Journal of Economics and Sustainable Development
ISSN 2222-1700 (Paper) ISSN 2222-2855 (Online)
Vol.6, No.15, 2015

Factors Affecting Production and Market Supply of Haricot Bean in Southern Ethiopia

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Abstract
Haricot bean has been an important export commodity for the Ethiopian economy for the last 40 years. It is the smallholder farmers in the low and mid-attitude zones of the country who use haricot bean, not only as source of income but also as source of food. The present study examines factors affecting production and market supply of haricot bean in Boricha district. Cross sectional data obtained from 165 sample respondents were used to estimate the cob-Douglas production function and supply model. The result of the log linear regression shows it is possible to increase production of haricot bean by increasing the supply of seed, fertilizer, nonfarm activities and labour. These variables cetirus-paribus significantly influence production positively. From the estimates of supply function, selling price and production amount positively and significantly affect marketable supply, but consumption significantly influences market supply negatively. Hence by increasing production and selling price, market supply can be improved. The policy implications of the present findings are to have increased and diversified nonfarm activities, with increased input delivery which would have great contribution in increasing haricot bean production and market supply in the area. Hence measures should be directed towards assuring appropriate remunerative prices and increases in investment on input supply to better commercialize the crop.
Keywords: Smallholders, haricot bean, production structure, market surplus

Introduction

Haricot beans are grown throughout Ethiopia and are increasingly becoming important commodities in the cropping system of small holder producers for food and income. With regard to the economic importance of haricot bean, it is used as a source of foreign currency, as a food crop, as a means of employment, and as a source of cash. Haricot bean production takes place to a varying degree in all regions of the low and mid altitude agro ecologies of the country. However, almost all haricot bean production (more than 99 percent) of the country comes from five major haricot bean production regions: Oromiya, Southern Nations Nationalities and Peoples Regional State (SNNPRS), Amahara, Benishangul Gumuz, and Tigray.

Yet production of haricot bean is not without problems in Ethiopia. According to Bindera (2009), among others, haricot bean productivity per hectare is very low. Moreover, the effect of pest and disease problem on haricot bean production is highly significant. All these problems affect the total haricot bean production, amount of market supply and total export volume.

In addition to the above mentioned reasons, Ethiopian haricot bean market structure, conduct and performance can be affected by a number of factors. The most prominent factors that play a great role in hindering the market development of haricot bean can be listed as: consumption behavior of Ethiopian farmers, poor coordination amongst traders, lack of market information, price volatility, lack of trade finance, lack of grading and standardizing, lack of insurance and market promotion (Bindera,2009). The consequence of these issues is obvious; clearly there is a need to strengthen haricot bean research in the country to improve productivity as well as create strong marketing development.

Methodology

Description of the Area

The study area lies in the Southern Nations Nationalities and Peoples Regional State (SNNPR) of Ethiopia, where growing plants and rearing animals are equally dominant agricultural activities. It is specifically situated in Sidama zone which is one of the most populated zones having around 19.46% of the total population of the region. The study area Boricha district is located at 306 km South of Addis Ababa and 31 km North East from the capital city of the region Hawassa. More than 90% of the population earns their living from agriculture and live stock, the rest less than 10% earn a living from trade and other livelihood activities.

Its agro ecology is classified 22% as Wet Woyna Dega 9% as Dry Kolla and 69% as Dry Woyna Dega. Maize, haricot bean and *enset*, are the major crops in the district where as *teff*, *chat*, sweet potato and potato are grown in small amount, chili pepper, coffee, banana, avocado and sugar cane are grown in a very limited amount. Erratic and shortage of rain fall is the major problem of the district in terms of affecting agricultural production.

Data type and data collection

The data for the analysis of factors affecting haricot bean production and supply were obtained from proceduraly chosen sample haricot bean producers from the district. It included only those who produced haricot bean in the 2011/2012 production year.

The primary (cross sectional) data were collected from households of four kebeles[1] (namely Konsore Chefa, Shello Abore, Shello Belela and Shello Elancho) from the district through a semi structured questionnaire, in order to cross check the reliability of the information focus group discussion, and key informant discussions were made with stakeholders.

Sampling design and procedure

Multi stage sampling technique was employed to select the sample respondents. This was used to select a representative sample of the total population which would provide the required estimator with associated margins of uncertainties arising from examining only a part of the population. The study district was selected purposively as it was the first in haricot bean production and supply from the zone as a result of its production potential. The study district comprised 39 rural kebeles and majority of the kebeles produced haricot bean. The 39 rural kebelles were grouped in to two strata by agro ecology (Wet Woyna Dega) and (Dry Woyna Dega and Dry Kolla) and one kebele out of the Wet Woyna Dega and three kebeles (from the Dry Woyna Dega and Dry Kolla)[2] were randomly selected. Then a total of 165 households from the respective kebeles were selected in collaboration with kebele chairmans, key informants and respective (Development agents)DA_S using systematic random sampling taking into account probability proportional to size of haricot bean growers in each of the four selected kebeles

Variables in the Study

The variables in this study were selected as those which were expected to be factors that may affect production and supply of haricot bean, based on past studies.

Production variables

Table 1 List of explanatory variables of haricot bean production

Variable name	Measurement Unit	Variable code	Expected sign
Age	Years	Age	±
Education	Schooling years	Edu	+
Nonfarm income	Money (Ethiopian birr)	Nonfarm income	+
Frequency of contact with DA	Days	Freq	+
Farm size	Hectare	Land	+
Labour	Man equivalent	Labour	+
Livestock	TLU	LiveS	+
DAP fertilizer	Kilogram	DAP	+
Seed	Kilogram	Seed	+

Initially urea fertilizer was selected to be entered to the model. However, from the survey it was found that almost all of the sample farmers did not use urea fertilizers. As a considerable number of observations for this variable were with zero values, direct use of this variable in the estimation of the model would bias the estimation, so it was omitted.

Supply variables

Table 2 List of explanatory variables in haricot bean market Supply

Variable name	Measurement unit	Variable code	Expected sign
Total production of haricot bean	Quintal (100kgs)	HbProdn	+
Number of Household	Number	NHH	-
Age	Years	Age	+
Distance to market	kilometers	Distmkt	-
Selling price of haricot bean	ETB	Price	+
Education	Schooling years	Edu	+
Farm size	Hectare	Land	+
Frequency of contact with DA	Days	Freq	+

Model estimation

A modified Cobb Douglas production function was used to determine the influence of different factors on the quantities of haricot bean produced by farm households. A Cobb-Douglas function estimates elasticity of production and marginal productivity of critical factors of production. The general form of Cobb-Douglas production function is presented in Equation 1(Gujarati, 2004).

[1] Kebele is the lowest government administration

[2] N.B. There are kebele which have both Dry Woyna Dega and Dry Kolla agro ecology simultaneously

$$\varphi_i = \theta\lambda_1^{\alpha1}\lambda_2^{\alpha2}\lambda_3^{\alpha3}\lambda_4^{\alpha4}\ldots\lambda_n^{\alpha n} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(1)$$

Where: φ_i = quantity of output I, λ = vector of variable resource with j = 1, 2, 3 ….n,
θ = constant;
α_k = coefficients with k= 1, 2…n: which estimate the elasticity of transformation ratio for the inputs λ.

Estimation of constant and coefficients for the establishment of elasticity involved transformation of Equation 1 to a logarithmic linear function specified in Equation 2. The Cobb-Douglass production function has some desirable properties, which make it more appropriate for this study. These include the use of α_k to estimate the partial elasticity of bean output with respect to the inputs. In other words, it measures the percentage change in that particular input while holding other inputs constant. The quantities of beans produced could, therefore, be inferred using these coefficients. It is possible to calculate returns to scale, that is the response of φ to a proportionate change in inputs (Gujarati, 2004). This could also be used to explain the factors influencing the volume of beans produced in Equation 2.

$$\ln\varphi = \ln\theta + \alpha_1\ln\lambda_1 + \alpha_2\ln\lambda_2 + \alpha_3\ln\lambda_3 + \alpha_4\ln\lambda_4 + \alpha_5\ln\lambda_5 + \ldots \alpha_6\ln\lambda_6 + \beta_1\varphi_1 + \beta_2\varphi_2 + \ldots \beta_n\varphi_n + e \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

Supply Function

A supply function was used to determine the factors influencing the quantity supplied to local market. Supply function was preferred because beans have other alternative uses such as home consumption and can also be stored for seeds and thus not all produce has to be taken to the market. The supply function was specified as: (Birachi et al., 2011)

$$\pi_i=\alpha_0+\alpha_1X_1+\alpha_2X_2+\alpha_3X_3+\alpha_4X_4+\alpha_5X_5+\varepsilon\ldots\ldots\ldots\ldots\ldots\ldots\ldots(3)$$

Where π_i = quantity marketed,
X_1 = quantity of beans produced (kg),
X_2 = distance to the market (km),
X_3 = quantity consumed at home (kg),
X_4 = quantity given as gifts (kg),
X_5 = Reserve for seed
ε = random error.

Statistical tests for the cross sectional data

One of the serious problems with the identification of variables to be included in the model is the existence of multicollinearity among the explanatory variables. There are different methods, which enable us to see whether or not there is multicollinearity among the variables, of which the Variance Inflation Factor (VIF) is one. The VIF is defined as: VIF = 1/(1-R2).

The VIF indicates the level of variance that has been inflated to the condition where the variable is not linearly related with other variables. Hence VIF is tested for the continuous variables entered in to both production function model and supply function model. The results show that tolerance for all variables is less than one and also R^2 is less than one which indicates the absence of the multicollinarity problem. The other is that the computed VIF result for all variables is less than one. Hetroschedasticity test was made and the result shows no hetroschedasticity problem in the variables

Results and Discussion

Factors affecting haricot bean production

Having the information about the production potential of the study area and haricot bean as the main cash crop in the area, we then looked for the cause of its output determinant factors. Determinants of production are dependent on different socio economic, farm and institutional factors. Therefore the variables included in the model are those that are continuous and changed to log linear form to fit to the modified Cobb-Douglas production function model. And the coefficients of the variables are computed using Cobb-Douglas production function model.

$$Qp = f(\text{age, educ, fetr, labour, land, seed, contact, livestock, labour, nonfarmincome})$$

The dependent variable is volume of production and the explanatory variables included are age of the respondent, amount of seed ,education status of the household head, amount of land allocated for haricot bean, amount of DAP fertilizer used, frequency of contact with the development agent, livestock ownership, nonfarm income and labour availability. Table 3 presents the results of the Cobb-Douglas regression.

Table 10 The log-linear regression of haricot bean production function model, Boricha district

Variables	Coefficients	Standard Error	p-value	t-value
Constant	-3.153723	1.402375	0.029	-2.25
LNLand[1]	0.1949923	0.1706506	0.258	1.14
LNAge	0.0955204	0.30819	0.758	0.31
LNEdu[2]	0.0012804	0.0122029	0.917	0.10
LNSeed	0.2906678	0.1396136	0.042**	2.08
LNDAP[3]	0.3071569	0.146516	0.041**	2.10
LNFreq[4]	-0.0252396	0.0490687	0.609	-0.51
LNLiveS[5]	0.0118676	0.0750329	0.875	0.16
LNNon farm income	0.2288624	0.1036222	0.031**	2.21
LNlabour	0.5012273	0.2650224	0.064*	1.89
F=0.0000		R^2=0.6601		

*, **, Significant at 10% and 5% level of significance, respectively

From the variables entered into the model coefficient of frequency of contact with the extension agent resulted as negative. But the rest of the variables were in the expected direction. The variables that significantly affected production include: amount of seed, amount of DAP, labour, and nonfarm income. The coefficients of these variables can be interpreted as the elasticity of output with respect to changes in those variables. The increase or decrease of these inputs will increase or decrease the output level of haricot bean. Hence, change in these variables may shift the production frontier curve upward or down ward direction according to their direction of change. However the coefficients of other variables such as age of the house hold head, land, education of the household head, frequency of contact with the extension agent and ownership of livestock in terms of TLU were not statistically significant. This means the effect of these variables is not different from zero in increasing the amount of haricot bean production.

The high values of coefficients of labour, amount of seed, and DAP show that these factors had great impact in determining the production level. Whereas, the magnitude of nonfarm income had a lesser magnitude, showing its lesser impact on the level of output. Adding the whole input elasticities gave the returns to scale parameter. The result of the sum of the elasticities was 1.6063355 and we can say that in the study area, production was characterized by increasing returns to scale, i.e, a proportionate change in these inputs resulted in more than proportionate increases in output.

Amount of Seed

Seed amount measured in kilograms, was found to be significantly positive. The elasticity (coefficient) of seed in this study was 0.291, implying that as there is a unit increase in quantity of seed, production will increase by 29% up to the point where applying population density of seed reaches its optimum level. Alternatively, for a unit decrease in amount of seed application per hectare of land, level of production decreases by 29%.

Labour

Labour availability was significantly positive, with a coefficient of 0.501. Hence for a unit increase/decrease in labour, output will increase/decrease by 50%. Labour was measured in terms of Man-equivalents. Availability of labour likely influenced the availability of working force in the house hold. In addition to this, a farm with a larger number of workers per hectare is more likely to be in a position to try and continue using a potentially profitable innovation and it is expected to influence adoption hence production positively. The result of this study fits with research by Alemitu (2011) which also reported labour availability has positive and significant effect on adoption, but opposite to Birachi et al. (2011) who reported an insignificant relationship between availability of labour and production volume in their research.

Fertilizer

The relationship between DAP and production was significantly positive. For a unit increase in use of DAP fertilizer, the amount of bean production increases by 31% until applying amount of DAP per hectare reaches its optimum level. On the other hand decreasing DAP usage per hectare of land decreases production by 31%. The present study's result is consistent with an earlier study by Birachi et al. (2011).

Nonfarm income

As the income of a farmer obtained from nonfarm activities increased, it was expected to see an increase in

[1] Farm size
[2] Education
[3] DAP fertilizer
[4] Frequency of contact with the DA
[5] Livestock

output level. Farmers would have more capital to purchase new technologies and other inputs like fertilizer and improved seeds that assist production. The coefficient of non farm income was 0.23 which implies that as non farm income changes by a unit output level will be changed by 23%.

Factors affecting market supply

From the result of the interview, clearly marketing of haricot bean is not easy in the study area. Among others, farmers face different supply side problems like lack of cooperatives, consumption pattern of farmers, and fluctuation in demand and price. In this section we will see how different selected factors affect haricot bean supply in the study area using supply function.

$$Qs = f(\text{mkt. distance}, \text{edu}, \text{age}, \text{price}, \text{produc}, \text{land and NHH}, \text{freq})$$

Variables that are included in the analysis are total production of haricot bean, number of the household, land size, distance to market, selling price of haricot bean, education level of the household head, age of the household head and frequency of contact with the extension agent. From the variables entered in to the model signs of coefficients of the variables result in as expected.

Table 11 Regression estimates of supply function model, Boricha district

Variables	Coefficients	Standard error	p-value	t-value
Constant	-1.712089	0.8078251	0.036	-2.12
Hbprodn[1]	0.3713309	0.0423235	0.000***	8.77
NHH[2]	-0.0331475	0.0747293	0.658	-0.44
Age	0.0083181	0.0157006	0.597	0.53
Edu[3]	0.0814878	0.0476109	0.089*	1.71
Land[4]	2.032414	0.3477077	0.000***	5.85
Freq[5]	0.0005343	0.0036828	0.885	0.15
Distmkt[6]	-0.0288741	0.0461352	0.532	-0.63
Price[7]	0.00123807	0.0007412	0.002***	3.21
F=0.0000	R^2=0.7269			

*,**and***, Significant at 10%, 5% and 1% level of significance, respectively

Haricot bean level of production

As expected, total production significantly influenced the supply of haricot bean to market. The coefficient of quantity of production was positive, showing that for a unit increment in level of production, the farmers directly increase market supply. This result supports the study by Biranchi (2011) and Wolelaw (2005), where, estimates indicate that the supply of bean and rice respectively were affected by total production.

Therefore the quantity of haricot bean produced greatly influenced the quantity supplied for market. And the small holder farmers who realized higher output, supplied a larger proportion of their beans to the market. Farmers with higher bean output have the potential for commercialization that could increase their incomes thereby enabling them purchase more inputs and increase output. Higher incomes from beans can only be realized by intensifying production.

Education level of the household head

In explaining the relationship between amount of market supply and education, it was often expected that educated farmers are better able to process information and search for appropriate technologies and methods to alleviate their farming and supply constraints. The survey results showed that education was statistically significant and explained the supply quantity of haricot bean. Hence as the level of education of the house hold head increases the level of market supply ultimately increases. The current survey result confirms findings of Alemitu (2011). But as Rahmeto (2007) discussed, the level of education that measures farmers' grade in the study were statistically insignificant .

Land

Total land owned by the households was assumed to be positively assist in changing level of production. As expected the variable land, measured in terms of hectare, was significantly positive. The size of the farm is a factor that is often argued as important in affecting production decisions. It is frequently argued that farmers with

[1] Total production of haricot bean
[2] Number of Household
[3] education
[4] Farm size
[5] Frequency of contact with the DA
[6] Distance to the nearest market
[7] Selling price of haricot bean

larger farms are more likely to adopt an improved technology (especially modern varieties) compared with those with small farms. The survey result confirms earlier findings of Hailu (2008) and Birachi et al. (2011) who reported that farm size exerts a positive influence on adoption of improved technologies. But Rahmeto (2007) and Alemitu (2011) reported an insignificant effect of land size on production. Generally, market supply is a mirror of the amount of production, therefore we can conclude that, all things being equal, as size of farm land increases level of production increases, and hence amount of market supply increases.

Selling price of haricot bean

The coefficient of price was positive and price influenced market supply significantly. Farmers increased their market supply as prices rose and reduced its volume as price decreased. In other words, the supply is sensitive to price offered by buyers and this is consistent with the law of supply. Nevertheless, market price of haricot bean determines farmers' decision to supply to market and hence higher haricot bean price increases market supply of haricot bean. The survey result supports findings of Wolelaw (2005) in which rice market supply was significantly affected by its selling price.

Conclusion

According to the Cobb-Douglas analysis amount of DAP fertilizer, amount of seed used, availability of labour measured in terms of Man-Equivalents and non farm income were the significant factors that affected haricot bean production in the study area. Increase in the amount of these inputs shifts the production frontier curve upward. On the other hand, market supply of haricot bean in the area according to the regression estimates result affected by, amount of haricot bean production, selling price of haricot bean, size of farm land and education level of the farmer. Increase in production amount, farm land size, educational status of the farmer and selling price help farmers to increase their market supply. The overall result calls for policy packages which focus on healthy and educated labour, setting minimum procurement price for inputs and providing input subsidies, ease delivery of inputs, improve access to credit and market than reducing input price alone. Diversified income sources should be created in order to increase income of the farmers. Introducing new farm technologies on cost sharing basis especially for the rural poor should be done by the Agriculture and rural development bureau. Fair commodity pricing should be there in order to benefit farmers and to boost supply and production.

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