Available online at www.pelagiaresearchlibrary.com

Pelagia Research Library

Advances in Applied Science Research, 2011, 2 (4):72-78

Productivity and Profitability Analyses of Cowpea Production in Kaduna State

[1]Adeola[*], S.S., [1]Folorunso, S.T, [1]Gama, E.N., [1]Amodu, M.Y, and [2]Owolabi, J.O.

[1]Department of Agricultural Economics and Rural Sociology, Institute for Agricultural Research, Ahmadu Bello University Zaria, Nigeria
[2]Department of Agricultural Engineering, Institute for Agricultural Research, Ahmadu Bello University Zaria, Nigeria

---

ABSTRACT

This study estimated the productivity and profitability of cowpea production in Kaduna State, north central Nigeria. A multi-stage random sampling method was used to select 150 cowpea farmers who were interviewed for the study. Information on the inputs used and output realized in cowpea production were collected from the farmers using well structured questionnaires. The data generated from the information collected were subjected to various analyses using the production function analysis model, total factor productivity (TFP) and the gross margin equations. The coefficient of determination (R^2) of the regression was 83% with the coefficients of all the input variables (except fertilizer) significant different levels. The TFP shows that the combined factor inputs used in cowpea production in the study area has a positive effect on cowpea output. Cowpea production in Kaduna state was profitable with a gross margin of ₦13584594. It was also found that the gross margin per hectare in cowpea production in the study area was ₦46, 090 while the return per Naira (₦) invested was 45kobo. It was further discovered that inputs were inefficiently utilized. Suitable adjustment in the inputs used was recommended to further widen the profit margin.

Key words: Profitability, productivity, cowpea.

INTRODUCTION

Cowpea (*Vigna Unguiculata*) is an important food grain legume in the tropics. The diet of most people in developing countries is based on processed cereal grains, root and fruits [1]. These provide starch for its consumers and also because they are eaten in large quantities, they provide considerable level of protein. However, the quality of protein leaves much to be desired particularly for children, pregnant and lactating women. Cowpea, because of its high protein

content, constitutes the natural protein supplement and represents the legume of choice for many people in Africa [2].

Cowpea is an important source of food for man, cash, animal feed and soil nitrogen [3]. The global annual production of cowpea was about 3.6 metric tones of which Africa accounts for about 64% [4]. Similarly, it was reported that Nigeria, being the largest producer of cowpea in the world accounts for more than 2 million metric tones which represents about 50% of the total world cowpea production annually [5]. The average yield per hectare of cowpea in Nigeria is only 417 Kg per hectare [6], below an achievable yield of between 1500-3000Kg/ha [7] and the grain yield per hectare of 2,666Kg and 687Kg obtained in Egypt and Malawi respectively in 2009 [8]. Over the years, the difficulties faced by many developing countries are satisfying the food requirement of her population [9]. As a result, widespread food shortage, hunger and malnutrition have persisted particularly among the low income groups in developing nations.

Productivity is defined as the ratio of the output that is produced to the inputs used [10]. It was further stated that the concept of productivity refers to total factor productivity, which is a productivity measure involving all factors of production. Productivity and resource allocation are important aspect of increased food production [11]. Major motivations for productivity are profitability and efficiency. The efficient allocation of resource at the farm level has great implication for national development. It will lead to a rise in Gross National Product (GNP) and consequently, increase in per capita income. Profit maximization may not be the primary aim of small scale farmers for many reasons, in the long run, farmers are still interested in knowing how much they have given up to meet other goals [12]. It is therefore believed that analyses of productivity , profitability and resource used efficiency levels of cowpea farmers enables one to make policy recommendations for better efficiency and productivity. The broad objective of the study therefore was to analyze the productivity and profitability of cowpea production in Kaduna State, Nigeria. Specifically, the study aimed at determining the technical relationship between the inputs used in cowpea production and the output realized; estimating the total factor productivity in cowpea production in the study area; computing the resource used efficiency levels of factor inputs in cowpea production in the study area and estimating the profitability of the cowpea production enterprise among the farmers in Kaduna State.

MATERIALS AND METHODS

The study was conducted in Kaduna state, Nigeria. The state falls within the savannah region where cowpea production is prominent. Kaduna State is located between latitude 10^0 21^1 and 10^0 33^1 N of the equator and longitude 7^0 45^1 and 7^0 75^1 E of the Greenwich meridian. Kaduna state occupies a total land area of about 46,053Km^2 with an estimated population of 6,066,562 people. A multi-stage sampling procedure was used to select 150 farmers from who the data used for this study were collected using the interview method with the aid of a well structured questionnaire in the 2009 production year.

A production function model implicitly stated as

$$Y = f(X_1, X_2, X_3, X_4, X_5, U) \quad \text{.....1}$$

was used to determine the technical relationship between the inputs used and output obtained. Y= output, X_1= farm size (Ha), X_2= fertilizer (Kg), X_3= labour (mandays), X_4= seed (Kg) and X_5= insecticides (litre) and U= error term. Three functional forms were tried and the functional form which best explains the input-output relationship was selected. The selection was based on the value of the coefficient of determination (R-square), number of significant variables and conformation to the *apriori* expectations.

The model specifications for the different functional forms used are as follows:

Linear form:

$$Y = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \mu \text{……..……(2)}$$

Semi-log form:

$$Y = \alpha + \beta_1 logX_1 + \beta_2 logX_2 + \beta_3 logX_3 + \beta_4 logX_4 + \beta_5 logX_5 + \mu \text{.....(3)}$$

Double log form:

$$logY = \alpha + \beta_1 logX_1 + \beta_2 logX_2 + \beta_3 logX_3 + \beta_4 logX_4 + \beta_5 logX_5 + \mu \ldots\ldots\ldots\ldots\ldots\ldots\ldots (4)$$

Where: $\beta_1 - \beta_5$ are the coefficients of the corresponding variables and these variables are as defined earlier, α is the constant of the regression model and U is the error term

The total factor productivity analysis was used to estimate the total productivity of inputs used in cowpea production.

$$TFP = \frac{Y}{TVC} \quad \text{……...(5)}$$

Where TFP is the total factor productivity, Y, the output of cowpea realized in Kg and TVC is the total variable cost in Naira. Equation 2 can further be stated as

$$TFP = \frac{Y}{\sum_{i=1}^{5} P_{Xi} X_I} \text{……..…….(6)}$$

Where X_1 to X_5 are as earlier defined and P_{Xi} is the price of the i^{th} input.

Resource used efficiency ratio was used to compute the resource used efficiency level (r) of each of the factor inputs used in the process of cowpea production in the study area. The equation is given as

$$MVP_{Xij} = P_{Xij} \text{…….……....(7)}$$

Where i= the i^{th} input used and j is the j^{th} farm. When r is 1, a farm maximizes its productivity with respect to inputs used. However, if r >1, for any of the factor input, it is an indication that the resource was underused and if on the other hand, r<1, it shows that the resource was over utilized.

Assuming a negligible fixed cost among the small scale cowpea farmers interviewed, the gross margin analysis was used to determine the profitability while the internal rate of return (IRR) ratio was used to compute the return per Naira invested in cowpea production.

$$GM = TR - TVC \quad \text{.....(8)}$$

Where GM is the gross margin (the positive difference between total revenue and total cost of production) and TR is the total revenue.

$$IRR = \frac{GM}{TVC} \quad \text{.....(9)}$$

RESULTS AND DISCUSSION

To examine the technical relationship between output and the various inputs used in cowpea production, the production function was estimated. Three functional forms were fitted into the model. These include linear, semi-log and Cobb-Douglass (double log). Table 1 shows the summary of the result for the three functional forms. The selection of the lead equation was based on the comparison of the value of the coefficient of multiple determinations (R^2), statistical significance of the coefficient of the variables and the signs of the parameters estimated. The double log was selected based on the criteria listed above,

The result shows that the value of the R^2-adjusted was 83% which is an indication that 83% of the total variation in the output realized in cowpea production was explained by the various inputs used. All variable inputs used except fertilizer were significant at different levels of significance ranging from 1% to 10%. The coefficient of fertilizer was not significant probably due to the fact that cowpea has the natural ability to convert atmospheric nitrogen to forms which it can use; and thus many farmers might deemed it unnecessary to use in the course of cowpea production. However it was expected that cowpea farmers would use phosphorous based fertilizer like the single superphosphate (SSP) in cowpea production for optimal performance.

The coefficient of the size of farm cultivated was significant at 1% but with a negative sign. The negative sign indicate an inverse relationship as against the *apriori* expectation of a direct relationship. However, the inverse relationship suggests the fact that farmers might possibly be practicing a pattern of farming which tends towards intensive farming rather than the extensive system which is expected among the peasant farmers. Similarly, the coefficient of insecticide was significant at 1% but also with a negative relationship with the output. This might possibly be due to the fact that farmers were not following the recommended rate of mixture of the chemicals with water and were using over diluted chemicals since these chemicals are expensive.

Expectedly, the coefficients of labour and seed were both significant at 1% level and positive. This suggests that a unit increase in any of the two variable inputs in cowpea production holding all other explanatory variables constant will lead to an increase in the output. Higher seed rates, all things being equal, implies a greater number of crops per stand and consequently, higher yield. The same thing applies to labour. As long as it is not overused, it is expected that it will lead to an increased output.

Table 1 Production function estimates of cowpea production

Variable	Parameter	linear	Double-log	semi-log
Constant	b_0	226.26 (-17.85)***	-68429 (-17.85)***	739.13 (1.022)NS
Farm size (X_1)	b_1	285.72 (0.186)NS	-45779 (-8.193)***	393.21 (0.373)NS
Fertilizer (X_2)	b_2	0.5921 (6.052)***	-259.48 (-0.2019)NS	-667.60 (-2.753)***
Labour (X_3)	b_3	20.702 (0.57)NS	297323 (6.964)***	-409.30 (-0.5084)**
Seed (X_4)	b_4	48.410 (0.38)NS	22525 (3.452)**	1468.3 (1.193)NS
Insecticides (X_5)	b_5	-354.83 (-0.242)NS	-6209.6 (-1.662)*	-2118.8 (-3.007)***
R^2		61.5%	83.5%	98.9%
R^2 –Adjusted		60%	83%	98.8%

*** = 1% level of significance, ** = 5% level of significance, * = 10% level of significance while NS = not significant. t-values in parentheses*

Table 2 costs and Returns in cowpea Production

Variable	Cost (₦)	Revenue (₦)	Gross Margin (₦)
Land	1127643	----------	
Fertilizer	441764.9	----------	
Labour	3969614.21	----------	
Seed	398731	----------	
Insecticides	193795.64	----------	
Output	----------	19716143	
Total	**6131549**	**19716143**	**13584594**

Table 3 Estimated resource-use efficiency in cowpea production

Inputs	*MPP*	*MVP*	$MFC(P_X)$	$r = \frac{MVP}{MFC}$
Land	-34.46	-1724.7	3917.24	-0.44
Fertilizer	-399.5	-1995	35.68	-560.39
Labour	762.3	38153.1	395.31	96.51
Seed	157.58	7886.8	146.72	53.75
Insecticides	-2.95	-147.64	1022.21	-0.144

The total factor productivity computed for cowpea production in Kaduna state was 0.061. This is an indication that if all variable inputs used in cowpea production were proportionately increased by a unit, cowpea output will consequently increase by 0.061kg. It also means that the combined factor inputs used in cowpea production has a positive effect on cowpea output.

Table 2 is a summary of the costs and returns of cowpea production in the study area. The cost incurred by all sampled farmers on land was ₦1,127,643 while those of fertilizer, labour and seed were ₦44176489,₦ 3969614.21 and ₦398731 respectively. The farmers altogether spent ₦ 193795.64 on insecticides. The summation of these costs gave a total variable cost of N6131549. The total revenue obtained from the product of output and its unit price was ₦19716143. Thus, the gross margin obtained was ₦13584594. It was also found that the gross margin per hectare in

cowpea production in the study area was ₦46, 090. Furthermore, the ratio of total variable cost to gross margin computed was 0.45 meaning that for every ₦1 invested in cowpea production in the study area, 45k was realized. We can therefore conclude that cowpea production in the Kaduna state was profitable.

Resource use efficiency: Economic efficiency of resources used in cowpea production was determined using the ratio of the Marginal Value Product (MVPs) to the Marginal Factor Costs (MFC). The MVP for each of the inputs used was computed by multiplying the marginal physical product (MPP) of each input by the arithmetic mean price of the crop output. The MVPs and their ratios to the MFCs of the variable inputs used in cowpea production are presented on table 3. The result shows that all inputs were inefficiently utilized because they all have their efficiency ratios different from unity. From the result, it can further be inferred that labour and seed were under used. This means that an increase in the use of these inputs would have led to an increase in output of cowpea production in the area. Furthermore, a decrease in the use of land and insecticides would have led to an increased profit in cowpea production in the area.

Conclusion and Recommendations

Based on the findings of this study, it is concluded that cowpea production in Kaduna state is profitable with a return of 45k on every naira invested in cowpea production. However, profit can be increased if inputs used are adjusted to increase efficiency of usage. In view of this conclusion, the following recommendations are proffered:

Inputs like seed and labour that were underutilized should be increased for optimum profit, while land and insecticides should be decreased.

REFERENCES

[1] Ricardo Bressani. Nutritive value of cowpea In: cowpea Research, production and utilization (eds): S.R. Singh and K.O Rache. John Wiley and sons Ltd, Great Britain **1985**

[2] Wieng, H.C. and Summerfield R.J. Cowpea In: Goldsworthy, P.R. and Fisher, N.M. (eds) *The Physiology of tropical field crops*. John Wiley and sons, Chichester England. **1984**, p.353-383.

[3] Quin, F. Advances in cowpea Research (eds) Singh B.B, Mahan, R.,Dashiel, K.E., and Jackai, L.E.N. copub. IITA and JIRCAS, IITA Ibadan, Nigeria. **1997**, p10

[4] Mbene, F., N'Draye, M. and Lowemberg-DeBoer J. Identifying cowpea characteristics which command price premium in Senegalese Market. Presentation at the world cowpea conference Ibadan, Nigeria. **2000**

[5] Singh, B.B, J.D Ehlers, B. Sharma and F.R Freire Filho. Recent progress in cowpea Breeding. In: Fatokun, C.A, Tarwali, S.A, Singh, B.B., Kormawa, P.M., Tamo,M (Eds), Challenges and opportunity for enhancing sustainable cowpea production. Proceedings of world cowpea conference III held at IITA, Ibadan, Nigeria. **2002**

[6] Abiola, M.O and P.B. *International Journal of Agricultural and Rural Development (IJARD)* **2010**, *Pp 9-15,1*

[7] Dzemo, W.D., Niba, A.S and J.A.N Asiwe. *African Journal of Biological Technology.* **2010**, *pp 1673-1679, 9(11)*

[8] FAOSTAT (2010) www.faostat.org 5th November, **2010**.

[9] FAO. Food and Agriculture Organization Production Year Book. **2000**, 143
[10] Coelli, T.J., Rao,D.S.P and Battese, G.E. An Introduction to efficiency and productivity analysis. Boston, Kluwer Academic publisher. **1998**
[11] Udoh, E.J and O. Falake:. *Journal of Agriculture and Social science* **2006**, *4,252-260*
[12] Adegeye and S. Dittoh (**1985**). Essentials of Agricultural Economics. University press Ibadan, Nigeria