ABHINAV
International Monthly Refereed Journal of Research In Management & Technology
ISSN – 2320-0073 Volume II, September'13

TECHNICAL EFFICIENCY OF SOYABEAN PRODCUTION IN IJEBU-ODE LOCAL GOVERNMENT AREA OF OGUN STATE, NIGERIA

O.O. Olayiwola

Research Scholar, Development Policy Centre (DPC), Ibadan, Nigeria
Email: olubodun_2008@yahoo.com

ABSTRACT

The policy maker can either attempt to enhance the uptake of important technologies relevant particularly to the small scale agricultural production by improving research and development process or they can take steps, which enables the farmers to improve technical efficiency in production, while the farmer probably require a long time, considerable funds and efforts but are likely to yield long run benefit. Farm specific technical efficiency for soybean crop in ijebu-ode increased without adding any additional resources. The results show a comparison of the small, medium and large farmer's variability and technical efficiency of different size groups. Mean technical efficiency is high in large farmer compared to medium and small farmers.

Keywords: Technical Efficiency, Soyabean Production and Ijebu-Ode

INTRODUCTION

The Soybean (*Glycine max* (L.) Merrill) is a species of legume native to East Asia, widely grown for its edible bean which has numerous uses. Soybean is a triple beneficiary crop which contains 18 to 20 % of edible oil, 45% of high quality protein and high level of essential amino acids. Soybeans are also used in industrial products, including oils, soap, cosmetics, resins, plastics, inks, crayons, solvents, and clothing. The demand for soybean, as predicted would increase by 2.92% per year, while the domestic production capacity remains low. Therefore, the import of soybean is predicted to be 1.04 million tons in 2000 and 1.22 million tons in 2010. Sudaryanto (1996) argued that domestic soybean production program is extremely importance, but its implementation, is problematic for various reasons. In the near future, given the relatively stagnant technology, efficiency improvement at farm level would probably be an appropriate way to increase soybean production. Since the available resources (the government budget in particular) are limited, then it is imperative to determine priorities of alternative activities. This implies that, in an effort to improve the managerial capacity of the farmers, the ministry of agriculture should be able to identify the target groups of the extension service. In other words, it is important to have a map of technical efficiency levels of soybean farmers. The significance of this paper is based on that argument and therefore, the objective of this paper is to estimate the technical efficiency that can be reached by soybean farmers and identify factors influencing technical inefficiency.

Nigeria has the potential to be self-sufficient in soybeans production, both for household's and industrial need and also for export. However, farmers have identified a number of constraints militating against concerted production effort. Addressing these obstacles is a key step toward attaining self sufficiency in soybean production. The Federal Department of Agriculture (FDA, 2012), identified soybean production problems as poor rate of capital formation, lack of credit facilities, inadequate extension service, poor farm management techniques and lack of incentives for producers. The need to solution soybean production, in the country in an effort at maintaining food security especially for low income earners (majority of whom mainly consume protein from soybean sources) suggest that farmers be empowered. A potent way of doing this is to design appropriate capacity building mechanism for them so that the level of their efficiency will be increased. Also, a study by the World Bank in 2012 revealed that agricultural development programmes of the various levels of government in the failed to make a desired impact on the fish production because their design and implementation lacked adequate Research and extension support. This study will therefore analyze technical efficiency of soybean production in Ijebu-Ode of Ogun State for the purpose of bringing out the areas in which they need to be empowered so that the farmers will be able to maximize advantage in production and it enhance effective utilization of National Resources available to them. In addition, an underlying factor behind this work is that farmers were not making efficient use f existing technology to improve farm level efficiency.

METHODOLOGY

The study was carried out in Ijebu-Ode Local Government of Ogun State, in Nigeria. Ijebu-Ode is a city located in South-western Nigeria. With an estimated population of 222,653 (2006 census survey), it is the second largest city in Ogun State after Abeokuta. In pre-colonial times, it was the capital of the Ijebu kingdom it is the city inhabited by the Ijebus, a sub-group of the Yoruba ethnic group who speak the Ijebu dialect of Yoruba. It is historically and culturally the headquarters of Ijebu land. The city is located 110km by road North-East of Lagos; it is within 100km of the Atlantic Oceans in the Eastern part of Ogun State and possesses a warm tropical climate. Multistage stratified random sampling was adopted to collect the data from the farmer. The first stage unit is village second stage unit is farmers which were grouped into three strata small medium and large farmers according to size of land holding from each group sample has been taken proportional to size of strata. The data was collected from the farmers through personal interview method using well-structured and pre-tested interview schedules. The major input for which the costs were worked out includes seeds, labour, plant protection, fertilizer, manures etc. the collected data was analyzed in order to estimate costs and return and to work out the technical efficiency.

Measurement of Technical Efficiency

The concept of technical efficiency, in a broad sense, is used to characterize the utilization of resources. These basic concepts may be formulized through a frontier production function define as one that yields maximum output for given levels of inputs. The production frontier is estimated using stochastic frontier approach. The frontier production function is defined as the function that denoted the maximum feasible or potential output that can be produced by a farm from a given combination of inputs and technology.

Using stochastic frontier model proposed by Aiger *et. al.,* (1977), the level of technical efficiency is estimated. The Cobb-Douglas functional form is generally preferred in most published paper on technical efficiency because of its well-known advantages. In this study also the Cobb-Douglas functional form is used and given by:

$$y_i = \beta_0 \prod_k X \beta_{ki}^{ki} e^{\xi i} \quad i= 1,2,\ldots\ldots\ldots n$$

Where, Y_i is the output per hectare of the i^{th} farm, X_{ki} is a vector of k input per hectare for the i^{th} farm and ξ_i is a farm- specific error term. On natural log transformation, it become as follows:

$$\ln y_i = \ln\beta_0 + \sum\beta_k (X_{ki}) + \xi_i ,\ i= 1,2, \ldots\ldots n$$

The disturbance term ξ_i is divided into two components, stochastic disturbance v_i, and one sided efficiency disturbance u_i

Thus, $\xi_i = v_i - u_i$

The v_i represents the symmetric component and permits random variation in output due to factors like weather and plant disease. It is assumed to be identically distributed as $N(0,\sigma_v^2)$.

The error component $u_i \geq 0$ reflects the technical efficiency and is generated from a one-sided probability distribution. It is assumed to be distributed independently of v_i - u_i is distributed as the absolute value of $N(0, \sigma_u^2)$. i.e., the distribution of u is half-normal. The disturbance u_i reflects the fact that is each farm's output must lie on or below the frontier. Thus $u_i = 0$ for any farm lying on the frontier, while $u_i \geq 0$ for any farm lying below the frontier. Weinstein (1964) first derived the distribution function of the composite error. The density function of ξ can be stated as:

$$F(\xi)= (2/\sigma)\ f^*(\xi/ \sigma)[1-F^*(\xi \,\square\, \sigma^{-1})] \quad -\infty\leq \xi \leq\infty$$

Where, $\sigma^2 = \sigma_u^2 + \sigma_v^2$ and $\square = \sigma_u / \sigma_v$,

f*(.) and F*(.) are the standard normal density and distribution functions respectively. This density is asymmetric around zero, with its mean and variance given by

$$E(\xi)= E(u) = (\sqrt{2}/\sqrt{\pi})\ \sigma_u$$

$$V(\xi) = V(u) + V(v) = [(\pi-2)/\pi]\sigma_u^2 + \sigma_v^2$$

ʎ is interpreted to be an indicator of the relative variability of the two sources of random error that distinguish farms from one another. In addition, the variance σ_u^2 / σ_v^2, ratio represented by ϒ can also be a useful indicator of the influence of the inefficiency component in the overall variance ϒ ranges from zero to one in value. A value of ϒ close to one implies that the one side error u_i dominates the symmetric error v_i and the short fall of the realize output from the frontier is largely due to technical inefficiency. Hence, u_i represent the amount by which the frontier exceeds realized output direct estimated of the stochastic production frontier.

A model with this error specification is called as the stochastic frontier, since the non-positive component of the disturbance represent the shortfall of the actual output from the frontier, while the frontier contains the normal component of disturbance and is therefore stochastic. For the study, a Cobb-Douglas production function of the following form will be specified.

$$\ln Y_i = \ln \beta_0 + \beta_{1i} \ln X_{1i} + \beta_{2i} \ln X_{2i} + \beta_{3i} \ln X_{3i} + \beta_{4i} \ln X_{4i} + V_i - U_i$$

Where, Y_i =yield (kg/farm), X_1= Expenditure on seed (Rs/farm), X_2= Expenditure on labour (Rs/farm), X_3=Expenditure on fertilizer (Rs/farm), X_4=Expenditure on irrigation (Rs/farm),

$\xi_i = v_i - u_i$ i=1, 2, 3………n farms. Farm specific technical efficiency was worked out as the ratio of production of the i^{th} farm to the frontier production of the same farm (Aigner *et al.* 1977). MTE was calculated by taking the average of the farm specific technical efficiencies.

RESULT AND DISCUSSION

The data was collected from the farmers through personal interview method using well-structured and pre tested interview schedules. The major input for which the cost was worked out included seed, labor labour, plant protection, fertilizer, manures etc. The collected data was analyzed in order to estimate costs and returns and to work out the technical efficiency. Olayiwola(2012) estimated a Cobb-Douglas production frontier by using a Maximum Likelihood (ML) procedure for a sample of 91 paddy farmers from the Ibadan Metropolis in Oyo state. Results of the second stage analysis showed that level of schooling was not significant in explaining differences between maximum and actual yield. However, farmer's non-formal education, defined as their understanding of current technology, had a significant positive role on productivity. In order to estimate the technical efficiency among the farmers, the stochastic function of Cobb- Douglas form was estimated using this method. The technical efficiency of soybean was estimated using this method. The technical efficiency of soybean was estimated using a frontier production function. The variables were expenditure on seed and fertilizers, expenditure on plant protection chemicals (PPC) and labour expenses and the dependent variable as the yield of soybean.

Table 1. Technical efficiency of soybean

Small			Medium			Large		
Yield	Predicted value	T. E.	Yield	Predicted value	T. E.	Yield	Predicted value	T. E.
1.00	1.25	0.8	1.41	1.52	0.93	1.60	1.73	0.92
1.15	1.25	0.92	1.30	1.33	0.98	1.48	1.53	0.97
0.95	1.25	0.76	1.20	1.32	0.91	1.43	1.52	0.94
1.04	1.14	0.91	1.30	1.57	0.83	1.54	1.63	0.95
1.11	1.12	0.99	1.15	1.16	0.99	1.49	1.49	1.00
1.15	1.34	0.86	1.08	1.28	0.84	1.52	1.62	0.94
1.18	1.38	0.86	1.18	1.24	0.95	1.40	1.50	0.93
1.00	1.23	0.81	1.34	1.36	0.99	1.51	1.63	0.93
1.08	1.18	0.92	1.40	1.63	0.86	1.38	1.41	0.98
1.04	1.14	0.91	1.36	1.56	0.87	1.58	1.73	0.91
			1.15	1.19	0.97	1.45	1.64	0.88
			1.11	1.21	0.91	1.46	1.62	0.90
			1.43	1.62	0.88	1.40	1.40	1.00
			1.30	1.33	0.98	1.53	1.62	0.94
			1.45	1.46	0.99	1.52	1.72	0.89
			1.28	1.56	0.82	1.49	1.59	0.94
			1.43	1.45	0.99	1.48	1.49	0.99
			1.15	1.34	0.86	1.54	1.55	1.00
			1.43	1.52	0.94	1.53	1.55	0.99
			1.20	1.49	0.80	1.38	1.43	0.97
N		**10**	**N**		**20**	**N**		**20**
Mean		**0.87**	**Mean**		**0.91**	**Mean**		**0.94**
S.D.		**0.093**	**S.D.**		**0.065**	**S.D.**		**0.037**
C.V.		**10.64**	**C.V.**		**7.10**	**C.V.**		**3.93**
Minimum		**0.760**	**Minimum**		**0.800**	**Minimum**		**0.880**
Maximum		**0.990**	**Maximum**		**0.990**	**Maximum**		**1.000**

Table 1 indicated that the technical efficiency of small farmers which varies from 76% to 99% with the coefficient of variation 10.64% with mean 87% and medium farmers varies from 88% to 99% with mean 91% and C.V. 7.10%. The technical efficiency of large farmers varies from 88% to 100% with mean 94% and C.V. 3.93%. Large farmers are more technically efficient than the medium and small farmers. The reason behind this is the large farmers are educated and they have more facility of agriculture implement and knowledge so due to this their technical efficiency is high and medium and small farmers are not as much as educated as higher groups. So they have the lack of knowledge and have less facility in comparison to large group. Therefore, small soybean grower should be given with the expose of technical knowledge by educating them, through training programme or demonstrated on their field. The medium farmers should also be given the training programme for the vertical growth in the production of soybean. The large farmers show high technical efficiency with the higher stability and variability in the small farmers are more in comparison to medium and large farmers. The tables 1 also indicated the technical efficiency of small medium and large farmers. For small farmers the mean technical efficiency is 88% with S.D. 6%, Medium farmers have the technical efficiency 91% with S.D. 6% and large farmers have the mean technical efficiency 94% and S.D. 5%. The variability among the small farmer is high followed by medium and large farmers. The finding is in line with olayiwola research work (2013).Technical efficiency is high in large followed medium and small farmer. It means large farmers have more knowledge about the technology and they apply it since their technology is stable in comparison to medium and small. So small and medium farmer need more training regarding the technology generates and also require education for the stability of technology.

Table 2. Frequency distribution and descriptive statistics of technical efficiency of soybean in study area

Small farmers			Medium farmers			Large farmers		
T.E.	**Frequency**	**Percent**	**T.E.**	**Frequency**	**Percent**	**T.E.**	**Frequency**	**Percent**
0.76-0.80	2	10	0.80-0.84	4	20	0.88-0.91	4	20
0.81-0.84	1	5	0.85-0.90	4	20	0.92-0.95	8	40
0.85-0.90	2	10	0.91-0.95	5	25	0.96-0.98	3	15
0.91-0.95	4	20	0.96-0.99	7	35	0.99-1.00	5	25
0.96-0.99	1	5	-	-	-	-	-	-
Total	**10**	**50**	**Total**	**20**	**100**	**Total**	**20**	**100**

The analysis of efficiency revealed the mean technical efficiency of soybean as 0.90 and 0.92 respectively. From table 2 the frequency distribution of the sample farmers according to the farm specific technical efficiency showed that 50-60% of the farmers in the areas lay in an efficiency level of 80-90%. The study has indicated that soybean farmers are substantial technical inefficient. Hence, the study indicates considerable potential for improving productivity of the crop with given level of input' use and technology. In addition, improving efficiency will mean farmers gaining considerably in terms of profits. Inefficiencies could be attributed to non-farm employment, education level, farm experience, degree of specialization, etc. setting minimum education level in primary schools for the long run result and increasing number of extension workers are other policy options to increase the technical efficiency. There is therefore, a substantial potential for enhancing profitability is by reducing costs through improved efficiency. By operating at full technical efficiency levels, on average, the sample producers would be able to reduce their costs of production. This potential cost saving in production costs will translate into enhanced profitability and additional income for soybean producers.

Table 3. Coefficient of production functions of small medium and large farmers

	Unstandardized Coefficients β			t			Sig.		
	small	Medium	Large	Small	Medium	Large	Small	Medium	large
(Constant)	0.27	1.80	-3.03	0.40	2.41	-5.68	0.71	0.03	0.00
Seed	0.27	0.38	0.36	0.88	1.68	1.26	0.43	0.15	0.23
Labour	-0.02	-0.99	-0.04	-0.13	-3.55	-0.31	0.91	0.01	0.76
Plant protection	0.51	0.79	0.37	4.04	5.24	3.80	0.02	0.00	0.01
Fertilizer	-0.13	0.38	-0.15	-0.58	2.75	-0.93	0.60	0.07	0.36
Manure	-0.24	-0.53	0.71	-0.81	-0.39	2.08	0.45	0.02	0.06

Dependent Variable: yield

The coefficients of production function of small medium and large the rates of all parameters are less in large farmers in comparison to small medium and large. It shows inputs inequalities utilization among the different categories of farmers. There are unfair for the latest knowledge of seed, optimum use of labour, proper timely application of plant protection and timely application of fertilizer and manure.

CONCLUSION

Some suggestions for higher and equitable production of soybean are given below:

1. Farmers having more contacts with extension agents are less inefficient than the farmers having low/no contacts. Therefore, the policy makers should focus on enhancing farmer's access to information via provision of better extension services.
2. Farmers having better access to credit are more efficient than those with poor access to credit. So government should ensure the implementation of credit schemes by opening branches of Banks and other related agencies in rural areas.
3. The younger farmers are technically less inefficient than the older ones. It is fact that increased age would lead to decline the efficiency of farmers. So government should device policies to attract and encourage younger people in farming by providing them incentives. This would lead to enhance agricultural productivity efficiency by the injection of new blood in agriculture.
4. The small farmers are pure technically more efficient than medium and large farms. Hence, government should devise programs aimed at supporting the small farms in the study area. However, government support programs for the small farms should not, in any way, hinder the growth of the large farms.
5. The scale inefficiency accounts for a larger share of technical inefficiency on small farms than on medium and large farms. Thus, the increasing scale of operation is imperative to improve overall technical efficiency of the farms. Cooperative and corporate farming appears to be the most feasible options in this regard.

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