GLOBAL JOURNAL OF AGRICULTURAL SCIENCES VOL. 7 NO. 2 2008: 127 - 130
 ISSN 1596 – 2903

ECONOMETRIC ANALYSIS OF COWPEA PRODUCTION IN THE NORTH-EASTERN PART OF ADAMAWA STATE, NIGERIA

J. STEPHEN and S. I. MSHELIA

(Received 11 June, 2007; Revision Accepted 13 March, 2008)

ABSTRACT

Primary data were collected by multi-stage random sampling from 146 cowpea farmers in Adamawa State using questionnaires, to determine the costs and returns and efficiency of resource use in cowpea production. Descriptive statistics, gross margin and regression were used to analyze the data. Majority (85%) of the respondents were small scale farmers and married (83%), while 52.05% had formal education. Cowpea production was found profitable with an estimated gross margin and net income of ₦13,654.33 and ₦9,663.21per hectare respectively. The Cobb-Douglas production function gave the best fit with 79.4% coefficient of determination. The enterprise exhibits increasing returns given the sum of elasticity (1.75). The beta coefficient result ranks the inputs (regressors) in descending order of magnitude as seed, farming experience, land, insecticide, hired labour, education and family labour which also shows the order of their importance. Efficiency of resource use proved land and seed to be under-used and thus, increase in the level of productive land and seed used could enhance profit and resource productivity. Inadequate inputs, lack of access to credit, pests and poor storage were the major problems of the farmers. Policy should be designed to ensure provision of inputs such as credit, seed and extension package timely and affordable to farmers.

KEY WORDS: Econometrics; Cowpea production; Adamawa State; Nigeria.

INTRODUCTION

Cowpea is an important food legume in Nigeria with much of it produced for domestic consumption. Its production is concentrated in the extreme northern part (Sudan zone) of the country which favours it (Gilbert, 1969). The commodity plays a significant role in the Nigerian economy as it occupies a unique position in the internal food chain, an income earner, a veritable source of protein and thus, capable of providing solution to the protein-carbohydrate imbalance of the nutrition of Nigerians; it is also used as livestock feed and has the ability to improve soil fertility (Afolami, 2001; Quin, 1997).

Increase in the demand for this commodity has led to extensive cultivation of the crop (cowpea) in many parts of the country making Nigeria a main producer in the world. According to International Institute of Tropical Agriculture (IITA) 2003, FAO estimates that 3.3 million tonnes of cowpea dry grains were produced worldwide in 2000 from a total of 9.8 million hectares. Nigeria produced 2.1 million tonnes of this, making it the world's largest producer with an average yield of 417kg/ha. Similarly, cowpea has the largest hectarage under cultivation amongst legumes grown in Adamawa State (ADADP, 1996). The same source reported that a total of about 40,000 hectares were put under cowpea cultivation in the state in 1994 with a total production of 22,600 tonnes. However, Owuama (2005) reported that from 1996-1999, 147,380 tonnes of cowpea were produced from a total of 203,520 hectares of land in Adamawa State with an annual average yield of 181kg/ha. It is a major food crop virtually grown throughout the state with an apparent transition in its production of recent, changing and expanding from mixed to sole crops especially with the release of improved varieties (Sajo and Kadams, 1999). The north-eastern part of the state is the prominent area for cowpea production.

However, despite the increase in the production of cowpea the demand for the commodity outstrips the supply (Gibbon and Pain, 1985). Most of the cowpea in Nigerian markets is produced by small scale farmers on scattered farms, who are resource poor and associated with poor yields. The need to examine the economics of their production particularly the costs and returns involved and the use of production resources becomes imperative. This aims at improving their production such as resource commitment and use in order to raise food supply in the nation. This study was, therefore, undertaken to carry out an econometric analysis of cowpea production in the north-eastern part of Adamawa State. Specifically, the study was meant to achieve the following objectives:

i. Examine the socio-economic characteristics of cowpea farmers;
ii. Determine the profitability of cowpea enterprise in the area;
iii. Determine resource-use efficiency in cowpea production.

METHODOLOGY

Study area

The north-eastern part of Adamawa State comprises of Gombi, Hong, Maiha, Mubi North/South, Michika and Madagali Local Government Areas (LGAs) which together constitute one agricultural zone in the state (Sajo and Kadams, 1999). The area lies between latitude 9° 21' and 11° N and longitude 12° 03' and 13° 44'E with distinct dry and rainy seasons (Adebayo, 2004). The major economic activities in the area are centered on agriculture (crop and livestock production) such as sorghum, rice, cowpea, sheep, goat, etc. It is the main area for cowpea production of the state.

Data collection

Gombi, Michika and Madagali LGAs were chosen for their relative importance in cowpea production and data were collected from a random sample of 146 cowpea farmers from a total of 18 villages randomly selected in the three (3) LGAs. Structured questionnaire was used to obtain information on production activities, costs, inputs, output, revenue as well as socio-economic variables such as age, sex, etc. The data was based on 2003/2004 production season

Data analysis

The analytical techniques used include descriptive statistics, gross margin and regression.

Gross margin was employed to ascertain profitability and is stated as follows

GM = TR – TVC

J. Stephen, Department of Agricultural Economics and Extension Federal University of Technology, Yola, Nigeria
S. I. Mshelia, Department of Agricultural Economics and Extension Federal University of Technology, Yola, Nigeria

NI = GM – TFC

Where;

GM = Gross margin (₦)
TR = Total revenue (₦)
TVC = Total variable cost (₦)
NI = Net income (₦)
TFC = Total fixed cost (₦)

The variable costs include costs of seeds, labour, agro-chemicals, ploughing, etc while fixed costs include depreciation of fixed assets and rent on land.

Regression model was used to study input-output relationship. Linear, exponential, semi-log and double-log functions were tried but the double-log gave the best fit and was selected for analysis based on statistical and econometric criteria. It is implicitly express as follows;

$LogY = bo + b_1LogX_1 + b_2LogX_2 + b_3LogX_3 - b_4LogX_4 + b_5LogX_5 + b_6LogX_6 + b_7LogX_7 + e$

Where;

Y = Output (kg)
X_1 = Farm size (ha)
X_2 = Seed used (kg)
X_3 = Insecticide (L)
X_4 = Family labour (mandays)
X_5 = Hired labour (mandays)
X_6 = Years of formal schooling (15 years for tertiary education, 12 years for secondary education, 6 years for primary education and 0 year for no formal education).
X_7 = Farming experience (number of years for being into cowpea production)
b = Coefficients of independent variables
e = Error term

The beta coefficient model was used to estimate the relative (critical) importance of production inputs. Following Gabdo *et al* (2005) and Polycarp *et al* (2004), the formula is given by

$$\beta = bi. \frac{\bar{SX_i}}{Sy}$$

Where;

β_i = Beta coefficient of inputs
b_i = Estimated regression coefficient of inputs
$S\bar{x_i}$ = Standard deviation of the independent variables
$S\bar{y}$ = Standard deviation of the dependent variable

The rule is that the higher the beta coefficient of an input, the more important (critical) it is in production.

Production function analysis was employed to determine resource-use efficiency of cowpea production based on the estimated Cobb-Douglas production function. The formula used is given below following Rahman and Lawal (2003) and Iheanacho *et al* (2000).

$$r = \frac{MVP}{MFC}$$

$MVP = MPP . Py$

$$MPP = b_i . \frac{\bar{Y}}{\bar{X_i}}$$

Where;

r = Efficiency of use
MVP = Marginal value product of inputs
MFC = Marginal factor cost of inputs
MPP = Marginal physical product of inputs
Py = Output unit price
b_i = Regression coefficient of inputs
$\bar{Y}$ = The arithmetic mean value of output
$\bar{X_i}$ = Arithmetic mean value of inputs

Here, if the efficiency ratio (r) is unit (one), it indicates efficient use of input but r-value of less than one and greater than one show over-use and under-used of resources respectively.

RESULTS AND DISCUSSION

Socio-economic characteristics of farmers

From the socio-economic attributes of the respondents (Table 1), 43.83% of them falling within age range of 21-40 years implies they are strong for farming practice while both male and female respondents are equally into cowpea production in the area. Also, 52.05% of them had formal education at different levels which means they can possibly be innovative and majority (82.88%) of the respondents are married who produce cowpea most likely to cater for their family. Majority (84.94%) of them are small scale farmers since they cultivate less than three (3) hectares with an average farm size of 1.80 hectares.

Table 1. Socio-economic characteristics of respondents.

Variable	Frequency	Percentage
Age		
21 – 30	27	18.49
31 – 40	37	25.34
41 – 50	42	28.77
≥51	40	27.40
Total	**146**	**100.00**
Sex		
Male	76	52.05
Female	70	47.95
Total	**146**	**100.00**
Education		
No formal	70	47.95
Primary	25	17.12
Secondary	34	23.29
Tertiary	17	11.64
Total	**146**	**100.00**
Marital status		
Married	121	82.88
Widowed	13	8.90
Single	12	8.22
Total	**146**	**100.00**
Occupation		
Farming	114	78.08
Civil service	24	16.44
Trading	8	5.48
Total	**146**	**100.00**
Farm size		
<1	48	32.88
1-2	76	52.05
≥ 3	22	15.07
Total	**146**	**100**

The study revealed that cowpea production is a profitable venture in the area with a gross margin and net farm income of ₦13,654.33/ha and ₦9,663.21/ha respectively (Table 2). This shows a high return to operating expenses considering the average cost and return of production involved.

Table 2. Cost and returns of cowpea production per hectare.

Input cost	Amount (₦/ha)
Total variable cost	22,346.31
Total fixed cost	3,991.12
Total cost of production	**26,337.43**
Total revenue	**36,000.64**
Gross margin	13,654.33
Net income	**9,663.21**

Inputs-output analysis

Based on statistical and econometric criteria the double-log function was chosen as the lead equation with R^2 value of 79.4%. Analysis of results shows that the inputs have positive relationship with output which means increase in the use of these inputs will also lead to increase in output except for family labour that was negatively related (Table 3). Farm size, seed and experience were found to influence output significantly and thus, indicating the importance of these factor inputs in production. It implies that, the significant variables are the major determinants of cowpea output.

Table 3. Results of regression analysis (double-log function).

Predictor	Coefficient	Standard deviation	T- ratio	Beta coefficient	Rank
Constant	3.394	0.7540	4.498***	-	-
Farm land (X_1)	0.447	0.73750	1.715**	0.2477	3
Seed (X_2)	0.625	0.84445	2.657***	0.3966	1
Insecticide (X_3)	0.03090	3.31679	1.204	0.077	4
Family labour (X_4)	- 0.02660	4.30366	-1.335	-0.0860	7
Hired labour (X_5)	0.02301	4.30054	1.062	0.0744	5
Education (X_6)	0.09637	0.0269	0.479	0.0269	6
Experience (X_7)	0.556	0.68828	4.526***	0.2875	2

*** = Significance at 1% ** = Significance at 10% $R^2 = 0.794$

Result of the beta coefficient model is also given in Table 3. From ranks of the regressors, the production inputs are put in descending order of magnitude as follows:

Seed, farming experience, land, insecticide, hired labour, education and family labour. However, the critical importance of the significant inputs (seed, land and experience) could reflect their basic requirement in traditional agriculture especially for the first-two.

Efficiency of resource used

The marginal addition to output and income that will result from the use of one more hectare and kilogram of seed in cowpea production is presented in Table 4. Land contributes more with 348.91kg and ₦18,830.67 addition to output and income respectively. However, efficiency result from the same table revealed that both the land and seed inputs were not efficiently utilized in production. Improving farm income and resource productivity will, therefore, require increase in the use of these two resources given the present state of technology.

Table 4. Efficiency of resource used.

Input	MPP(Kg)	MVP(₦)	MFC(₦)	Use-efficiency (r)
Farmland	348.91	18,830.67	3,047.33	6.18
Seed	36.91	1,992.03	56.41	35.31

The study identified the major constraints affecting farmers' production to be inadequate inputs, lack of access to credit, pests, poor storage and low education. These have contributed to low productivity and output of the respondents in the area.

CONCLUSION AND RECOMMENDATIONS

Based on the findings of this research, cowpea production is a profitable enterprise in the north-eastern part of Adamawa State However, inputs were not optimally used by the farmers and thus, to raise profit, it is appropriate to increase the level of land and seed used. Therefore, it is recommended that inputs like improved seeds and productive land should be subsidized to farmers and financial assistance as well to be extended to them to boost their production. It is equally important to educate farmers through extension to improve their resource management for increased food (cowpea) production.

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