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PROFITABILITY, INPUTS ELASTICITIES AND RESOURCE-USE EFFICIENCY IN SMALL SCALE COWPEA PRODUCTION IN NIGER STATE, NIGERIA

OJO M.A., SALAMI, A.E. AND MOHAMMED U. S.
Department of Agricultural Economics and Extension Technology,
Federal University of Technology, Minna, Niger State, Nigeria

Corresponding author E-mail: akinmikky@yahoo.co.uk

ABSTRACT
The study examined profitability, inputs elasticities and resource-use efficiency in small scale cowpea production in Niger State, Nigeria. The primary data for the study were obtained using structured questionnaire administered to one hundred randomly sampled farmers from two Local Government Areas. Descriptive statistics, gross margin, net farm income, gross ratio, operation ratio and return on capital investment and production function using regression model were used to analyze the data. The result showed that estimated gross margin; net farm income; gross ratio; operating ratio; and return on capital investment gives an estimated values of N28,063.63 per hectare, N25,550.50 per hectare, 0.46, 0.30 and 1.46 respectively.The regression model estimated revealed that double log (Cobb Douglass) as the lead equation with the value of coefficient of determination (R^2) 0.765, indicated that 76.5% of the variation in output of cowpea production was explained by the inputs included in regression model. The F-ratio estimated as 16.369 was significant at 1% level of probability. The result also showed that land (X_1), labour (X_2) and fertilizer (X_5) were significant at 1%, level of probability while Seed (X_3) was significant at level of probability. Elasticity of production (return to scale) estimated as 14.383 implies that the production is characterized by increasing return to scale Estimated efficiency ratio(r) shows that the resources used were not efficiently utilized. It was therefore recommended that farm inputs, especially improved seeds and agrochemicals, should be supplied to farmers at the right time and at cost that is within their reach. Also extension agents should be provided to disseminate research findings to cowpea farmers on modern technology.

Key words: profitability, inputs elasticities, efficiency and cowpea production

INTRODUCTION
The rapid increase in the country's population from about 60 million in 1963, to a recent figure of about 120 million in 1991 coupled with increase in the standard of diving and other economic and political factors have greatly raised the demand for food. The importance of legume crops is becoming clearer to most of farmers and citizenry in the recent years. For most of the major food crops of the world, a lot of information is already available, however, legumes such as cowpeas, Soya bean, bean and groundnut which are widely used as a good source of plant protein in the diet of both man and livestock, have been largely neglected. Only in recent time has the awareness been growing in the food, especially cowpea that is mostly grown as late season crop in the forest, forest or savanna mosaic and southern (Stephen *et al.*, 2006). The growth in cowpea production has been primarily due to rapid population growth, large internal market demand complemented by the availability of high yielding improve varieties of cowpea, relatively well developed market access infrastructure, then existence of improved processing technology and an international movement structure (Rowland 1993).

Almost all the vegetable cowpea and seed are valuable food and source of vitamins and protein. This provides household food security, compared to other grains, cowpea is more

tolerant to soil fertility and thrives well in warm climate with moderate and evenly distributed rainfall. Cowpea provide income and employment opportunities for most people in the rural communities, particularly women are entirely responsible for it's processing and marketing. It provides them additional earning opportunity to contribute to the household food security.

Resource allocation and productivity is an important aspect of increased food production which is also associated with the management of the farmers who employ these resources in production. Furthermore, efficiency in the use of available resources is a major pivot for a profitable farm enterprise. Therefore, inefficiency in the use of resources, wrong choice of enterprise combination and cropping systems constitute the major constraints to increased food production in Nigeria (Okorji and Obiechina, 1985).

The subject of economic analysis of cowpea production in Nigeria has received considerable attention in the literature, however none of such studies from the study area has estimated profitability of cowpea production, inputs elasticities as well as determined economic efficiency in cowpea production. Thus, this study aimed at: (a) identifying the socio-economic characteristics of the cowpea farmers; (b) estimating the profitability of cowpea production in the study area; (c) determining returns to scale in cowpea production; (d) determining the efficiency of resource use in cowpea production in the study area.

METHODOLOGY

Study Area: The study was conducted in Niger State of Nigeria. The state is located within latitudes 8o – 10o north and longitudes 3o – 8o east of the prime meridian with land area of 76,363 square kilometers and a population of 4,082,558 people (Wikipedia, 2008). The state is agrarian and well suited for production of arable crops such as cowpea, yam, cassava and maize because of favourable climatic conditions. The annual rainfall is between 1100mm – 1600mm with average monthly temperature ranges from 23oC and 37oC (NSADP, 1994). The vegetation consist mainly of short consist mainly of short grasses, shrubs and scattered trees.

Sampling Techniques: The data mainly from primary sources were collected from two Local Government Areas (LGAs) which were purposively selected because of prevalence of the crop in the area using multistage sampling technique. The LGAs include Paiko and Gurara LGAs. The second stage involved a simple random selection of 50 farmers from each of the two LGAs, thus, making 100 respondents. The data were collected with the use of structured questionnaire designed in line with objectives of the study.

Data Analysis

Descriptive Statistics: The method employs arithmetic mean, frequency distribution, percentage etc. The technique was used to group and summarize the data obtained from the field.

Gross margin: This is the difference between the Gross Farm Income (GFI) and the Total Variable Cost (TVC). It is a useful planning tool in situations where fixed capital is negligible portion of the farming enterprises in the case of small scale subsistence agriculture (Olukosi and Erhabor, 1988).

$$GM = GFI - TVC \quad (1)$$

Where GM = Gross Margin, GFI = Gross Farm Income, TVC = Total Variable Cost.

Gross margin analysis is one method of calculating profitability of small scale cropping enterprises (Olukosi *et-al*, 2006).

Net Farm Income (NFI) = Gross Margin (GM) – Total Fixed Cost (TFC)

Gross ratio: This is is a profitability ratio that measures the overall success of the farm. The lower the ratio, the higher the return per naira.

$$GR = \frac{TFE}{GI} \quad (2)$$

Where GR = Gross Ratio, TFE = Total Farm Expenses and GI = Gross Income.

Operating Ratio*:* The operating ratio is directly related to the farm variable input usage. The lower the ratio, the higher the profitability of the farm business.

$$OR = \frac{TOC}{GI} \quad (3)$$

Where OR = Operating Ratio, TOC = Total Operating Cost and GI = Gross Income.

Return on Capital Invested*:* This is defined as gross margin divided by total variable cost.

$$RI = \frac{GM}{TVC} \quad (4)$$

Where RI = Return on Capital Invested, GM = Gross Margin and TVC = Total Variable Cost

Production Function Analysis: Regression model was used to examine input-output relationship and the implicit form of the model is given by:

$$Y = f\left(X_1, X_2, X_3, X_4, X_5 U_i\right) \quad (5)$$

Where Y = Output from Cowpea Production (Kg)

X_1 = Farm Size (ha)

X_2 = Quantity of Seeds (Kg)

X_3 = Quantity of fertilizer (Kg)

X_4 = Labour Input (Manday)

X_5 = Agrochemical (Liters)

U_i = Error term.

The explicit form of this function takes the following forms:

$$Y = a + b_1 X_1 + b_2 X_2 + b_3 X_3 + b_4 X_4 + b_5 X_5 + U_i (linear) \quad (6)$$

$$Y = a + b_1 \ln X_1 + b_2 \ln X_2 + b_3 \ln X_3 + b_4 \ln X_4 + b_5 \ln X_5 + U_i (semi\log) \quad (7)$$

$$\ln Y = a + b_1 \ln X_1 + b_2 \ln X_2 + b_3 \ln X_3 + b_4 \ln X_4 + b_5 \ln X_5 + U_i (double\log) \quad (8)$$

$$\ln Y = a + b_1 X_1 + b_2 X_2 + b_3 X_3 + b_4 X_4 + b_5 X_5 + U_i (\exp onential) \quad (9)$$

Efficiency of Resource-use*:* This was determined by the ratio of marginal value product (MVP) to marginal factor cost (MFC) of inputs based on the estimated regression coefficients. Following Rahman and Lawal (2003) and Iheanacho et al (2003) efficiency of resource (r) is given as

$$r = \frac{MVP}{MFC} \quad (10)$$

The rule provides that when r = 1, there is efficient use of resource; r > 1 and r < 1 indicate underutilization and overutilization of a resource respectively. The values of MVP and MFC were estimated as follows:

$$MVP = MPP \bullet P_Y$$

$$MFC = Px_i$$

Where MVP = Marginal Value Product of variable input;

MPP = Marginal Physical Product;

Py = Unit Price of output;

Px_i = Unit Price of input Xi

r = Efficiency ratio.

Economies of Scale: This is the measure of farm's success in producing maximum output from a given set of inputs. The elasticity of production (*Ep*) and return to scale (RTS) was estimated using the formula

$$\sum^{k} Epx_i = RTS$$

RESULTS AND DISCUSSION

Socio-economic characteristics of sampled farmers: Some socio-economic characteristics may influence cowpea in the area. The variables analyzed in this study include sex, marital status, age, education, household size, years of farming experience and means of land acquisition.

Table1: Socio-economic Characteristics of Sampled Farmers.

Variables.	Frequency	Percentage
Sex		
Male	85	85
Female	15	15
Marital Status		
Single	35	35
Married	58	58
Divorced	4	4
Widow(er)	3	3
Age (years)		
21	3	3
21-30	33	33
31-40	35	35
41-50	25	25
51-60	3	3
61-70	1	1
Education		
No Formal Education	34	34
Primary	18	18
Secondary	24	24
Tertiary	24	24
Household Size		
0-5	2	2
6-10	98	98
Years of Farming Experience		62
1-10	62	29
11-20	29	7
21-30	7	2
31-40	2	
Means of Land Acquisition		
Owned	2	2
Gift	4	4
Family land	60	60
Rented	6	6
Inherited	28	28

Source: Field survey, 2008

Table 1 shows that majority of the respondents (85%) were males. This is a manifestation of gross inequality in gender distribution and calls for concerted effort in empowering the women to contribute their own quota to production in the study area. It is also shown in the table that 60% of the sampled farmers were between the ages of 30 and 50 years. Thus, majority of the sampled farmers were middle aged, which could result in a positive effect on production. The modal class of educational level of respondents was non-formal education

(34%) followed by secondary (24%) and tertiary (24%) education. This is not surprising outcome as the study area falls within educationally disadvantaged states of Nigeria. Table1 also showed that only 2% of the farmers had less than 5 family members while 98% had 6 to 10 members. Generally, in agrarian settlements, a large family size guarantees free and cheap labour. The table revealed that 62% of the farmers were within the range of 0-10years farming experience, while13.3% had 11years and above farming experience.

Gross Margin Analysis of Cowpea Farmers: The estimated gross margin analysis for cowpea farmers is shown in Table2. The table showed that cost of hired labour constituted 34 percent of the total cost of production in cowpea farming followed by fertilizer and gifts with 28.97 and 22.53percents respectively. A confirmation of profitability of cowpea production is shown by a net income of ₦25, 550.50. Also, the return on a naira invested was ₦1.46 while gross and operating ratios were 0.46 and 0.30 respectively. All the ratios were less than 1 indicating profitability of the farming.

Table 2: Estimated Gross Margin Analysis for Irrigated Onion Production

Cost Items and Revenue	Cost (₦ /Ha)	% of Total cost
Variable Cost		
Hired labour Cost	7,395.40	34.00
Fertilizer Cost	6,300.00	28.97
Seed Cost	159.00	0.73
Gifts	4,900.00	22.53
Agrochemical cost	482.00	2.22
Total Variable Cost	**19,236.40**	88.45
Fixed Cost		
Knapsack sprayer(Depreciation)	614.81	2.83
Farm tools (Depreciation)	1,898.29	8.73
Total Fixed Cost	**2,513.10**	11.55
Total Cost	**21,749.50**	100
Returns		
Gross Income	**47,300**	
Gross Margin	**28,063.60**	
Net Farm Income	**25,550.50**	
Returns on Naira Invested	**1.46**	
Operating Ratio	**0.30**	
Gross Ratio	**0.46**	

Source: Field Survey, 2008

Production function Analysis: The production function that was used to determine the nature of inputs – output relationship in cowpea production is shown in Table 3 (Double log production function as the lead equation). The value of coefficient of determinations (R^2) indicated that 76.5 of the variation in output of cowpea production was explained by the inputs indicated in the regression model (Table 3). The regression coefficients of land size (X_1), labour (X_2), seed (X_3) fertilizer (X_4) and labour (X_5) are positive indicating that an increase in these inputs, holding others constant will lead to an increase in the gross output. The F-ratio 16.37 and significant at ($P<0.01$) percent, implying that the variables significantly explained variations in the gross output. The result also showed that land (X_1), labour (X_2) and fertilizer (X_5) were significant at 1%, level of probability while Seed (X_3) was significant at level of probability

Table 3: Estimated double log production function (lead equation)

Variables.	Regression Coefficients	T-value
Constant	2.809	7.676***
Land (X_1)	1.725	2.893***
Labour (X_2)	12.300	2.731***
Seed (X_3)	0.150	2.382*
Herbicides (X_4)	0.078	1.233^{NS}
Fertilizer (X_5)	0.130	3.710***
R^2	0.765	
F Ratio	16.369***	

Source field survey, 2008

**** = Significant at 1% level of probability, * = Significant at 10% level of probability*

NS: not significant.

Resource-use Efficiencies: The efficiency indicator in Table 4 revealed land, labour and seed were under-utilized while fertilizer was over-utilized. Efficiency and productivity could be improved if the farmers use more of land, labour and seed and less of fertilizer.

Table 4: Estimated efficiency Ratio (r)

Variables	MPP	MVP	MFC	Efficiency ratio
Land (X_1)	144.297	23087.52	7200	3.207
Labour (X_2)	69.205	11072.92	350	31.636
Seed (X_3)	35.529	5684.65	140.00	40.604
Fertilizer (X_5)	0.151	24.19	110.00	0.220

Source: field survey, 2008

Elasticity of production inputs and returns to scale: The input elasticities of production is shown in Table 5. The summation of the elasticities of 14.383 obtained indicated an increasing return to scale and that cowpea production was in stage I of the production region.

Table 5: Elasticity of Productive Resource and Returns to Scale

Inputs	Elasticity
Land size (X_1)	1.725
Labour (X_2)	12.300
Seed (X_3)	0.150
Herbicides (X_4)	0.078
Fertilizer (X_5)	0.130
Return to scale	**14.383**

Source: Field Survey, 2008

CONLUSION

This empirical study is on profitability, elasticities and resource-use efficiency in small scale cowpea production in Niger State. The study showed that cowpea production was profitable with a net income of N25, 550.50 per hectare. Estimates of the production function indicated that farm size, labour, seed and fertilizer were the major important factors in cowpea production in the study area. While the estimates of the returns to scale obtained indicated e increasing returns to scale, cowpea farmers were not efficient in the use of their production resources.

POLICY IMPLICATION AND RECOMMENDATIONS

The policy implication of this study is that Food sufficiency target should include raising farm production from subsistence and small-scale levels coupled with efficient use of available resources. Therefore, farm inputs, especially improved seeds and agrochemicals, should be supplied to farmers at the right time and at cost that is within their reach. Similarly, tractor-hire services should be made available to farmers for better use of labour and management in production. Finally, extension agents should be provided to disseminate research findings to cowpea farmers on modern technology.

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