ANALYSIS OF DEMAND FOR SELECTED AGROCHEMICAL INPUTS AMONG OIL PALM FARMERS IN EDO STATE, NIGERIA

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ABSTRACT

Agrochemicals are important inorganic inputs in oil palm production to improve quantity and quality of its products. Thus, this paper investigated demand for the selected agrochemical among oil palm farmers in Edo state. Specifically, it described the socioeconomics characteristics of the farmers; analyzed the demand of agrochemicals among oil palm farmers; determined the factors affecting the demand for agrochemicals among oil palm farmers; and estimated the costs and returns to the use of agrochemical among the oil palm farmers. A multistage sampling procedure was used to obtain data from 100 respondents for the study. Data collected were analyzed using descriptive statistics, probit regression model, and budgetary analysis. The result showed average values of 46.49 ±10.6 years for age, 14.74±7.01 years for formal education, 7.25±4.92 persons for household size, and 7.43±6.58 hectares for farm size. It further showed that 85%, 78%, 14% of the respondents demanded for herbicides, fertilizer, and pesticide, respectively. The mean quantities applied were 150 kg/hectare, 4.41 kg/hectare, and 3.53 kg/ hectares for fertilizer, herbicide, and pesticide respectively. Probit regression estimates revealed that factors such as unit cost of fertilizer (P<0.01), quantity of fertilizer applied (P<0.01), and cost of hired labour (P<0.1) were the significant determinants of demand for fertilizer, while the age of the farmer (P<0.01), unit cost of herbicides (P<0.01), the size of farm applied (P<0.01), farming experience (P<0.1), the distance to the input market (P<0.01) and the quantity of herbicides(P<0.01) were the significant determinants of demand for herbicides in the study area. Budgetary analysis showed that average gross margin and rate of return were ₦580354.26 and ₦3.26, respectively. In accordance with the finding of the study, we therefore, recommend that a subsidized cost of agrochemicals as well as reduction in its transport cost would encourage farmers to demand for more agrochemical inputs thereby improving oil palm production in the study area.

Keywords: Demand, Agrochemicals, Oil palm farmers

Introduction

Oil palm (*Elias guineensis*) is a perennial crop grown in the tropics of Africa for its production of vegetative oil (Verheye, 2010). The oil palm belt of Africa runs through the southern latitudes of Guinea, Sierra Leone, Liberia, Ivory coast, Ghana, Togo, Benin, Cameroon, Equatorial Guinea, Congo, and Nigeria (Verheye, 2010). Nigeria supplies about 55% of Africa's oil palm output (Omoti, 2003; Ayodele, 2010; Gourichon, 2013). In Nigeria, Edo state is a leading producer of oil palm with the situation of the National Institute for Oil Palm Research in the State (Gourichon, 2013).

Oil palm and oil palm products serve as a major foreign exchange for many countries, Nigeria inclusive. Oil palm has several food and non-food uses (World Growth, 2011; Kongsager and Reenberg, 2012). Though, palm oil is the major product obtained from oil palm which is a very important ingredient in the kitchen because it is an excellent source of vitamins and other nutrients, it could also be used for margarine, confectionary fats and shortenings (Omoti, 2003). Alternative to food uses are Palm wine which is a good source of yeast (Chandrasekhar *et al*., 2012). Others include domestic, medicinal, agricultural, industrial and economic importance. Domestically, palm fronds can be used to make brooms, baskets and mats, and roofing and thatching materials. Palm fruit bunches, shell and fibre after oil extraction are excellent mulching materials in agriculture. Palm kernel cake is also a very important ingredient in feed formulation in animals. Industrially, it can be used in the production of candles, detergents, polish, etc. (Omoti, 2003).

Despite the potentials of oil palm in addressing the increasing food demand of the growing population in Nigeria as well as its diverse uses, oil palm production in Nigeria has remained abysmally low. Recent statistics showed that oil palm production in Nigeria (930,000 metric tonnes (MT)) has relegated to fifth position after Indonesia (33,000,000MT), Malaysia (19,800,000MT), Thailand (2,000,000MT) and Columbia (1,108,000MT) (USDA, 2015). The local consumption is estimated to be about 1.4 million MT creating a demand-supply gap of about 400,000MT to 600,000MT per annum (USDA, 2015). This wide gap could be attributed to some set of factors which include weed infestation, low soil fertility and the problem of insect pests and diseases among others (Eifediyi *et al*., 2014).

To effectively combat these production problems, the integrated management approach involving chemical, cultural and biological control methods is recommended (Ogbalu and Umeozor, 2003). However, the greatest reliance is on the use of agrochemicals because it works faster and effectively as well as ensuring profit to the farmers (Kehinde, 2016). Agrochemicals are inorganic substances used to improve quantity and quality of farm products. Agrochemicals include fertilizers, herbicides, fungicides, rodenticides, nematicides, insecticides among others. These agrochemicals grouped together with the exception of fertilizers are called pesticides.

However, the demand for agrochemicals is a function of some set of factors (Nonga *et al*., 2011). These factors include occurrence and severity of pest attack, soil depletion, and level of damage caused, and season of the year among others. This implies that farmers would only demand for agrochemicals as the need for it arises. The demand habits of farmers for agrochemicals is based on some factors which could be socioeconomic factors. This factors include price of agrochemicals, price of crops, and price of substitutes or complements, years of formal education, years of farming experience, availability of credit, access to extension services, household size, farm size cultivated, cost of labour, amount of labour used on farm, (Abdullahi, 2014; Kabiru, 2002; Sharma and Thaker, 2011). Consequently, understanding factors that influence the

farmers' decision to buy agrochemicals as well as the cost benefit analysis of agrochemicals becomes imperative. This paper investigates demand for selected agrochemical inputs among oil palm farmers in Edo State. Specifically, it describes the socioeconomics characteristics of the farmers; analyzes the demand of agrochemicals among oil palm farmers; determines the factors affecting the demand for agrochemicals among oil palm farmers; and estimates the costs and returns to the use of agrochemicals among the oil palm farmers.

2.0 Methodology

2.1 Study area

This study was carried out in Edo State, Nigeria. The State is an inland state with Benin City as its capital. The State is divided into three agro-ecological zones with a total of eighteen local government areas. It has a tropical climate characterized by distinct wet and dry seasons. The wet season ranges from April to October while the dry season ranges from November to March. The annual rainfall averages 250 cm near the coastal areas and 150 cm in the extreme northern part of the State while temperature ranges from 22 – 36°C. Farming is the predominant occupation of the people in the State. The major cash crops in the State are rubber (*Ficus elastica*), cocoa (*Theobroma cacao*) and oil palm (*Elaeis guinensis*). Other crops such as yam (*Dioscorea spp.*), cassava (*Manihot esculenta*), rice (*Oryza sativa*), plantain (*Musa paradisiaca*), and guinea-corn are also produced in the State.

2.2 Sampling procedure

Multistage sampling procedure was used to obtain data for the study. The first stage was purposive selection of two Local Government Areas (LGAs) in Edo states (Ovia North East and Oredo LGAs) based on the predominance of oil palm enterprises in the study area. The second stage was a random selection of five villages per LGA. The third stage was the random selection of 10 farmers per village making a total of 100 farmers for the study. Data were collected on socio-economic characteristics such as age, gender, household size, demand habits as it relates to agrochemicals as well as frequency of use of these agrochemicals among others.

2.3 Analytical techniques

Data were analyzed using descriptive statistics, probit regression model, and budgetary analysis.

2.3.1 Descriptive statistics

Descriptive statistics such as mean and percentages were used to describe the socioeconomic characteristics of the respondents.

2.3.2 Probit regression model

Probit regression model was used to determine factors affecting the demand for agrochemicals among oil palm farmers. The regression model was implicitly specified as follows:

$$Y = \beta_0 + \beta_{1x1} + \beta_{2x2} + \ldots + \beta_{10x10} + \varepsilon \quad \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Where Y= demand for agrochemicals (1= Yes, 0 = No)

b_0= regression constant; $b_1 – b_{10}$ = regression coefficients; X_1 is years of formal education; X_2 = farming experience (years), X_3 = distance to input market (km); X_4 = age of farmer (years); X_5 = household size (#); X_6 = transportation cost for agrochemical (₦); X_7 = cost of labour (₦/manday); X_8 = total revenue from product sales (₦/unit); X_9 = price of agrochemicals (₦/unit); X_{10}= farm size cultivated (Hectares); E = error term.

The marginal effect of the variables is calculated using the formula:
Marginal effects =B_i Ø (Z)
Where B*i* are the coefficients of the variables and Ø (Z) are the cumulative normal distribution value associated with the mean dependent variable from the probit estimation

2.3.3 Budgetary analysis

Budgetary analysis was used to estimate the cost and return accruing to the use of agrochemicals by the oil palm farmers. The average total cost of production per hectare and the average cost of agrochemicals use per hectare were also calculated. Then, the percentage of the total cost incurred on agrochemicals was obtained. This percentage was used to calculate the return accruing to agrochemical use from the profit.

Gross margin = total revenue – total variable cost

$$Return\ on\ investment\ (ROI) = \frac{gross\ margim}{total\ variable\ cost} \quad \text{..... (2)}$$

3.0 Results and Discussion

3.1 Socioeconomic characteristics of oil palm farmers

The socioeconomic characteristics of oil palm farmers were presented in Table 1. The average age in the entire sample of farmers was 46.49 ±10.6 years. This implies that farmers are relatively young in the study area. This could suggest that the farmers are active and productive. This agrees with the findings of Emokaro and Ugbekile (2014). Majority (79.0%) of the farmers were male. This implies that men dominate oil palm production. This could be attributed to the labour intensive nature of oil palm production. Larger percentage (75%) of respondents are married. This could imply some level of commitment into the farming business in order to meeting their family needs. An average household size of farmers in the entire sample was 7±4 persons. This could indicate that there is access to family labour for oil palm production in the study area. The average years of formal education for the entire sample was 14.74±7.01 years. Formal education could help farmers to understand and process the information related to agrochemicals. The mean years of farming experience attained by the oil palm farmers was 19.97±12.53 years. This could indicate that farmers in the study area have many years of farming experience in oil palm production. The average farm size for respondents was 7.43±6.58 hectares. According to Federal Office of Statistics (FOS) 1999, it implies that oil palm cultivation is done on a medium scale in the study area. Majority (61.0%) of the respondents inherited their farm lands. This

could be ascribed to the perennial nature of oil palm.

Table 1: socioeconomic characteristics of oil palm farmers

Variables	Oil-palm farmers
Age (years)	46.49 ±10.6
Male (%)	79
Married (%)	75
Household size(#)	7.25±4.92
Years of formal education	14.74±7.01
Years of experience	19.97±12.53
Farm size (#)	7.43±6.58
Divided inheritance (%)	61

Note: Figures in parentheses are standard deviations

3.2 Demand of agrochemicals

3.2.1 Types of agrochemical used and mean quantities

Herbicide, pesticide and fertilizer were the common agrochemicals used in the study area as shown in Table 2. Out of the three, herbicide (gammalin, aldrex 40, touchdown, etc) is the most used agrochemical as majority (85.0%) of the farmers used it on their farm. This could be attributed to a large expanse of land used for oil palm plantation which cannot be easily weeded by hand. The second most used agrochemical was fertilizer (78%) while few (14%) of the respondents used pesticides. The mean quantities applied were 150 kg/hectare, 4.41 kg/hectare, and 3.53 kg/ hectares for fertilizer, herbicide, and pesticide, respectively. This result implies that majority of the farmers heavily purchase agrochemical inputs though they complement it with some cultural practices such as bush burning and rouging.

Table 2: Agrochemicals used and their mean quantities

Agrochemical	Percentage	Mean quantity
Fertilizer	78.0%	150kg/hectare
Herbicide	85.0%	4.41 kg/hectare
Pesticide	14%	3.53 kg/hectare

Source: Data analysis, 2016

3.2.2 Frequency of agrochemical use

A larger percentage (61%) of respondents used agrochemicals irrespective of the frequency of use as shown in Table 3. About 47.0% of the farmers use agrochemical inputs occasionally. This could be ascribed to the fact that there was no serious pest and weed attack on oil palm plantation in the study area. Small percentage (14.0%) of famers use it more often while 24% never used agrochemicals on their farm. This could be attributed to the high cost of agrochemical inputs in Edo State.

Table 3: Agrochemical usage frequency

Agrochemical use	Frequency	Percent
No response	15	15.0
Never	24	24.0
Occasionally	47	47.0
Often	14	14.0
Total	100	100.0

Source: Field survey, 2016

3.3.3 Determinants of demand for agrochemical inputs

Determinants of demand for agrochemical inputs were presented in Table 4. The coefficients of quantity of fertilizer per hectare, unit cost of fertilizer, and cost of hired labour significantly influenced the demand for fertilizer at different levels of probability. The coefficients of quantity of fertilizer per hectare and cost of hired labour had positive signs, implying that for every unit increase in any of these variables increase the demand for fertilizers by the magnitude of their coefficients; 6481.36 and 175.10 units, respectively. Also, the negative coefficient of unit cost of fertilizer implies that this variable reduces the demand for fertilizer by the magnitude of its coefficient (114.42) units. These findings are in agreement with Ogunlade et al. (2009).

For herbicide, the age of the farmer, unit cost of herbicides, the size of farm applied, quantity of herbicides used per hectare, farming experience, farm size and distance to source of herbicide significantly influenced its demand. The coefficients of farming experience, farm size, and distance to source of herbicide had positive signs, implying that for every unit increase in any of these variables increase the demand for herbicides by the magnitude of their coefficients; 12.96, 174.79 and 33.23 units, respectively. On the other hand, the coefficients of age of respondents, size of farm applied, unit cost of herbicides, and quantity of herbicides used per hectare had negative signs. This implies that these variables reduce the demand for herbicides by the magnitude of their coefficients: 24.03, 167.04, 0.481, and 135.55 units, respectively. These findings are in line with a prior expectation (Kabiru, 2002; Sharma and Thaker, 2011; Abdullahi, 2014).

Table 4: Determinants of demand for agrochemical inputs

Variable	Fertilizers	Herbicides
Age	-1400.58(-0.43)	-24.03(-2.81)***
Household size	-15467.17(-1.03)	-37.25(-0.91)
No of Children	23417.93(1.23)	36.82(0.72)
Formal Education	54.99(0.03)	7.56(1.39)
Farming experience	279.37(0.09)	12.96(1.77)*
No of farms owned	1979.14(0.13)	-1.98(-0.05)
Farm size	330.95(0.08)	174.79(14.26)***
Quantity per hectare	6481.36(4.47)***	135.55(11.13)***
Unit cost of input	-114.42(-7.45)***	-0.481(-39.91)***
Size of farm applied	32.22(0.25)	-167.04(-53.56)***
Distance to source	6637.48(1.25)	33.23(2.77)***
Cost of transporting agrochemical inputs	-22.72(-1.33)	-0.03(-0.77)
Cost of family labour	25.85(0.99)	.002(0.22)
Cost of hired labour	175.10(1.66)*	-0.18(-1.49)
Total revenue from palm kernel	.030(1.26)	7.214E-006(0.11)
(Constant)	333149.61(1.77)	620.55(1.70)

***, **, * implies Significant at 1%, 5%, and 10%. Figures in parentheses () are t-values.

Source: Data analysis, 2016

3.4 Cost and returns to agrochemical use

The distribution of various costs incurred and returns to agrochemical use among oil palm farmers were presented in Table 5. The analysis was computed on twelve (12) months basis for farmers. The average variable cost of production was ₦ 178283.5. Agrochemicals accounted for 54.24% of the total production cost. This suggests that there is high demand for agrochemical input in the study area. The average gross margin realized to the enterprise was ₦ 580354.26. The net profit analysis showed that oil palm farmers were making profit at the time of the study. The rate of returns analysis implies that every ₦1.00 invested by the oil palm farmers yielded ₦3.26 to the farmers. This suggests that oil palm enterprise is profitable in the study area, though, cost of agrochemical inputs covers above average of the total oil palm production cost in the study area. It is important to state that farmers operates on already established oil palm farms as such the running costs have reduced over time, hence the seemingly huge profit.

Table 5: Gross margin analysis of oil palm production

Items	Amount (naira)	Total (naira)
Total revenue (₦)		758637.76
Variable cost (₦)		
Total cost of labour (₦)	54690.41	
Total cost of fertilizer (₦)	67733.28	
Total cost of herbicides (₦)	20892.91	
Total cost of pesticides (₦)	8071.36	
Agrochemicals transport cost (₦)	2198.82	
Transport cost for product (₦)	8489.13	
Subtotal (₦)	162075.91	
Miscellaneous expenses (10%)	16207.59	
Total variable cost (₦)		178283.5
Gross margin		580354.26
ROI		3.26

Source: Data analysis, 2016

4.0 Conclusion and Recommendation

Agrochemicals are important inorganic inputs in oil palm production to improve quantity and quality of its products. Thus, this investigated the determinants of demand for selected agrochemical inputs among oil palm farmers in Edo State. The study concluded that oil palm is a profitable enterprise in the study area. This could be ascribed to high use of agrochemical inputs which covers above average of the total variable cost of oil palm production in the study area. The study employed probit regression model to analyze the determinants of demand for selected agrochemical inputs. The model revealed that unit cost of fertilizer ($p<0.01$) and quantity of fertilizer applied ($p<0.01$) were the significant determinants of demand for fertilizer while the age of the farmer ($p<0.01$), unit cost of herbicides ($p<0.01$), farm size ($p<0.01$), farming experience ($p<0.1$), the size of farm applied ($p<0.01$), the distance to the input market($p<0.01$) and the quantity of herbicides($p<0.01$) were the significant determinants of demand for herbicides in the study area. In accordance with the finding of the study, we therefore, recommend that a subsidized cost of agrochemicals as well as transport cost would encourage farmers to demand for more agrochemical inputs in order to improving oil palm production in the study area.

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