

ANALYSIS OF RESOURCE USE EFFICIENCY AMONG SOYBEAN (*GLYCINE MAX*) FARMERS IN GBOKO LOCAL GOVERNMENT AREA OF BENUE STATE, NIGERIA

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ABSTRACT

The study examined the efficiency of resource use in soybean production in Gboko Local Government Area of Benue State, Nigeria. The objectives of the study were to identify and describe the socio economic characteristics of soybean farmers and to determine resource allocation among soybean farmers. Multi-stage random sampling technique was used to select a sample of 120 respondents. Data collected were subjected to Descriptive statistics and production function analysis. The result revealed that 93.3% of the farmers had one form of formal education, or the other with over 65% cultivating between 1-4 hectares. Also, 87.5% of the farmers were in their active age, and 81.7% utilized their personal saving as a major source of finance for production. The result of the production function analysis indicated that 87.21% of the variation in the output of soybean is explained for by the independent variables. Resource-use efficiency revealed that quantity of seed, farm size, herbicide and inorganic fertilizer were underutilized while labour was over utilized. Provision of adequate and timely farming inputs, making loans accessible to farmers and reasonable market price of soybean are essential to boost production.

KEYWORDS: Analysis, Resource use efficiency, Farmers, production function analysis, Benue, Nigeria.

INTRODUCTION

Soybean (*Glycine max*) is an important crop in the world. The crop can be successfully grown in many states in Nigeria using low agricultural input. Soybean cultivation in Nigeria has expanded as a result of its nutritive and economic importance and diverse domestic usage. It is also a prime source of vegetable oil in the international market. Soybean has an average protein content of 40% and is more protein-rich than any of the common vegetable or animal food sources found in Nigeria. Soybean seeds also contain about 20% oil on a dry matter basis, and this is 85% unsaturated and cholesterol-free (Dugje *et al.* 2009). Of the oil fraction, 95% is consumed as edible oil with the rest used for industrial products from cosmetics and hygiene products to paint removers and plastics (Liu 2008). Recently, soybean is found to be an industrially important crop used as anti-corrosion agent, core oil, and bio-fuel due to less or no nitrogen element in the oil, and as disinfectant, in pesticides, printing inks, paints, adhesives, antibiotics and cosmetics (Ngalamu *et al.* 2012).

The animal protein intake in Nigeria is below the United Nations and Food and Agriculture Organization recommended optimal daily requirement of 20 grams for developing country as against the 75 grams for normal growth and development (FAO, 1992). Although protein in human diet is derived from both plant and animal sources the declining consumption of animal protein due to its high prices requires alternative sources. Soybean

provides a cheaper and high protein rich alternative substitute to animal protein. The inclusion of soybean in the carbohydrate rich staple food in Nigeria will increase their protein content (Ashaye, Adegbulugbe and Sanni, 2005 and Ajobo and Akinyemi, 2007). Estimates show that about 925 million individuals are undernourished worldwide (FAO 2010b). Soybean has the potential to address the needs of these individuals through increased local production and consumption of the crop. Development of locally adapted soybean varieties consumed either as cooked mature seeds or immature green seeds would offer vital nutrients and bring balance to the undernourished diet. Other than the high protein content, it also has good amount of calories and fat. It contains the eight essential amino acids and is a rich source of polyunsaturated fatty acids (including the good fat-omega 3) and is free of cholesterol (Food and Agriculture Organization, 1999).

Agricultural research centers like the International Institute of Tropical Agriculture's (IITA) main goal is to generate technologies that will improve productivity, welfare of the farmers, and household nutritional status. Benue state is acclaimed the nation's "food basket" because of its rich and diverse agricultural produce which include yams, rice, beans, cassava, potatoes, maize, Soybeans, sorghum, millet and cocoyam. The state also accounts for over 70 percent of Nigeria's Soybeans production. (Retrieved from: <http://www.greaterbenue.com> on the 25th February, 2015) The Benue State Agricultural and Rural Development Authority (BNARDA 1995) also reported

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that Benue state accounts for over 70% of soybean production in Nigeria. Similarly, a survey conducted and reported by IITA in 1989 revealed that Benue State remained the major producer of soybean in Nigeria. The citizens of the state especially in the rural areas are predominantly engaged in farming activities.

Production efficiency means the attainment of production goals without waste. Efficiency is often used synonymously with that of productivity which relates output to input. In agriculture, the analysis of efficiency is generally associated with the possibility of farm production to attain optimal level of output from a given bundle of input at least cost. Resource use efficiency means how efficiently the farmer can use his resources in production process. Analysis of resource use is very important because our resources are limited. In order to achieve optimum production level, resources must be available and whatever quantities of available resources must be used efficiently. Successful result oriented farm planning and policies require the knowledge of productivities of farm resources to know the resources whose quantity or rate of use should be increased or decreased (Sani *et al.* (2010) in (Alimi, 2000). Mugabo *et al.* (2014) in their study of Resource use Efficiency in Soybean Production in Rwanda reported that with an elasticity of 0.46, plot size was the most important factor of soybean production. It was closely followed by intermediate inputs (fertilizers, pesticides and seeds), with a coefficient of 0.44. When intermediate inputs were decomposed, fertilizers with an elasticity of 0.062 appears to contribute more to soybean production than pesticides (0.057) and seeds (0.034). Technical inefficiency was responsible for at least 93% of total variation in soybean output among the survey farmers. The relative efficiency (allocative efficiency) of resource use, expressed as the ratio of marginal value product (MVP) to marginal factor cost (MFC), were 1.73 for soybean plot size, 1.36 for fertilizers, and 1.92 for pesticides. These indicate that too little of these inputs are being used in relation to the prevailing market conditions.

Also, Olorunsanya *et al.* (2009), in their study revealed the marginal analysis of resource utilization for soybean in Kwara State, North Central Nigeria, and showed that there was inefficiency in the utilization of resources in the area with land being underutilized and other resources labour, seed and herbicide been over utilized. Findings from most of the existing studies revealed that farmers are inefficient in their resource allocation. Some of the different variables that leads to inefficiency as reported by most studies majorly are socio-economic variables such as farmers' age, level of education, farm size, number of hired workers, years of farming experience, access to extension contact, land ownership, cooperative membership etc. All these negatively affect the efficacy of resource use by the peasant farmers.

In order to ensure efficiency of resource use by farmers in Benue state, the Benue State Agricultural and Rural Development Authority (BNARDA) to serve as a research centre too, was established by the Benue State government as a Parastatal under Edict No. 7 of 1985 targeting essentially the small scale farmers. BNARDAs overall objectives are to promote increased agricultural production in the state and raise the income and

standard of living of the farmers. In order to make the impact of BNARDA felt in the whole state it is operated on the basis of three agro-development zones, namely, Central Zone with headquarters at Otukpo, Eastern Zone with headquarters at Adikpo, and Northern Zone with its headquarters located at Gboko.

Despite the efforts of BNARDA in the state and other agricultural research institutes, soybean farmers are still not efficient in the use of available resources and in an attempt to address this, the study was carried out with the broad objective to determine the Analysis of Resources use Efficiency among Soybean Farmers in Gboko Local Government Area of Benue State, Nigeria. The specific objectives were to describe the socio-economic characteristics of soybean farmers in the study area and determine the efficiency of resource use among the soybean farmers.

METHODOLOGY

The study was conducted in Gboko Local Government Area of Benue State. Gboko Local Government is located between latitudes $6^{\circ} 3'$ and $8^{\circ} 1'$ North of the Equator and longitudes 8° and 10° East of the Greenwich Meridian (Benue State Government Diary, 2009). The Local Government is bounded by Tarka and Guma local government's Areas to the north, Ushongo Local Government to the south, Buruku Local Government to the East, and Konshisha Local Government to the South- West while Gwer Local Government lies in the West. The local government derived its name from the sceneries common trees known as Gboko which grows especially on the hills at the north western part of the area (Abaya, 2013). The local government covers a land mass of 2264 km² with a population of 361,325 people (National Population Commission, NPC, 2006) making Gboko one of the most populous Local Government Areas in Benue State.

The Local Government Area has a tropical climate marked by two distinct seasons (the wet or rainy season and the dry season). The rainy season lasts from April to October with an August break. The annual rainfall is in the range of 1500 mm to 1800 mm. The dry season begins in November and ends in March with a dust laden spell, the Harmattan wind that blows from across the Sahara. The temperature fluctuates between 23°C and 35°C. Because the soil is rich, sandy loamy and very fertile for most savannah food crops, Gboko farmers produce root crops such as yams, cassava, and sweet potatoes in large quantities beyond subsistence level. The rich agricultural soil of the local government ranks Gboko as the highest producers of soybeans as well as other grains/seeds like maize, guinea corn, groundnut etc. (Abaya, 2013).

The population of this study consisted of soybean farmers in Gboko Local Government Area of Benue State. Gboko Local Government Area has six districts and seventeen wards. The districts are; Ipav, Mbayion, Yandev, Township, Mbatyav and Mbatieriev while the wards include; Gboko North/West, Gboko South, Gboko East, Gboko Central, Igyorov, Mbakpegh, Mbadim, Mbaanku, Mbaavarakaa, Mbakwen, Mbadam, Mbatyu, Ukpekpe, Mbatsegh, Mbatan, Mbaiwar and Utabar Mbatieriev. Multi-stage random sampling technique was used to select respondents for the study. In the first stage, six out of the seventeen wards in

Gboko Local Government Area were randomly selected, that is, one wards each from the six districts. In the second stage, two villages were randomly selected from each of the six wards giving a total of twelve villages. A total of 350 farmers were found to be involved in soybean production in the selected villages (BNARDA, 2012). A total of 120 questionnaires were administered

to randomly selected farmers in the villages. The distribution was proportionately done based on the number of farmers in the selected villages and all the questionnaires were retrieved and used for the analysis. The distribution of sample in the twelve (12) selected villages is presented in Table 1.

Table 1: Distribution of Sample in the 12 Selected Villages in the Study Area

S/N	Wards	Villages	No. of farmers	No. sampled
1	Igyorov	Mbadim	41	14
		Mbangu	23	8
		Subtotal	64	22
2	Gboko North-West	Anikyenge	52	18
		Ayaba	30	10
		Subtotal	82	28
3	Mbadim	Akpagher	47	16
		Ikumbur	35	12
		Subtotal	82	28
4	Mbakwen	Mbajen	38	13
		Mbajor	20	7
		Subtotal	58	20
5	Utabar	Mbaanyabe	23	8
		Mbatitiv	18	6
		Subtotal	41	14
6	Mbatyu	Tsekucha	14	5
		Amua	9	3
		Subtotal	23	8
Grand Total			350	120

Source: Field survey, 2014

Descriptive statistics made use of percentages and means to describe the socio-economic characteristics of soybean farmers while the production function analysis was used to examine resource allocation pattern among respondents. Four functional forms of production function analysis namely linear, semi-log, double log and exponential function were tried. The Cobb-Douglas or double log gave the best fit and is expressed explicitly as $\text{Log } Y = B_0 + B_1 \text{Log} X_1 + B_2 \text{Log } X_2 + B_3 \text{Log} X_3 + \dots + B_5 \text{Log} X_5 + U_i$ (3.1) Where: Y = Output of soybean in (kg), X_1 = Quantity of soybean seed used (kg), X_2 = Farm size (ha), X_3 = Quantity of herbicides used (litres), X_4 = Labour in man-days, X_5 = Quantity of inorganic fertilizer used (kg), B_0 = Constant, B_1 - B_5 = coefficient of independent variables to be estimated and U_i = Error term.

Regression coefficients ($b_1 - b_5$) from the regression analysis were used to compute the Marginal Value Product (MVP) for each input used. The computation of MVP and the Marginal Factor Cost (MFC) are as follows:

$$MVP = MPP_x P_y \dots\dots\dots (3.2)$$

$$MFC = P X_i \dots\dots\dots (3.3)$$

Where:

P_y = Unit price of 100 kg bag of soybean

MPP = Marginal Physical Product ($\frac{dy}{dx_i}$) to be estimated based on the selected functional form (i.e., the product of regression coefficient and the mean output).

MFC = Unit cost of that particular input

The ratio of the MVP to MFC was used to determine the efficiency resources were used. That is,

$$r = \frac{MVP}{MFC} \dots\dots\dots (3.4)$$

Where: r = efficiency parameter, MVP = the Marginal Value Product, MFC = the Marginal Factor Cost of input (input prices).

Decision Rule

- i. If the efficiency ratio (r) = 1: there is efficiency of resource-use
- ii. If the efficiency ratio (r) > 1: the resource is under-utilized
- iii. If the efficiency ratio (r) < 1: the resource is over-utilized (Moses and Adebayo, 2007; Goni and baba, 2007).

The MVP_x for each input used will be computed using the regression coefficients of each input. The MFC is the prevailing market price of each input or geometric mean value of the input (x).

Socio-economic Characteristics of Respondents

The study revealed that 82.5% of the respondents were male and 82.5% were equally married indicating that soybean production in the study area is dominated by the male although the female plays complimentary roles. Ndaghu *et al.* (2009) reported that males are the most household heads and they are

responsible for major production decisions. The majority 68.3% of the respondents were aged 15-44 years, while the average age of the respondents was 39 years indicating that majority of the soybean farmers in the study area were within the most active age of the population. It also indicates that their productivity is expected to increase because younger farmers adopt new agricultural innovations easier than older farmers. The majority 93.3% had one form of formal education or the other. Ajao *et al.* (2012) stated that the more educated farmers are, the higher there utilization of soybean production process. The predominant land tenure system was inheritance; representing 65%. Ojo *et al.* (2008) and Omonona *et al.* (2010) both reported that majority of their respondents acquired their land through inheritance and family land. The mean farm size

was 3.4 ha, with 71.6% of the respondents having a farm size of 1-4 ha. The major source of finance was through personal savings, 81.7%. This could negatively affect farmers especially when there is need to buy new farm inputs. Also, 84.2% of the respondents used improved seed in cultivating soybean and majority 72.5% had no personal access to extension personnel. Similarly, 60% had farming as their main occupation while 49.2% made use of family labour in the cultivation of soybean. The mean age of farming experience was 18 years and 35% of the respondents were having 21 years and above. Tashikalma (2007) also reported that farmers with more years of farming experience are better in terms of handling farm operations compared to farmers with fewer years of farming experience. Also, only 39.8% were members of a cooperative association.

Table 2: Descriptive Statistics of Soybean Farmers

Item	Frequency	Percentage
Gender		
Male	99	82.5
Female	21	17.5
Total	120	100
Marital status		
Married	99	82.5
Single	12	10.0
Widow	6	5.0
Divorced	3	2.5
Total	120	100
Age (years)		
15-24	10	8.3
25-34	24	20
35-44	48	40
45-54	33	27.5
55	5	4.2
Total	120	100
Level of education		
No formal education	8	6.7
Primary education	29	24.2
Secondary education	64	53.3
Tertiary education	19	15.8
Total	120	100
Mode of land acquisition		
Inherited/family land	78	65.0
Leased land	34	28.3
Gift	8	6.7
Total	120	100
Farm size		
1-2	49	40.8
3-4	37	30.8
5-6	23	19.2
7	11	9.2
Total	120	100
Farming experience (years)		
1-10	24	20
11-20	54	45
21-30	30	25
31	12	10
Total	120	100
Source of labour		
Family labour	59	49.2
Hired labour	16	13.3
Family and hired labour	33	27.5
Group contribution	12	10.0
Total	120	100
Type of seed used		
Improved seed	101	84.2
Local variety	19	15.8
Total	120	100

Source: Field Survey, 2014

Production function analysis

Production function analysis was used in examining the influence of various inputs ($X_1 - X_5$) on the output of soybean. The data obtained were subjected to four functional forms namely linear, semi-log, double log and exponential function and Double log gave the best fit based on a priori expectation of fulfilling economic, statistical and econometric criteria with respect to signs, magnitude and significance of the regression coefficients and the result is presented in Table 3. The coefficient of multiple determination, (adjusted R^2 in the model was 0.872058 meaning that 87.21% of the variation in the output Y is explained by the independent variables. The entire coefficients in the chosen model carry the expected positive sign. The production function estimates indicates the relative importance of factor inputs in soybean production. From the result in Table 3, farm size (X_2) factor input appears to be the most important factor of production with an elasticity of 0.470. The positive coefficient of farm size conforms to *a priori expectations* and is significant at 1% probability level. The significance of this variable is as a result of its importance in crop production since its

shortage would not only pose a direct negative effect on production but also an indirect negative effect on output through reducing the marginal productivity of non-land input (Shehu and Mshelia, 2007). The coefficient of seed (X_1) was positive (0.388761) and is statistically significant at 1% implying that a unit increase in the quantity of soybean seed will cause a corresponding increase of 0.388761kg *ceteris paribus*. The coefficient of labour input (X_4) is also positive (0.033) and statistically significant at 1% level, suggesting its importance in agricultural production. The coefficient of inorganic fertilizer (X_5) is also positive (0.192) and statistically significant at 1% meaning that fertilizer increases yield (output) when applied appropriately. In this analysis, a 1% increase in fertilizer application by soybean farmers would increase output by 19.2%. Similarly, the coefficient of herbicide used (X_3) is positive (0.154) and is statistically significant at 5% level, meaning that a 5% increase in the quantity of herbicide would bring about 15.3% increase in output of soybean if applied appropriately by the farmers. Ani *et al.* (2012) also reported on similar findings on leguminous crops in Benue state.

Table 3: Regression Result Double log function for Soybean Farmers

Variable	Coefficient	Standard Error	t-value
Quantity seed (X_1)	0.388761	0.075586	5.143274***
Farm Size (X_2)	0.470114	0.065685	7.157072***
Herbicide (X_3)	0.153530	0.076803	1.999003**
Labour (X_4)	0.033065	0.004461	7.411400***
Inorganic fertilizer(X_5)	0.192362	0.037259	5.162815***
R^2	0.880659		
Adjusted R^2	0.872058		
S.E of regression	0.056498		
F-Value	528.7607***		
Durbin-Watson Stat	1.493442		

Source: Computer printout, 2014: **, *** indicate significance at 5% and 1% probability

Marginal productivity of resource use in soybean production

The marginal physical product (MPP) for input utilization was derived from the estimated regression coefficients and the arithmetic mean values of output and inputs as shown in Table 5. The marginal physical product for each of the resources was obtained based on the Double log production function. Farm size (hectares) gave the highest value of marginal physical product (233.49). The implication is that an increase in farm size by one hectare would result in extra 233.49 kg of soybean. Efficiency of the marginal value product

(MVP) of seed (X_1), farm size (X_2), herbicide (X_3), and inorganic fertilizer (X_5) to their corresponding marginal factor costs (MFC) revealed that the ratio was greater than unity for these inputs, indicating that the inputs were both underutilized. On the other hand, the efficiency of the marginal value product (MVP) of labour (X_4) to its corresponding marginal factor costs (MFC) showed that the ratio was less than unity for this input implying that it was over utilized. Optimal resource allocation requires that the marginal value product (MVP) be equal to marginal factor cost (MFC).

Table 4: Estimated Marginal Physical Product and Resource Use Efficiency

Variable	Production elasticity	MPP	MVP	MFC	MVP/MFC	Resource efficiency
Seed (X_1), Farm size	0.388761	12.54	94,014.37	6,469.4	14.53	Under-utilized
(X_2) Herbicide	0.470114	233.49	163,442.97	4200	38.91	Under-utilized
(X_3) Labour	0.153530	77.28	66,979.45	5,130.69	13.05	Under-utilized
(X_4) Fertilizer	0.033065	1.16	463.47	34,016	0.01	Over-utilized
(X_5)	0.192362	2.33	12,816.31	5,333	2.40	under-utilized

Source: Field Survey, 2014

CONCLUSION

The study examined the analysis of resource use efficiency among soybean farmers in Gboko local government area of Benue state, Nigeria. The socio economic analysis of the respondents revealed that the majority 68.3% were young with mean age of 39 years. 82.5% were married and also 82.5% of the farmers were male. Majority of the farmers were small scale farmers and also the majority 93.3% had one form of education or the other. The major source of financing production was personal saving and the predominant land tenure system was inheritance. The majority of the farmers 72.5% had no personal access to extension personnel and only 39.8% belonged to a cooperative society. The production function analysis also revealed that quantity of seed used, farm size, herbicide and inorganic fertilizer were underutilized whereas labour was over utilized. The following recommendations are suggested; appropriate use of quantity of seed/ha, efficient use of available farm size for planting soybean as sparsely planted by some farmers, inadequate application of fertilizer and herbicide should be adjusted to bring output to optimal level. Also the standard man days of labour should be utilized in soybean production to avoid its overutilization and the surplus hours channel into other farming activities. Or necessary adjustments of the production inputs should be made to bring production to optimal level. Farmers are also encouraged to form cooperative groups to help them buy farm inputs (fertilizer, herbicide) etc. at reasonable prices and jointly market their produce at favourable prices too to eliminate the role of middlemen. Cooperative societies also will help the farmers' access agricultural loans at reasonable interest rates too. Additionally, favourable prices of soybeans could attract the youths into its production and will correct the existing scenario that farming is left for the weak and old in our rural communities. Lastly the mode of land ownership, inheritance, should be addressed by the government at all levels to facilitate additional production of soybean in the study area.

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