash-2, Dinkinesh and Mexican-142 were the common bean varieties produced by the households in the areas. Naser and Dinkinesh are the red type common bean varieties which mostly produced in shalla, while Awash-1 and Awash-2 are white common bean types commonly produced in Boset district. Mexican-142 is the old varieties which was in the hand of the farmers for relatively longer period of time. It produced by some of the farmers in both districts. From the total sample of the households, 39% produce Awash-1 variety and 27.3 % produce Naser variety. About 15.1% and 2.9% produce Dinkinesh and Mexican-142 respectively. Only 2.3% of the sample households produce wash-2. On top of this, 10.5% were produce both Naser and Dinkinesh variety. Those who produced both Awash-1 and Awash-2 accounts for only 2.9% of the total sample. The proportions of households that produce each common bean varieties are well illustrated on the figure 2 below.

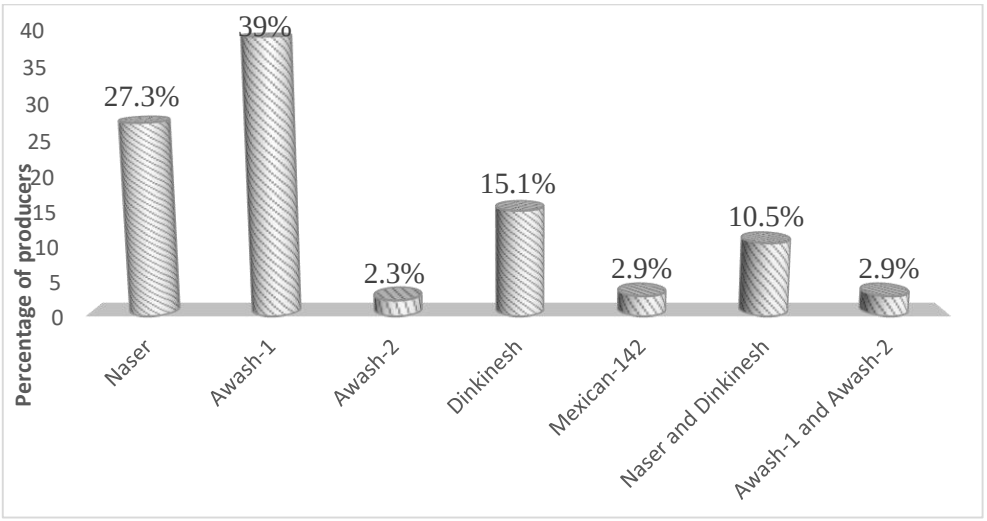

Figure 2. Varieties of Common Bean Produced by the Smallholder Farmers
Source: Survey data

4.3. Common Bean Market Destination

The farm households had different category of market destination for their common bean. Farm gate level, village market, district market and zonal market were the main categories of common bean market destination in the study area. The common bean market destination for the majority (48.8%) of the sample farm households was the village market. 23 and 18.4% were sold their produce at the farm-gate and zonal market respectively. The rest 9.8% of common bean producers were used the district market for their common bean marketing. This implies that the village market is the main common bean market destination of the smallholder farmers in central rift valley of Ethiopia. (Figure 3).

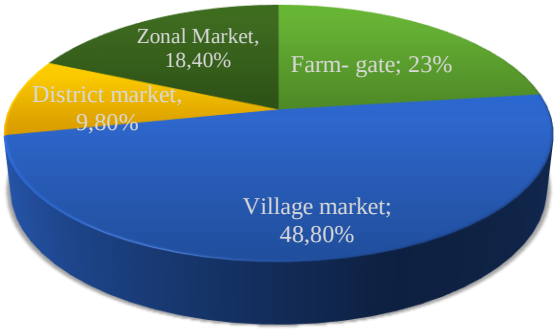

Figure 3. Common Bean Market Channels
Source: Survey data

4.4. Difference in Common Bean Productivity Among the Farm Households

Table 2 shows the difference in mean common bean productivity among the smallholder common bean producers depending on their different characteristics. The significant difference in common bean productivity existed between the profitable and non-profitable farmers. Profitable farmers had significantly higher common bean productivity than non-profitable farmers. The mean difference between the group is 4quintals per hectare which significant at1% level of significance. This shows that the profitability performance of farmers contributes to their productivity. There was a significant difference in common bean productivity among the smallholder farm households depending on their membership to Common Bean Seed Producers' Group. Mean common bean productivity of the group members and non-members was 23.1 and 16.3 quintals per hectare(table2). The productivity difference between the groups was 6.80 quintals per hectare which was statistically significant at 1% level of significance ($p<0.01$). This reveals that the productivity of the common bean seed producers' group members was significantly higher than that of non-members.

Table 2. The Difference in Common Bean Productivity Among the Smallholder Farmers

Variable	Comparison	Mean	Mean difference	t	Sig.
Profitability	Profitable	20	4.00	4.120	0.000
	Non-Profitable	16			
Group membership	Member	23.1	6.80	9.969	0.000
	Non - member	16.3			
Credit	Credit user	23.6	6.40	8.099	0.000
	Non-user	17.2			

Source: Survey data

Likewise, there was a significant difference in common productivity among the farm households who use and not use credit. The productivity of the farmers who used credit is significantly higher than that of non-users. This could be due the reason that, the use credit for purchase of adequate inputs of production including quality seed can improve productivity.

4.5. Determinants of the Productivity of Smallholder Common Bean Producers

The multiple regression result shows that estimated F-ratio was 48.88 and it was statistically significant at 1%level of significance, since the probability of F-statistic was very small (Prob>F = 0.0000). This implies that the model was statistically significant, thus the joint effect of all explanatory variables on common bean productivity is not zero. The Adjusted R squared of 0.72 implies that 72% of the variation in common bean productivity explained by the explanatory variables estimated in the model. As indicated in table 3, farm size, family size, number of years of experience in common bean production, common type produced, membership to Common Bean Seed Producers Group, credit utilization and nonfarm income were explanatory variables affecting common bean productivity at different significance level.

As shown in table 3, unit percent increase in farm size of the smallholder farm households decreases their common bean productivity by 4.6 percent. This might be due to the reason that managing larger farm is difficult relative to the management of small farms. The result is in conformity with Haggblade et al. (2010) who reported that large farms yield lower output and returns relative to small farms due to more input demand and an increasing production costs under large farms.

The result shows that family size affects common bean productivity negatively. One percent increase in family size decreases common bean productivity by 10.7 percent (table 3). The effect is highly significant at 1% level of significance($P<0.01$). This might be due to the reason that an increased use of household income to meet the family consumption demand limit funds for purchase of inputs and improved seed which used to improve common bean production and productivity. The result agrees with Ahuja (2000) who found the negative relationship between productivity and household size. According to the author, family size negatively affects productivity due to diminishing marginal returns to labor and large proportion of non-active family members in the household who do not participate in the production activities. The finding coincides with also Oband Mabvut (2012) who reported that household size negatively affects the productivity and profitability of cassava production in Chongwe district of Zambia, since the increased use of household income for the growing family consumption leads to poor investment on crop production.

Experience in common production affects common bean productivity positively with a coefficient of 0.635. Hence, for a unit increase in number of years of farmers' experience in common bean production, common bean productivity will increase

by 63.5 percent (table 8). The result of this study fits with the research by Lawal et al. (2013) and Okoli et al. (2015) who reported that the positive effect of farming experience on farm productivity. Likewise, the type of common bean produced have a significant effect on common bean productivity. The farmers producing red beans are 6.1 percent more productive than those farmers producing white beans. This could be due to the higher yield potential of red beans. However, white beans had better market value and profitable than red beans, since they are highly demanded on export market whereas, domestic consumption is the major market for red beans (Ferris and Kaganzi,2008).

Group membership have a significant positive influence on the productivity of common bean. Common bean productivity of farmers who are the member to Common Bean Seed Producers is significantly higher than that of non-member. The productivity of group members is 11.8 percent higher than non-members. The result concurs with Birachi et al. (2011) and Owuor et al. (2004) who reported that group membership had a significant positive effect on output produced and farm profitability, since being a group member can facilitate the condition for easy access of extension services and other necessary agricultural inputs than being alone.

Table 3. Common Bean Productivity Determinants of Smallholder Producers

Variable	Regression Coefficients	Robust Std.Err	t values	P values
Gender	0.028	0.057	0.48	0.629
Farm size	-0.046	0.024	-1.9	0.059*
Distance to nearest market	-0.007	0.014	-0.51	0.61
Family size	-0.107	0.025	-4.31	0.000***
Experience	0.635	0.059	10.67	0.000***
Common bean types	-0.061	0.029	-2.12	0.035**
Group membership	0.118	0.032	3.70	0.000***
Credit utilization	0.062	0.031	1.95	0.053**
Non-farm income	-0.018	0.010	-1.79	0.075*
Constant	1.346	0.185	7.30	0.000

*=Significant at 10%level **= Significant at 5% level ***= significant at 1% level Adj.R2 =0.72
F= 48.88 Prob>F = 0.0000 Number of obs = 17

Credit utilization is one of the important variables that affects the common bean productivity in the study areas. The result shows that the productivity of credit user is 6.2 percent higher than non-users. This could be due to the reason that reason that the use of credit enabling the farmers to purchase improved varieties, increase farmers' inputs use and hence, increase productivity and farm output. The result is in accord with Luoga et al. (2007) who reported that access to credit enables the farmers to use improved agricultural inputs and hence increasing their farm output and profit. Furthermore, non-farm income is the other determinants of common bean productivity of smallholder common bean producers. A unit percent increase in non-farm income of the household will decrease the common bean productivity of the smallholder farm households by 1.8 percent. The finding in line with Simon,

et al. (2011) who found the negative effect of non-farm income on the productivity and farm profitability of common bean production in Babati district of Tanzania. According to his study, as farmers owns a more rewarding non-farm income generating activity, the more they concentrate to that business and light-touches the common bean business which can, therefore, lead to low production, productivity and farm profit profitability.

4.6. Determinants of the Profitability Performance of Common Bean Producers

The parameters of the logistic regression model were used to identify the factors influencing the profitability performance of smallholder common bean producers. The result of logistic regression model showed significant Likelihood ratio (LR), since the value of calculated Likelihood ratio (LR) was 34.77 which was greater than the critical value of Likelihood Ratio (LR=16.919). This implied the statistical significance of the fitted logistic regression**.** Moreover, the probability greater than chi-square value (Prob >chi-square=0.0001), suggested that all of the model parameters were jointly significant in explaining the dependent variable at 1% level of significance which showed the goodness of fit of the model (table 4). From the result of the logistic regression illustrated in table 4, it is shown that five out of fourteen explanatory variables were found to have a significant influence on the probability of farmers' profitability (profitability performance). Farm size, number of livestock (TLU), experience in common bean production, participation in collective marketing and common bean type were the explanatory variables that affected probability of farmers' profitability from their common bean production. The marginal effect of each explanatory variable was discussed in detail one by one as follows.

Farm size of the household had negative effect on the profitability performance of smallholder common bean producers. Unit percent increase in farm size of the household would decrease the probability of farmers' profitability in common bean production by 11 percent. This could be due to the reason that it is difficult to properly manage large farms in relative to small farms. Hence, poor management and additional input costs on large farms would be the cause for low profit from large farm. The result is in conformity with (Haggblade et al., 2010) who found that large farms yield lower returns relative to small farms. This could be due to the reason that an increasing area under production must be accompanied by an increase in production costs since more inputs are needed.

A unit percent increase in Tropical Livestock Unit (TLU) would increase the probability of farmers' profitability from common bean production by 4.7 percent (Table 4). This could be due to the reason that farmers with large TLU can have alternative cash sources which used to purchase the adequate amount of inputs for production. The result is in line with Mulgeta (2011) who reported that households with large livestock holding can have good access to more drought power and have also alternative cash sources to purchase the necessary inputs of production. Thus, they improve their agricultural production and farm profitability by using the income from livestock and livestock products. Techane et al. (2002) also reported

that households with larger TLU have better economic strength and financial position to purchase the sufficient amount of agricultural inputs and improve their farm profitability.

Unit increase in farmer's years of experience in common bean production leads to 26 percent increase in the likelihood of the farmers to be profitable from their common bean production. This could be due to improvement in production skill of the farmers through years. The result agrees with Okam et al. (2016) who reported that more experienced farmers have better production skills which associated with higher productivity and farm profitability.

Table 4. Marginal Effect of Factors Affecting the Performance of Common Bean Producers

Variable	Marginal effects (β = dy/dx)	Standard. Error	z values	Probability (P >|z|)
Gender of the household head*	0.216	0.141	1.53	0.126
Family size	-0.009	0.008	-1.18	0.237
Farm size	-0.110	0.060	-1.84	0.065*
Non-farm income	0.009	0.020	0.44	0.658
Livestock (TLU)	0.047	0.027	1.75	0.08*
Experience	0.260	0.115	2.26	0.024**
Distance to nearest market	0.015	0.040	0.38	0.707
Participation in collective marketing*	0.163	0.060	2.72	0.007***
Common bean type*	0.249	0.065	3.84	0.000***
Log-L = -66.769 Pseudo R2 = 0.2433 LR chi2(9)=34.77 Prob>chi2 = 0.0001				

Number of obs =172 ***= significant at 1% level **= significant at 5% and *=significant at 10%, (*) dy/dx is for discrete change of dummy variable from 0 to 1

The result indicates that participation in collective marketing was positively and significantly affected the profitability performance of smallholder common bean producers in central rift valley of Ethiopia. The shift from non-participant to participant in collective marketing would increase the probability of profitability by 16.3 percent (table 4). This could be due to the reason that participants in collective marketing can easily access a market for their product, agricultural inputs and other extension services more easily than being alone. The result further shows that those farmers producing white bean were more likely to profitable than those producing the red bean types. The production of white beans is 24.9 percent more likely to profitable than production of red bean types. The result agrees with Ferris and Kaganzi (2008) who reported that white beans have better market value than the red bean types. According to their findings the leading white beans including Awash-1 are produced exclusively for the export market, since they are popular in industrialized nations like United States, United Arab Emirates and United Kingdom (UK). Hence, the market value of white beans higher relative to read beans.

5. Conclusion, Recommendations and Areas for Further Studies

5.1. Conclusion

The central rift valley region of Ethiopia had a huge potential for wide varieties of common bean production and marketing. The white bean types such as Awash-1, Awash-2, Mexican-142, and red bean types like Naser and Dinkinesh were among the major common bean varieties produced in the region. The majority of the sample farm households used village market for their common bean production. Only small portion of the sample were sold their common bean to the district and zone market. The significant difference in common bean productivity is existed among the smallholder farmers based on their profitability status, group membership and credit utilization. The common bean productivity is higher for profitable farmers than non-profitable farmers. This shows, profitability status contributes to the productivity of the farmers in common bean production. The common bean productivity of those farmers who are member to Common Bean Seed Producers' Group and utilize credit is significantly higher than non-member and non-credit users, respectively.

Despite the potential of the central rift valley of Ethiopia in common bean production and marketing, there exists different factors which influence the productivity and profitability performance of smallholder common bean producers. Farm size, family size and non-farm income are significantly and negatively affecting the common bean productivity, whereas, experience in common bean production, group membership and credit utilization have a significant positive effect on the productivity of common bean under smallholder-based production. The productivity of the farmers producing white bean is less than those producing red beans.

Farm size, number of livestock (TLU), experience in common bean production, participation in collective marketing and common bean type were among the factors that significantly influence the profitability performance of smallholder common bean producers. Farmers with a large farm size are less likely to be profitable from their common bean production. This could be due to the difficulties in managing larger farms and increasing in cost of production on larger farms than small farms. Farmers with larger livestock (TLU) are more likely to be profitable from their common bean production, since they used their livestock and livestock products as an alternative source of income for purchase of different agricultural inputs. On the other hand, farmers with many years of experience in common bean production are more likely to be profitable from their common bean production. The producers participating in collective common bean marketing are more likely to fetch higher profit than non-participant. On top of this, the profitability performance of the farmers is significantly influenced by the type of common bean produced. Farmers producing white beans are more likely to be profitable than those producing red beans.

5.2. Recommendations

The study recommends the government to implement policies that enhances the farmers' profitability and productivity. It is difficult for farmers to support large family with limited production. Hence, it is imperative to integrate family planning with health extension service in the study area. Government and other stakeholders operating to improve the welfare of the rural society should introduce the credit service providing institutions in order to provide the farmers with an alternative financial source and improving their agricultural productivity and farm profitability. Facilitating market access in rural areas like establishment of farmers' cooperatives and farmers' collective marketing is important to help the small holder farmers to negotiate better prices for their product. Creating awareness among farmers on business diversification like livestock production besides the production of crop is necessary to support their crop production with an alternative income sources and to minimize the natural and market related business risks. Establishing village-based farmers' group with a greater experienced farmers' participation is important and unexperienced or less experienced farmers can therefore, benefited from the well experienced farmers' innovative skill and techniques of production and thus improved their productivity and farm profitability. To improve the profitability of red beans producers the government should promote formal exportation of red beans as white beans through investment incentives to local and foreign companies. To sum up, it is necessary to integrate the essential policy measures to add to the positive and conquer the negative influence of the identified factors and the productivity and profitability of the smallholder farm households can, therefore, enhanced in the study area.

5.3. Areas for Further Studies

Although the study plays significant role in providing an information on the productivity and profitability analysis of common bean production, it concentrates only on the smallholder common bean producers. Thus, productivity and profitability of common bean under large scale production should be the areas of further research. The study further focused on the productivity and profitability of common bean grain production with much to the exclusion of common bean seed production. The role of common bean seed producers is pertinent in improving the access of farmers for quality seed of common bean. Hence, further research on profitability and determinants of quality seed of common bean production is important in generating valuable information that is important in the measures towards enhancing production of improved common bean seed, increasing profitability of smallholder common bean seed producers and improving the access of farmers for quality seed of common bean.

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Appendix

Table A.1. Fitness Test Results for Different Functional Forms

Indices	Linear	Semi log	Exponential	Double log
Akaike's Information Criteria (AIC)	851.3515	850.6641	-110.8986	-127.4266
Bayesian Information Criteria (BIC)	882.8264	882.1391	-79.42366	-95.95161
F-Statistic	56.56	56.86	42.75	48.88
Prob(F-statistic)	0.000	0.000	0.0000	0.0000
R squared(R^2)	0.7452	0.7462	0.6872	0.7159
Number of significant variables	6	7	5	7

***= Significant at 1% level

Table A.2. The Summary of the Diagnostic Tests in Multiple Regression Model

Test statistics	Type of test employed	Statistical results
Normality	Shapiro-Wilk W test on residual	Prob>z =0.59556
	Skewness/Kurtosis tests on residual	Prob>chi2 =0.2964
Heteroskedasticity	Breusch-Pagan/Cook-Weisberg	Prob>chi2 =0.2103
Model Misspecification	Ramsey RESET test	Prob> F = 0.5123
Multicollinearity	Variance Inflation Factor (VIF)	Mean VIF = 1.32

Table A.3. VIF for Continuous Explanatory Variables in Logistic Regression

Variable	VIF	Tolerance level((TOL=1/VIF)
Distance to nearest market	1.08	0.926
Family size	1.05	0.955
Non-Farm Income	1.08	0.928
Farm size	1.08	0.932
Experience	1.03	0.969
Mean Value	1.064	0.942

Table A.4. Contingency Coefficients for Dummy Variables in Logistic Regression

	Gender	Collective marketing	Common bean type
Gender	1	0.065	0.065
Collective marketing	0.065	1	0.115
Common Bean type	0.065	1.115	1

Table A.5. The Link Test Result of Logit Model Specification

Profit	Coefficients	Standard Error	z values	P values
_hat	1.155	0.319	3.62	0.000***
_hatsq	-0.068	0.105	-0.65	0.514
_cons	0.006	0.298	0.02	0.985
Log-L = - 66.562 Pseudo R2 = 0.2457 LR chi2(2) = 43.36 Prob > chi2 = 0.0000 N= 172				