Analysis of Resource Use Efficiency of Sesame Production in Hong Local Government Area of Adamawa State, Nigeria

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Abstract
The study was conducted to examine the resource use efficiency of sesame production in Hong L.G.A of Adamawa State, Nigeria. Multistage sampling technique was used to select fifty seven sesame farmers in the study area. Data were collected using a structured questionnaire. Data were analysed using descriptive statistics and multiple regression analysis. The results revealed that high percentage (57.9%) of the respondents were female, 91.2% were married and 54.4% were within the age bracket of 31-50 years. Among the farmers, 35.1% attended tertiary institution, most (56.1%) of them had a household size of 3-6 persons and 70% of them had no extension visit. The study also revealed that the majority (70.2%) of the sesame farmers had farm size of 1-2 hectares, 33.3% had a farming experience of 10-15 years, and many had no access to credit (91.%) and membership of cooperatives (86%). The results showed that effects of labour, fertilizer, farm size, chemical and seed were positive and statistically significant. R² of 90.0% and F-ratio of 65.5 were recorded for the inputs. The study showed that the production inputs (especially labour and seed) contributed to sesame production output and production resources were under-utilized by the farmers.

Keywords: Borno, Efficiency, Farmers, Production, Resource use and Sesame

Introduction
Sesame (Sesamum indicum) is one of the ancient oil seeds known to mankind. It is also known as benniseed. Sesame grows in a wide range of environments extending from semi-arid tropics and subtropics to temperate regions (Naturland, 2002). It is grown mainly for its seed, which has many important uses to man (El khier et al., 2018). Sesame production has captured world attention due to its nutritional, medicinal and industrial importance which cannot be overemphasized. Chemically, the seed constitutes 41% oil, 22% protein, 32% carbohydrates and antioxidants 5% including lignins (lignans) and tocopherols in the oil which serve as resistance to oxidative rancidity (Eleuch et al., 2017). The numerous discoveries of its importance make it one of the valuable crops in the world. In Nigeria, it is consumed or processed as candies, seed can be toasted or roasted with salt popularly known as (kantu), sesame seed can also be used to prepare soup and sesame seed oil.

Sesame crop is cultivated in almost all the tropical and subtropical Asian and African countries of the world. About 56% of the world’s production of the crop is in Asia and 44% production is from Africa (FAO 2018). Nigeria is among the largest sesame producer in Africa (Iwo et al., 2002; FAO STAT, 2013; FDC, 2018) and the third largest sesame seed producer in the world (FDC, 2018). About 580,000 tonnes of sesame seed were produced in Nigeria in 2017, 90% of which was exported and sold internationally, between $1600-$1800 per tonne for white sesame seed and $700-$1000 per tonne of a brown sesame seed (NEPC
Nigeria exports sesame to China, Turkey, Japan, Vietnam and South Korea. The export of sesame contributes 0.5% of the total export value of non-oil commodities and 36.59% of the agriculture exports market (World atlas, 2017; FDC, 2018). Sesame’s contribution to Nigeria’s export trade and its increasing demand has placed pressure on production (FDC, 2018). Production of sesame in Nigeria has been increasing steadily as a result of favourable prices. Consequently, earnings of the producers and marketers are enhanced and available records show that Nigeria exported 140,800 tonnes of sesame seed worth $139 million in 2010. It also recorded that Nigerian earned N 210 billion from the export of sesame seed products in the first half of 2012 (Circu consulting 2013; Achike and Anazku, 2010). Sesame seed has over 15% margin in terms of value-added compared to other cash crops such as tiger nuts and palm kernel. Locally, however, the white sesame seed is sold for N340, 000 per tonne and N320, 000 per tonne for brown sesame (FDC, 2018).

Production and export market for sesame seed in Nigeria has very high potential with regards to 3.5 million hectares estimated out of 74 million hectares of agricultural land suitable for sesame seed production (NEPC 2018). The average yield per hectare, however, is low (0.5-1.0 tonne) compared to 1.4-16 tonnes per hectare in China, 1.0 tonne and above recorded in the United State of America (FAO, 2016; NAERLS, 2010). Farmer’s profitability and production output can be enhanced through more efficient use of production input (Udoh, 2005). Efficiency of resource use is the ability to derive maximum output per unit resources. The efficiency of resource use can therefore be assessed from the productivity of the output. This is an important issue at present time because productivity growth and resource use efficiency issues are the core element of sustainable crop production of small scale farming activities (Edet and Oluwatoyin, 2014). Shehu et al. (2017) studied analysis of resources use efficiency in small-scale sesame production in Tafawa-Balewa Local Government of Bauchi State revealed that double-log function gave the best fit with adjusted R² of 81.6%. Production inputs such as seed, fertilizer, labour, affected outputs significantly. Umar et al. (2000) studied gender based analysis of labour productivity in sesame production in Doma Local Government Area of Nasarawa State revealed that R² value of double-log production function was 0.472 indicating that 47.2% of the variation in the dependent variable was explained by the independent variable. The result also indicated that the mean output of sesame per hectare was 600kg, being influenced by male labour, seed and pesticide at significant level of 1% and 5%. The study reported that quantity of seed, male labour, and pesticide were the major factors influencing sesame production. Zongoma et al. (2015) studied resources use efficiency in maize production among small scale farmers in Biu Local Government Area, Borno State and reported that semi-log function was the lead equation chosen with R² value of 0.81 i.e. 81% of the change in output is attributed to change in the independent variables. The result also showed that all farm size and labour has a positive coefficient of 0.06, and 0.07 but both are not statistically significant. Other variables fertilizer and quantity of seed were also positive which there will be more than proportionate increase in the output of maize in the study area.

In Hong Local Government Area of Adamawa state, there are many sesame small scale farmer who extensively cultivates or intercrop sesame with other crops like groundnut and cowpea both as a source of household food and as a cash crop. The challenge that is currently confronting Nigerian’s agriculture is related to the problem of low Agricultural productivity resulting from inefficient use of resources (Obasi and Agu, 2000). Hong L.G.A is known to have a suitable environmental condition that favours high yielding and quality sesame production than other crops. Also, sesame production in the L.G.A is dominated by small scale farmers with wide variations in output level. However, most of the farmers are producing below the potential yield level. This type of production is often associated with inefficient resource utilization and poor profit level. The efficiency or inefficiency of utilization of available resources for sesame farming has remained an important question in the quest for increased sesame production in Hong L.G.A. Since agriculture constitute a significant section of rural livelihood in Nigeria, even a small
percentage loss in agricultural production would impose a larger proportionate income loss which will subsequently affects farmers livelihood. It is against this background that the study was designed. Objectives of the study are to:

i. describe the socio-economics characteristics of sesame farmers in the study area

ii. estimate the resource use efficiency in sesame production in the study area

Materials and Methods

Study area

The study was carried out in Hong Local Government Area of Adamawa State. The study area lies between latitude 7° N-11° N and longitude 11°E-14°E of the Greenwich meridian (Adebayo, 1999). The area is bounded by Askira/Uba Local government Area of Borno State to the North, Mubi to the East, Song to the South and Gombi Local government Area to the West. The area has a landmass of about 117,240 square kilometres, with a population of about 169,183 people (NPC, 2006). The area falls within the northern guinea savannah zone and has a tropical wet and dry climate. The dry season lasts for a minimum of five months (November-March) while the wet season spans April to October: mean annual rainfall is about 700mm (Adebayo, 1997). The area has an average temperature between 25°C and 35°C during November and December. In January, the temperature may decrease to as low as 15°C, but from March to April; the temperature begins to rise making the whole region very warm. The climatic condition of the area is suitable for sesame product. The predominant ethnic group is kilba (huba).

Sampling and data collection

The Multistage random sampling procedure was used to select the respondents for the study. In the first stage, three wards (Hildi, Hong, and Gaya) were purposively selected because of their prominence in sesame production. In the second stage, one village from each of the selected wards were randomly selected. Twenty sesame farmers were randomly selected from each village making sixty respondents. Three out of the sixty respondents returned their questionnaire unanswered. Both primary and secondary data were used for this study. Primary data was collected with the aid of a structure questionnaire. The questions were structured to provide answers to the research questions of the study.

Data analysis

Regression analysis was used to determine the relationship between resource use and productivity.

The implicit form of the model is specified as;

\[ Y = f(X_1, X_2, X_3, ...X_n), u \] …………… (ii)

Where;

- \( Y \) = output of sesame (kg/ha)
- \( X_1 \) = farm size (ha)
- \( X_2 \) = labour (N paid per unit)
- \( X_3 \) = fertilizer (kg)
- \( X_4 \) = chemicals (liters)
- \( X_5 \) = seed (kg)
- \( \beta_0 \ldots \beta_5 \) = parameter of be estimated,
- \( U \) = random error term or disturbance term.

Where, \( Y \) = output in kilogram (kg); \( X_1 \ldots X_n \) = variable inputs used during production process, \( U \) = random error term or disturbance term. Four functional forms namely: linear, semi-log, double log and exponential functions were fitted and the functional form with the best fit was selected based on the coefficient of determination, statistical significance of the variables, sign of the coefficient and conformity with economic theory. The double log equation had the best fit and is expressed in its explicit form as:

\[ \ln Y = \ln \beta_0 + \ln \beta_1 X_1 + \ln \beta_2 X_2 + \ln \beta_3 X_3 + \ln \beta_4 X_4 + \ln \beta_5 X_5 + U \] …………(iii)

Where; \( Y \) = output of sesame (kg/ha); \( X_1 \) = farm size (ha); \( X_2 \) = labour (N paid per unit); \( X_3 \) = fertilizer (kg); \( X_4 \) = chemicals (liters); \( X_5 \) = seed (kg); \( \beta_0 \ldots \beta_5 \) = parameter to be estimated; \( U \) = random error term or disturbance term; The apriori expectation of the variables (farm size, quality of seed, labour, chemical and fertilizer) will be positive i.e. a unit increase in any one of the variable will lead to a corresponding increase in output.

Resource use efficiency among small scale farmers was determined using the following model:
The model was estimated as follows:
\[ r = \frac{\text{MVP}}{\text{MFC}} \]  
(iv)

The value of MVP and MPC will be estimated as follows;

\[ \text{MVP} = \text{MPP}.P_Y; \text{MPP} = b_i.Y; \text{MFC} = P_x \]

Where: \( r \) = Efficiency ratio; \( \text{MVP} \) = Marginal value product; \( \text{MPP} \) = marginal physical product; \( \text{MFC} \) = Marginal factor cost; \( P_x \) = (unit price of input \( X \)); \( Y \) = Arithmetic mean value of output; \( P_y \) = unit price of output; \( b_i \) = estimated coefficients of independent variables. Based on the econometric theory, a firm maximizes profits with regard to resource use efficiency when use ratio of marginal return to the opportunity cost is one. The values are interpreted as follows:

i. If \( r \) is less than 1 = resource was excessively used or over-utilized, hence decreasing quantity use of that resource increases output.

ii. If \( r \) is greater than 1 = resource is under used or being under-utilized hence increasing its rate of use will increase output level.

If \( r = 1 \) it shows the resource is efficiently used, that is optimum utilization of resource, hence the point of maximization.

Results and Discussion
The age distribution revealed that majority (70%) of sesame farmers in the study area were within the active age of < 20-40 years with the mean of 30 years (table 1). This implies that most sesame farmers were young, strong, agile, and can be fully involved in production of sesame. This agrees with the findings of Dzer (2018) which noted that most farmers can make positive contribution to agricultural production owing that majority of the sesame farmers were within the active age of farming.

Table 2 shows that majority (96%) of the sesame farmers in the study area had formal education (primary, post primary, or tertiary ) while about 4% had no formal education. This is an indication that the use of resources as well as adoption of innovation by the sesame farmers in the study area can be efficient since information can be utilized owing to the literacy level among the farmers. This result agrees with the findings of Adole (2016) which observed that respondents in that study were literate and had one level of education or the other.

Table 3 shows distribution of extension visits. The result revealed that 70 % of the sesame farmers had no extension contact with agents, while about 30% had extension contact. The 30% that had extension contact were visited 1-3 times by extension agents in a year. This implies that there is low level of extension education to sesame producers. This low level of extension education could result in inefficient production and low output as a result of inefficient use of production inputs. This agrees with the findings of Adole (2016) in a study on economic analysis of sesame production among small holder farmers in Benue State revealed that only 21.1% of the sesame farmers in the study are had contact with extension agents. Ikwuakan et al. (2016) in a study on information needs of sesame farming households in Katsina State also revealed that majority (94.39%) of the farmers lacked extension agents contact visits. According to Abu et al. (2012), low level of information about sesame production might likely result to inefficiency production.

Table 4 revealed that majority (79%) of the sesame farmers in the study area had farm sizes between 1-2ha, while the remaining 21% had farm sizes above 2 ha. The result is in line with the findings of Zongoma et al. (2015) that reported that majority of sesame farmers had farm sizes of between 1-3ha. This is an indication that majority of the sesame farmers operated at the small scale level.

Table 5 presents results on farming experience of respondents. About 88% of the respondents had farming experience equal to or greater than 10 years. The more the years of farming experience, the higher the likelihood of greater efficiency in managerial decision making and the allocation of farm resources, resulting in higher outputs. This tallies with the findings Abu et al. (2012) studied profit efficiency among sesame farmers in Nasarawa State showed that farmers had average
farming experience of 12 and 12.8 years respectively. They opined that farming experience enables the farmers to set realistic targets and to make effective farm management decisions with regards to good agronomic practices and wise choice of input combination or resource allocation which reduces inefficiency.

Table 6 revealed that majority (91%) of the sesame farmer had no access to formal credit while 9% had access to informal credit in the study area. This implies that there is no access to formal sources of credit in the study area. This can limit farmers’ resource allocation as a result of inadequate capital. Access to credit reduces inefficiency as it enables farmers to access information and adequate inputs useful for increasing productivity and efficiency (Ogundari, 2006; Oluwatosin, 2011).

Table 7 shows the impact of inputs on outputs produced in the production of sesame in the study area. The functional form with the best fit was the double log production function and the result shows that the value of R^2 was 0.90 that means 90% of the total variation in the dependent variable is explained by variation in the independent variables included in the model showing that only 10% of output is as a result of an error. The Table also reveals that all the variables i.e. farm size, labour, fertilizer, chemical and seed have positive regression coefficient of 0.072, 0.263, 0.008, 0.069 and 0.120 respectively and are all statistically significant at either 1% or 5% level of significance as shown in Table 8. The result indicates that a unit increase in any of the explanatory variables in the model will result in an increase in the output. The T-value coefficient of the double log is also its elasticity. Therefore, it indicates the extent to which the dependent variable will change in response to a unit increase in each of the explanatory variables. The coefficient of labour (0.263) and seed (0.120) had the greatest effect on the output of sesame in this study. This implies that a unit increase in labour will result in 0.263kg of sesame while a unit increase in seed will result in 0.120kg of sesame. This finding agrees with Shu’aib et al. (2010), who studied Resource Use Efficiency in sesame Production in Bagwai Local Government Area of Kano State, and reported that double-log function gave the best fit with adjusted R^2 of 81.6%. Production inputs such as seed, fertilizer, labour, affected outputs significantly. Usman (2009) studied resource use efficiency in sesame production in Jigawa state and reported that R^2 value of double-log production function was 0.472 indicating that 47.2% of the variation in the dependent variable was explained by the independent variable. The result also indicated that the mean output of sesame of sesame per hectare was 600kg, being influenced by male labour, seed and pesticide at significant level of 1% and 5%. He reported that quantity of seed, male labour, and pesticide were the major factors influencing sesame production.

Table 8 shows that the ratios of MVP to MFC are more than unity for labour, fertilizer, chemical and seed (21.36, 3.47, 3.74, and 13.52) implying underutilization of the inputs. This means that input was being used below the optimum level such that an increase in the inputs will still yield more output. This is so with regard to use of labour and seed. On the other hand, the ratio of farm size (0.94) is almost unity. This implies that the farm size used for the production of sesame in the study area was optimal as the MVP and MFC were almost equal. The result in Table 9 therefore indicates that except in the use of land, sesame farmers in the study area were not resource use efficient. This result is in line with Zongoma et al., 2015; Oluwatayo et al., 2016; Ahegbeye et al., 2017; Mohammed and Ahmed, 2007.

Conclusion and Recommendation
Based on the findings of the study, it was concluded that all production inputs (especially labour and seed) contribute to sesame production output. Production resources were under-utilized by sesame farmer in the study area except for farm size. Therefore, it can be recommended that government should support sesame farmers by providing subsidized production inputs and farm credit. Sesame farmers should form cooperative societies so as to put resources together for the purpose of more efficient production.
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Table 1: Distribution of Sesame Farmers based on Age

| Age    | Frequency | Percentage |
|--------|-----------|------------|
| <20    | 2         | 3.5        |
| 20-30  | 7         | 12.3       |
| 31-40  | 31        | 54.4       |
| 41-50  | 10        | 17.5       |
| >50    | 7         | 12.3       |
| Total  | 57        | 100        |

Source: field survey, 2019.

Table 2: Distribution of Sesame Farmers Based on Level of Education

| Level of education       | Frequency | Percentage |
|--------------------------|-----------|------------|
| No formal education      | 2         | 3.5        |
| Years of primary school  | 17        | 29.8       |
| Years of secondary school| 18        | 31.6       |
| Years of tertiary school | 20        | 35.1       |
| Total                    | 57        | 100        |

Source: field survey, 2019.

Table 3: Distribution of Sesame Farmers Based on Extension visit

| Extension visit | Frequency | Percentage |
|-----------------|-----------|------------|
| No visit        | 40        | 70.2       |
| 1-3             | 17        | 29.8       |
| Total           | 57        | 100        |

Source: field survey, 2019.

Table 4: Distribution of Sesame Farmers Based on Farm size

| Farm size | Frequency | Percentage |
|-----------|-----------|------------|
| <1        | 5         | 8.8        |
| 1-2       | 40        | 70.2       |
| 2.1-3     | 4         | 7.0        |
| >3        | 8         | 14         |
| Total     | 57        | 100        |

Source: field survey, 2019.

Table 5: Distribution of Sesame Farmers Based on Farming Experience

| Farming experience | Frequency | Percentage |
|--------------------|-----------|------------|
| <10                | 7         | 12.3       |
| 10-15              | 19        | 33.3       |
| 16-20              | 11        | 19.3       |
| 21-25              | 13        | 22.8       |
| Total              | 57        | 100        |

Source: field survey, 2019.

Table 6: Distribution of Sesame Farmers Based on Access to Credit

| Access to credit | Frequency | Percentage |
|------------------|-----------|------------|
| No access        | 52        | 91         |
| 10,000-20,000    | 4         | 7          |
| 21,000-30,000    | 1         | 2          |
| Total            | 57        | 100        |

Source: field survey, 2019.
Table 7: Determinant of Sesame Production in the Study Area

| Variables     | Coefficients | t-value |
|---------------|--------------|---------|
| Farm size ($X_1$) | 0.072 | 2.2*    |
| Labour ($X_2$)   | 0.263 | 4.3*    |
| Fertilizer ($X_3$) | 0.008 | 4.5*    |
| Chemical ($X_4$) | 0.069 | 2.0*    |
| Seed ($X_5$)     | 0.120 | 2.1*    |
| Constant        | 3.348 |         |

Adjusted $R^2$: 0.86
$R^2$: 0.90
F-ratio: 65.6

Source: field survey, 2019.

*significant at 5% level of probability

Table 8: Estimate of Resource use Efficiency of Sesame Production

| Variables     | MPP  | MVP  | MFC  | R   |
|---------------|------|------|------|-----|
| Farm size ($X_1$) | 11.71| 4684 | 5000 | 0.94|
| Labour ($X_2$)   | 42.77| 17108| 800  | 21.36|
| Fertilizer ($X_3$) | 1.30 | 520  | 150  | 3.47|
| Chemical ($X_4$) | 11.22| 4488 | 1200 | 3.74|
| Seed ($X_5$)     | 19.52| 7808 | 600  | 13.52|

Source: field survey, 2019.