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Supply Response of Haricot Bean: The Case of Boricha District, Southern Ethiopia

Wogayehu Abele*
South Agricultural Research Institute, Hawassa Agricultural Research Center, Ethiopia

Tewodros Tefera
Hawassa University, Ethiopia

Abstract: Even though Ethiopia had undertaken different policy measures since 1991 to boost agricultural production and increase the spillover effects of agriculture, there is no available study done to know the effects of such policies. This study aimed to fill this gap by analyzing the supply response of the commodity chosen haricot bean in Sidama Zone of Southern Ethiopia. The study applies the modified Nerlovian model and uses price data and non price data from 1991-2012.The result of the estimates of the time series data shows that acreage is positively and significantly influenced by change in its own price in the long run. Acreage and yield are highly influenced by price and non price factors both in the long run and short run. Generally farmers respond to price incentives by reallocating land and increase yield. The error correction term shows that deviation of acreage from the equilibrium corrected in the current period and it takes less than five years to come to the equilibrium. On the other hand any deviation of yield from the equilibrium corrected in the current period and takes less than two years to come to the equilibrium. The empirical results illustrate that there is still great potential to increase production through improvement of price and non price inputs. Hence the ongoing measures should be directed towards assuring appropriate remunerative prices and increase investment and supply of other non price factors like, increase investment in irrigation.

Keywords: Supply response; Long run response; Short run response; Equilibrium; Error correction model.

1. Introduction

Haricot bean has been produced in Ethiopia for export for over 40 years but its growth was interrupted by unfavorable policies implemented between 1975 and early 1980s.During this period, the government put restrictions on all private trade and gave the state controlled board full monopoly over the marketing of all grains in the country [1]. Besides, these policies resulted in low incentives to farmers and consequent underinvestment into crop management. In particular, quality standards were severely affected, resulting in substantial decline in export volumes, from 80 to 23% of the total production (Katungi, *et al.* [2] quoting Ayele, 2000).

After 1991, as Ethiopian People Revolutionary Democratic Front (EPRDF) came to power, the government of Ethiopia adopted a number of economic reforms oriented towards stabilization and structural adjustment measures. Such as Agricultural Development Led Industrialization (ADLI) approach,Liberalization of markets, devaluation and further depreciation of agricultural prices and exchange rate, subsidy removals [3].

But the impact of any policy reforms on economic growth and poverty alleviation crucially depends on the response to agricultural supply to incentives. In order to make an assessment of the effects of different policies on agricultural growth, estimates of response of supply to prices and non price variables are needed. Despite its relevancy, the size of the supply response to price incentives and non price factors in Ethiopia generally and in the study area particularly is still largely unknown. The main objective of this study is to analyze the price and non price response of supply for the selected agricultural product haricot bean in the study area.

2. Research Methodology

2.1. Description of the Study Area

Sidama administrative zone is found in Southern Nations and Nationalities People Regional State (SNNPRS) and it is one of the 14 zones in the region. It is located in the North Eastern part of the region and bounded by Oromia in the North East and South East, with Gedio zone in the South, and Wolaita zone in the West. Its geographic location lies between $6^0$14’ and $7^0$18’ North latitude and $37^0$92’ and $39^0$14’East longitude.

Total area of the Sidama administrative zone is about 6981.8km^2. It consists 19 woredas and two administrative towns namely: Hawasazuria, Malga, Wondo-Genete, Gorche, Wonsho, Chuko, Loka-Abaya, Bursa, Bona-zuria,

*Corresponding Author

Chire, Shebedino, Dale, Aleta-Wondo, Dara, Hula, Aroresa, Bansa, Arbegona and Borechaworedas including the two towns i.e. Alata-Wondo and Yirgalem town administrations.

According to the estimation from 2007 house and population census, the total population of the zone is around 2,921,336. Based on 2007 house and population census 2011 zonal population were projected 3,277,078. Average population density of the zone is in the 2011 469.3person/km^2. It is one of the densely populated zones in the region. Climatic condition of Sidama zone can be described as 'Wet moist woinadega' and 'wet moist dega' accounting 45.4% and 27.7% respectively.The remaining part of the zone classified as dry woinadega, dry kola and wet moist kola are 14.5%, 8.6% and 3.8% respectively.

As it is an economic base of the country, agricultural production is the pre dominant activity of Southern region which encompasses growing of plants and rearing animals. So as in Sidama both practiced in every woredas. However due to cultural and environmental factors peasants in the zone mainly depends on production activities of *enset* and coffee for consumption as well as for commercial purposes. Traditional farming is mainly practiced in the zone. Based ontheir agro ecology condition land productivity and suitability, Hula, Bursa, Goriche, Wondo-Genet, Malga, Loka-Abaya, Hawasa-zuria, Arbegona and Aroressaworedasare termed as food crop growing woredas while Aleta-Wondo, Chuko, Dale, Dara, Wonsho, Bona-Zuria, Shebedino, Chire and Bensa are coffee growing and food crops producing woredas.

Based on land use pattern of the zone, 6981.8km^{2}is the total land coverage of the zone, of this 216,028.2 ha is covered by annual crop and 292249 ha is covered by perennial crop. Grazing land accounts 73372.2 ha, 108908.2 ha covered by forest and 82598ha land is used for other purpose according to Sidama zone agricultural and development report/2003E.C

Both annual and perennials crops are produced in the zone such as, maize, teff, barely, *enset*, haricot bean, coffee. Subsistence mixed farming exits in most part of the zone. Crop and livestock productions are practiced together in the same management units. Small private farms are the major sources of crop production. The zone receives bimodal rain season known as Belg (the shortest rainy season) and Meher (the longest rainy season). Farmers majorly use systems of multiple cropping to maximize production per unit area. Individualpeasantslandholdings in most part of Sidama are small mainly due to high population density. About 53 percent of the farmers own less than one hectare of family land 42percent of the farmers own one to two hectares of land. While only 5percent own two hectares and more.(SNNPRS Sidama zone administration socio economic profile 2003E.C Finance and Economic Development Department Development data collection and dissemination work process).

2.2. Data Type and Data Source

The data that helps for the analysis of supply response was secondary data and obtained from Central Statistic Authority (CSA), National Metrology Agency (NMA), and different published and unpublished sources. Price and non price factors data from 1991-2012 was used in order to best estimate the supply response model.

2.3. Econometric Models

2.3.1. Supply response model

To identify the response of supply for its major factors the Nerlovian econometric model was used. The Nerelovian supply response approach enables us to determine short run and long run elasticities. It also has the flexibility to introduce non price production shift variables in to the model [4]. The long run and short run supply response is estimated using Pc Give version 10 software.

$$A_{dt} = \alpha_0 + \alpha_1 * p_{et} + \alpha_2 * Z_t + U_t \quad \text{...................... (The General Nerlovian supply response model)}$$

Z_t = a set of other exogenous shifters including fixed private and public factors such as weather

U_t= error term (unobservable random factors that affect area under cultivation) in time t

α_{0-2} = are parameters to be estimated especially α_1 is the long run coefficient of supply response

2.3.2. Supply Response Models for Haricot Bean

Acreage and yield supply response of haricot bean was estimated using the following regression model,

Haricot bean acreage is assumed to be a function of its own price, (P), Rainfall during Belg[1](BRF),Meher[2] rainfall (MRF),Belg minimum temperature (BMIT), Belg maximum temperature (BMAXT), Meher minimum temperature (MMINT) and Meher maximum temperature (MMAXT).

[1] The short rain season which stays from February-April
[2] The long rain season which stays from June-September

$$LHBA = f(\mathbf{P}, \mathbf{BRF}, \mathbf{MRF}, \mathbf{BMINT}, \mathbf{BMAXT}, \mathbf{MMINT}, \mathbf{MMAXT})$$

Similarly haricot bean yield is a function of its own price (P), Rainfall duringBelg (BRF), Meher rainfall (MRF), BelgMinimum temperature (BMINT) and BelgMaximum temperature (BMAXT)

$$LHBY = f(\mathbf{P}, \mathbf{BRF}, \mathbf{MRF}, \mathbf{BMINT}, \mathbf{BMAXT})$$

3. Empirical Results and Discussion of Time Series Regression

3.1. Unit Root Test

The formal investigation to test stationarity was carried out by examining the stochastic properties of the variables using Unit Root Test. In this context, the widely used technique Augmented Dickey Fuller (ADF) test is conducted to detect stationary of proportion of annual haricot bean yield (AY), annual area covered by haricot bean or acreage(AA), Belg rainfall (BRF), Belg average temperature (BAVT), Meher rainfall (MRF), Meher average temperature (MAVT), haricot bean price (HP) and maize price(MP). Some of the variables were found to have unit root problem (non-stationary) at level, thus the variables have been treated by taking the first difference of the level data, which turned the data to be stationary. The Unit Root results are summarized in table below.

Table-1. Unit Root Tests for Stationarity, Sidama Zone (1991-2012)

Variables	**Level without trend**	**Level with trend**	**Difference without trend**	**Difference with trend**
AA/Acreage	-1.390	-2.407	-3.889**	-3.850*
AY/Annual Yield	-2.053	-2.641	-4.669**	-4.593**
BAVT/Belg average temperature	5.304**	5.680**	-10.23**	-9.978**
MAVT/Meher average temperature	-4.225**	-4.570**	-7.200**	-7.020**
Haricot bean price(HP)	-0.2087	-2.285	-6.135**	-6.573**
BRF/Belg rainfall	-3.112*	-3.541	-6.335**	-6.145**
MRF/Meher rainfall	-5.401**	-5.319**	-8.779**	-8.648**
Maize price(MP)	-0.8884	-2.685	-5.805**	-5.833**
Critical value at 1%	-3.75	-4.38	-3.75	-4.38
Critical value at 5%	-3.00	-3.60	-3.00	-3.60

Where; **and* denotes rejection of the null hypothesis (non stationary) at **1% and 5%** significance level

3.2. Co Integration Analysis Using Engle-Granger Two Step Test

To detect the co integration (long run relationship) between time series variables we can use either Engle-Granger two step procedure or Johansen maximum likelihood estimation techniques. The first step Engle Granger two step procedure is to estimate the long run model of the I(1) and obtain the residual (error term), then test the stationarity of the residual. The next step is to estimate the error correcting model by regressing the first difference of the dependent variable on the first difference of the independent variables with respect to their respective lag and also on its own lag and one year lag of the residual obtain in step one. The existence of the long run relationship among the variables can also be indicated by the sign of the lagged residual value. If the sign is negative it means errors are corrected annually. If positive means the relationship is explosive. Magnitude of the error term shows the adjustment speed towards the long run equilibrium level.

Table-2. Unit Root test for Residuals using ADF, Sidama Zone (1991-2012)

Variables	**With constant only**	**With constant and trend**
ACREAGE residual	-3.102*	-2.649
Yield residual	-5.337**	-7.163**
Critical value at 1%	-3.75	-4.38
Critical value at 5%	-3.00	-3.60

Where; **and* *denotes rejection of the null hypothesis (non stationary) at* ***1% and 5%*** *significance level respectively*

3.3. Estimating the Overall Significance of the Model

To test the overall significance of the model it is preferable to use F-test than the R^2, since the R^2 value is usually high and misleading as it may be affected by spurious correlation of the variables. Thus it is advisable to use F-test in order to see the overall significance of the model. Alternatively a very small F probability detects the overall significance of the model that is if F-probability is closer to zero, it means the model is significant, in this study the F probability are (≤ 0.034), which means the models are significant at 5% and 10%level of significance. TheLag length test results for acreage and yield models indicate that long run test statistics rejects the order zero but do not reject the order one.So chosen order is one in both acreage and yield models.

4. Long Run Supply Response

In this section we will see the long run acreage and yield response of haricot bean supply for change in the selected price and non price variables.

4.1. Acreage Response

The test summary of the long run acreage response model in the table below shows that there is no problem of autocorrelations between the error terms, hetroskedasticity and the assumption of normal distribution is satisfied.

From the OLS table estimates, acreage is significantly influenced by own price only. Own price has a positive and significant effect on acreage, a unit increase in price increases allocated land for haricot bean by 59% in the long run which is consistent with the theory of production. The theory of production states positive acreage response for increase in own price. This result is consistent with the findings of Yu, *et al.* [4], which reported positive and significant relationship between rice acreage response and its own price in their paper. On the other hand Mohammad [5] also reported similar significant and positive relationship between acreage response of rice and wheat for theirown price.

Table-3. Long run Model Estimates for Acreage using OLS, Sidama Zone (1991-2012)

Variables	Coefficient	Std.Error	t-value	t-probability
Constant	-33.8007	36.20	-0.934	0.364
LBAVT	16.4290	10.14	1.62	0.125
LMAVT	-3.95955	7.186	-0.551	0.589
LP	0.594000	0.2182	2.72	0.015***
LBRF	0.135057	0.5420	0.249	0.806
LMRF	0.312616	0.6434	0.486	0.634

TEST SUMMARY
AR 1-2 test: F(2,14) = 2.8018 [0.0947]
ARCH 1-1 test: F(1,14) = 0.17114 [0.6854]
Normality test: Chi^2(2) = 1.9805 [0.3715]
hetero test: F(10,5) = 0.40500 [0.8951]
RESET test: F(1,15) = 0.1900 [0.2925]
*,**and***, Significant at 10%, 5% and 1% level of significance, respectively
R^2=0.500294 DW=1.18 F-Statistics=0.034

Concerning the other variables even though their results are statistically insignificant Belg and Meher rainfall have positive relationship with supply. In the other hand Meher average temperature again it is insignificant but has a negative relationship with land allocation decision of farmers in the long run.

4.2. Yield Response

The tests made for the yield variables data assures there is no problem of autocorrelation and the normality distribution assumption is satisfied. The Table below shows the estimated results of the long run yield model.

Table-4. Long run Regression Result of Yield Model Estimates, Sidama Zone (1991-2012)

Variables	Coiefficient	Std.Error	t-value	t-prob
Constant	65.1763	21.09	3.09	0.009
LBRF	0.363603	0.2686	1.44	0.176
LMRF	-0.770795	0.2530	-2.37	0.035**
LP	0.336562	3.292	1.25	0.234
LBAVT	-11.5207	6.064	-1.90	0.082*
LMAVT	-7.73452	3.292	-2.35	0.037**
LMP	-0.220011	0.3488	-0.631	0.540

TEST SUMMARY
AR 1-2 test: F(2,10) = 0.96063 [0.4153]
ARCH 1-1 test: F(1,10) = 0.44156 [0.5214]
Normality test: Chi^2(2) = 2.1510 [0.3411]
RESET test: F(1,11) = 1.5469 [0.2394]
*,**and***, Significant at 10%, 5% and 1% level of significance, respectively
R^2=0.635 DW=2.45 F-statistics=0.031

The long run yield response is dependent on Meher rainfall, Belg average temperature and Meher average temperature. An increase in a unit of rainfall in Meher season reduce long run haricot bean yield by 77%. Whereas a unit increase in Belg and Meher average temperature reduce yield by 1152% and 773% respectively. The result of the estimates explains that yield in the long run is mainly influenced by non price variables than price variables. The result of negative and significant effect of Meher rainfall on yield response confirms the report by Yu, *et al.* [4] as rainfall has negative effect on oil crops yield in the long run. We also consider average Belg and Meher temperature and both are negative for haricot bean yield response function. This is refers higher temperature during Belg and Meher seasons is harmful for haricot bean growth. The current study supports earlier findings of Yu, *et al.* [4] as summer average temperature has a negative and significant effect on grain crops.

5. Short Run Error Correction Model

The coefficients of short run dynamics were estimated following the Engle Granger two step procedures. The results are summarized in Table 5 and 6. The variables are significance not only in the long run but also they are determinant in the short run too.

5.1. Short Run Acreage Response

Table-5. Short run Dynamic Model Estimates for Acreage,Sidama Zone (1991-2012)

Variables	Coefficients	Std.Error	t-value	t-probability
Constant	0.0796108	0.04748	1.68	0.122
DLBAVT	17.2500	3.084	5.59	0.000***
DLBAVT_1	14.3455	3.187	4.50	0.001***
DLMAVT	-3.96011	2.201	-1.80	0.099*
DLMAVT_1	-8.93158	2.423	-3.69	0.004***
DLP_1	0.496536	0.1406	3.53	0.005***
DLBRF	0.567832	0.1849	3.07	0.011***
DLMRF	0.820026	0.1729	4.74	0.001***
Residuals_1	-0.212254	0.09088	-2.34	0.039**

TESTSUMMARY
AR 1-1 test: F(1,10) = 1.9282 [0.1951]
ARCH 1-1 test: F(1,9) = 0.85182 [0.3801]
Normality test: Chi^2(2) = 0.61857 [0.7340]
RESET test: F(1,10) = 1.5077 [0.2476]
*,**and***, Significant at 10%, 5% and 1% level of significance, respectively
DW= 2.7 R^2=0.850882F-statistics=0.001

As it is summarized in Table 5, short run acreage response is significantly and positively influenced by lagged first difference of Belg average temperature, lagged first difference of own price, first difference of Belg rainfall, first difference of Meher rainfall, first difference of Belg average temperature. The first difference of Meher average temperature and lagged first difference of Meher average temperature significantly and negatively affect short run acreage response. The results show in order for farmers to allocate land for haricot bean in the short run production period, previous year haricot bean price and presence of high temperature during Belg growing season significantly affect their decision. If price of haricot bean was attractive in the previous year and for a unit increase in price in the previous period farmers will increase their land allocated for haricot bean by 49% in the current period. And for a unit increase in previous year Belg average temperature farmers increase their allotted land for haricot bean by 1434% in the short run production period.

On the other hand rainfall during the two growing seasons Meher and Belg also significantly affect land allocation in the short run. Farmers increase their land allocation for haricot bean by 56% and 82% in Belg and Meher respectively for a unit increase in rainfall in the two growing seasons respectively. Current period Belg average temperature also affect the short run decision of land allocation, a unit increase in Belg average temperature increases land allocation by 1725%. But increase in lagged Meher average temperature and current period Meher average temperature negatively influence short run land allocation decision. For a unit increase in lagged and current Meher average temperature, land allocation is reduced by 893% and 396% respectively. Lagged own Price, rainfall in the two growing seasons, and acreage have moved in similar direction and these results are consistent with previous studies by Mohammad [5] and Yu, *et al.* [4] which reported similarly positive and significant relationship among own price and rainfall with wheat and rice acreage respectively in the short run.

To complete the short run acreage response, we need to check the significant variable which is the lagged residual. The lagged error correcting factor is negative indicating an adjustment towards long run equilibrium level. The coefficient of the error correction term (-0.212254) indicates that the deviation of haricot bean acreage from the long run equilibrium level is corrected by about 21% in the current period. This means it takes less than five years for the variable to return in to equilibrium. The rationale for this slow adjustment may be the technical characteristics of agriculture production in the area i.e. the farmers in the short run have a fixed land, buildings and capital equipment and this may limit the process of adjustment in response to rising output prices and other non price factors.

5.2. Short Run Yield Response

The estimated results from the dynamic short run model in Table 6 show a significant yieldsupply response to maize price, Belg and Meher average temperature. Yield response to maize price isnegative and significant. In other words maize is a competing crop with haricot bean, as maize price increases farmers will shift to production of maize as a result haricot bean yield decreases. A unit increase in maize price will decrease haricot bean yield by 46%.Belg and Meher average temperature have negative effect on yieldand a unit increase in Belg and Meher temperature reduce yield by 727%and 503% respectively. This result is consistent with [4, 5], reporting negative and significant short run effect of competing crop price i.e. cotton price on wheat and rice yield. Summer average temperature also has negative and significant effect according to Mohammad [5] and Yu, *et al.* [4] on grain yield. The coefficient (-0.551336) of the error correction term indicated that any disequilibrium between the desired and actual haricot bean yield in the previous period is corrected by about 55% in the current period. Which means it takes less than two years for the variables to return to equilibrium.Similarly the variables have a long run relationship and current period disequilibrium converges towards the equilibrium by 55% each year.

Table-6. Short run Dynamic Model estimates for Yield,Sidama Zone (1991-2012)

Variables	Coefficient	Std.Error	t-value	t-probability
Constant	0.0634055	0.06016	1.05	0.311
DLBAVT	-7.27562	3.045	-2.39	0.033**
DLMAVT	-5.03456	1.877	-2.68	0.019***
DLMP	-0.467415	0.1839	-2.54	0.025**
Residuals_1	-0.551363	0.2855	-1.93	0.076*

TEST SUMMARY
AR 1-2 test: F(2,11) = 0.016811 [0.9834]
ARCH 1-1 test: F(1,11) = 0.44401 [0.5189]
Normality test: Chi^2(2) = 3.1920 [0.2027]
hetero test: F(8,4) = 0.51843 [0.8010]
RESET test: F(1,12) = 1.0706 [0.3212]
*,**and***, Significant at 10%, 5% and 1% level of significance, respectively
R^2=0.654277 F-statistics=0.005DW=1.81

6. Conclusion

The study estimated the short run and long run acreage and yieldresponse of haricot bean. The results of long run acreage supply response for haricot bean showed,acreage responsiveness was significantly influenced by own price. Long run yield response was significantly and negatively influenced byMeher rainfall, Belg average temperatureand Meher average temperature.Price in the long run was an important factor in determining haricot bean acreage. In the short run, lagged own price, rainfall (Belg and Meher), Belg average temperature, lagged Belg average temperature were positively and significantly influence acreage response. But Meher average temperature and lagged Meher average temperature negatively and significantly affect acreage response in the short run. Maize price, Meher average temperature and Belg average temperature negatively and significantlyaffect yield short run responsiveness.

The results showed that the farmers are quite responsive to price signals.The analysis of long run indicates that a price change in a single crop affectthe allocation of land and other resources for that particular crop. Hence if reallocations of resources are made it is from nowhere but from other competing and supplement crops according to their relationship. The impact of changes in the prices of haricot bean on the acreage allocation could provide an insight to determine an integral structure of agricultural prices. Further haricot bean price is not the only determinant factor for increasing haricot bean supplies. Among the factors yield of haricot bean could be reduced by high temperature in the two growing seasons and high price of maize. Policies on investment on small scale irrigation and availing prior weather forecast information in parallel with providing drought resistant varieties will reduce the problem.

References

[1] Eleni, Z.-M., 2001. *Of markets and middlemen: transforming agricultural markets in Ethiopia*. Washington, DC: IFPRI (International Food Policy Research Institute).

[2] Katungi, E., Horna, D., GebeyehuShimelis, and Sperling, L., 2011. "Additional market access, intensification and productivity of common bean in Ethiopia: a micro economic analysis." *African Journal of Agricultural Research,* vol. 6, pp. 476-487.

[3] Oertel, S., 2004. *Governance profile of Ethiopia*. Addis Ababa: ECA (Economic Commission for Africa).

[4] Yu, B., Fengwei, L., and Lliangzhi, Y., 2010. *Dynamic agricultural supply response under economic transformation a case study of Henan province. Working paper 00689*. Washington, DC: IFPRI (International Food Policy Research Institute).

[5] Mohammad, S., 2005. "Supply response of Major crops in different agro ecological zones in Punjab." PhD. Thesis, University of agriculture, Faisalabad University, Faisalabad.