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 8° – 10° north and longitudes 3° – 8° 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 23°C and 37°C (NSADP, 1994). The vegetation 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).

\[ GM = GFI - TVC \]  

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)**  
\[ NFI = GM - TFC \]  

**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.

\[ GR = \frac{TFE}{GI} \]
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.

\[
OR = \frac{TOC}{GI}
\]  

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.

\[
RI = \frac{GM}{TVC}
\]  

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:

\[
Y = f(X_1, X_2, X_3, X_4, X_5 U_i)
\]  

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:

\[
Y = a + b_1 X_1 + b_2 X_2 + b_3 X_3 + b_4 X_4 + b_5 X_5 + U_i (linear)
\]  

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

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

\[
\ln Y = a + b_1 X_1 + b_2 X_2 + b_3 X_3 + b_4 X_4 + b_5 X_5 + U_i (exponential)
\]

**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

\[
r = \frac{MVP}{MFC}
\]

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:

\[
MVP = MPP \cdot P_y
\]

\[
MFC = P_{x_i}
\]

Where MVP = Marginal Value Product of variable input;

- MPP = Marginal Physical Product;
- \(P_y\) = Unit Price of output;
- \(P_{x_i}\) = Unit Price of input \(X_i\)
- \(r\) = 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

\[
\sum_k Ep_{x_i} = RTS
\]
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.

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

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 0-10 years farming experience, while 13.3% had 11 years 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% of the total cost of production in cowpea farming followed by fertilizer and gifts with 28.97% and 22.53% respectively. A confirmation of profitability of cowpea production is shown by a net income of N25,550.50. 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>
<thead>
<tr>
<th>Cost Items and Revenue</th>
<th>Cost (₦/Ha)</th>
<th>% of Total cost</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Variable Cost</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hired labour Cost</td>
<td>7,395.40</td>
<td>34.00</td>
</tr>
<tr>
<td>Fertilizer Cost</td>
<td>6,300.00</td>
<td>28.97</td>
</tr>
<tr>
<td>Seed Cost</td>
<td>159.00</td>
<td>0.73</td>
</tr>
<tr>
<td>Gifts</td>
<td>4,900.00</td>
<td>22.53</td>
</tr>
<tr>
<td>Agrochemical cost</td>
<td>482.00</td>
<td>2.22</td>
</tr>
<tr>
<td><strong>Total Variable Cost</strong></td>
<td>19,236.40</td>
<td>88.45</td>
</tr>
<tr>
<td><strong>Fixed Cost</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Knapsack sprayer (Depreciation)</td>
<td>614.81</td>
<td>2.83</td>
</tr>
<tr>
<td>Farm tools (Depreciation)</td>
<td>1,898.29</td>
<td>8.73</td>
</tr>
<tr>
<td><strong>Total Fixed Cost</strong></td>
<td>2,513.10</td>
<td>11.55</td>
</tr>
<tr>
<td><strong>Total Cost</strong></td>
<td>21,749.50</td>
<td>100</td>
</tr>
<tr>
<td><strong>Returns</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gross Income</td>
<td>47,300</td>
<td></td>
</tr>
<tr>
<td>Gross Margin</td>
<td>28,063.60</td>
<td></td>
</tr>
<tr>
<td>Net Farm Income</td>
<td>25,550.50</td>
<td></td>
</tr>
<tr>
<td><strong>Returns on Naira Invested</strong></td>
<td>1.46</td>
<td>0.30</td>
</tr>
<tr>
<td><strong>Operating Ratio</strong></td>
<td>0.30</td>
<td></td>
</tr>
<tr>
<td><strong>Gross Ratio</strong></td>
<td>0.46</td>
<td></td>
</tr>
</tbody>
</table>

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)

<table>
<thead>
<tr>
<th>Variables</th>
<th>Regression Coefficients</th>
<th>T-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>2.809</td>
<td>7.676***</td>
</tr>
<tr>
<td>Land ($X_1$)</td>
<td>1.725</td>
<td>2.893***</td>
</tr>
<tr>
<td>Labour ($X_2$)</td>
<td>12.300</td>
<td>2.731***</td>
</tr>
<tr>
<td>Seed ($X_3$)</td>
<td>0.150</td>
<td>2.382*</td>
</tr>
<tr>
<td>Herbicides ($X_4$)</td>
<td>0.078</td>
<td>1.233NS</td>
</tr>
<tr>
<td>Fertilizer ($X_5$)</td>
<td>0.130</td>
<td>3.710***</td>
</tr>
<tr>
<td>$R^2$</td>
<td>0.765</td>
<td></td>
</tr>
<tr>
<td>F Ratio</td>
<td>16.369***</td>
<td></td>
</tr>
</tbody>
</table>

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 ($r$)

<table>
<thead>
<tr>
<th>Variables</th>
<th>MPP</th>
<th>MVP</th>
<th>MFC</th>
<th>Efficiency ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Land ($X_1$)</td>
<td>144.297</td>
<td>23087.52</td>
<td>7200</td>
<td>3.207</td>
</tr>
<tr>
<td>Labour ($X_2$)</td>
<td>69.205</td>
<td>11072.92</td>
<td>350</td>
<td>31.636</td>
</tr>
<tr>
<td>Seed ($X_3$)</td>
<td>35.529</td>
<td>5684.65</td>
<td>140.00</td>
<td>40.604</td>
</tr>
<tr>
<td>Fertilizer ($X_5$)</td>
<td>0.151</td>
<td>24.19</td>
<td>110.00</td>
<td>0.220</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Inputs</th>
<th>Elasticity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Land size ($X_1$)</td>
<td>1.725</td>
</tr>
<tr>
<td>Labour ($X_2$)</td>
<td>12.300</td>
</tr>
<tr>
<td>Seed ($X_3$)</td>
<td>0.150</td>
</tr>
<tr>
<td>Herbicides ($X_4$)</td>
<td>0.078</td>
</tr>
<tr>
<td>Fertilizer ($X_5$)</td>
<td>0.130</td>
</tr>
<tr>
<td>Return to scale</td>
<td>14.383</td>
</tr>
</tbody>
</table>

Source: Field Survey, 2008

CONCLUSION
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 an 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.

REFERENCES