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IMPACT ANALYSIS OF THE ADOPTION OF MOTORIZED FRUIT BUNCH HARVESTER BY OIL PALM FARMERS IN CROSS RIVER STATE, NIGERIA

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Abstract

The study analyzed the impact of the adoption of motorized fruit bunch harvester by oil palm farmers in Cross River State, Nigeria. Two-stage sampling procedure was used to select a sample size of 180 respondents. Primary data were collected using structured interview schedule and analyzed using descriptive and inferential statistics. The study revealed that many (50%) of the farmers were at the adoption stage, the mean time two minutes, 30secondsand cost (–N11.88 of harvesting of adopters) was less than that of non-adopters (four minutes, 30seconds and N7.16). It further revealed that high cost of motorized fruit bunch harvester and inadequate handling skillswere perceived by farmers as factors militating against adoption of motorized fruit bunch harvester. It was recommended that subsidy be provided to help bring down the cost of motorized fruit bunch harvester to further enhance adoption.

Keywords: Motorized fruit bunch harvester, Adoption, Cost, Oil palm farmers and Crude palm oil.

Introduction

Oil Palm (*Elaeis guineensis*) is a common cash crop cultivated by farmers in Nigeria. The crop is important because it could serve as a means of livelihood for many rural families. The oil palm subsector of Nigeria's agriculture presented itself as a potential productive sector that could be used to diversify the economy. The drop in interest of Nigerian Government on plantation development accounts for reasons why Nigeria is losing her leading position to Malaysia whose total production is export-oriented (Green, 2003; World Rainforest Movement, 2010).

Significant quantity of palm oil in Nigeria is from small-scale farmers, processed mainly through traditional methods or with simple mechanized equipment (Olagunju, 2008; Ekine and Onu, 2008; Gourichon, 2013). The Cross River State, in the hope of broadening its agricultural investment in 2011 and 2012, sold several plantain sites in the state to Wilmar's New Nigerian Holdings. These purchases were part of Cross River State's efforts to court "high capacity" foreign investors to revive its flagging or weakening of plantations. Wilmar'sNew Nigerian Holdings acquired several estates including the plantations of Biase, Ibia and Calaro totaling 19,173 hectares (Onoja and Achike, 2015).

Ahmed (2001) highlighted the importance of oil palm in providing direct employment to about four (4) million people in Nigeria. Apart from palm oil, palm kernel and palm kernel oil which are the main products of the oil palm, the tree and the processing waste generated when the fruits are processed to obtain palm oil and palm kernel have several uses. While many products as shown in Figure 1 are derivable from the oil palm trees (palm oil, wood by-products), the focus of this research is on impact analysis of the adoption of motorized oil palm fruit bunch harvester by oil palm farmers in Cross River State, Nigeria.

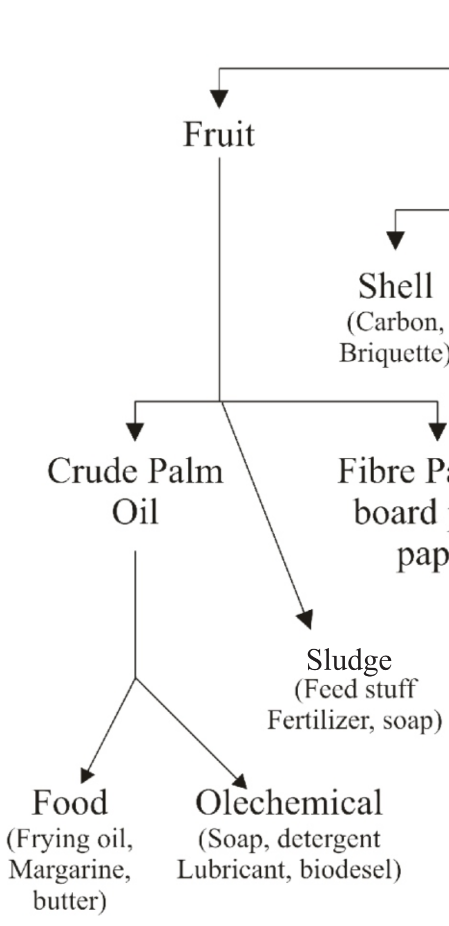

Figure 1: Uses of Oil Palm Products

Source: Partnership Initiative in Niger Delta (2011)

Oilpalmharvest is the work, which has the highest labour requirement of oil palm production.In a bid to overcome this stress,Wilmar,as part of their social responsibility in conjunction with Cross River State Government through Ministry of Agriculture and Natural Resources, Commercial Agriculture Development Project (CADP) and Fadama organized training and demonstration of the use of motorized oil palm bunch harvester across the state in

2012 (CADP, 2012).

The Motorized Fruit Bunch Harvester (MFBH) has a single-cylinder, spark-ignition engine which runs on a mixture of petrol and oil. A quarter of a litre of engine oil is usually mixed with four litres of petrol. Harvesting and processing is very critical in oil palm, as the faster the process and reduce time to processing the reduced levels of Free Fatty Acid (FFA). With the use of mechanized harvester, the overall average time of harvest per bunch, and the speed of harvest are one minute, 50 seconds and 40 fresh fruit bunches (FFB) per hour (Aramide, *et al*., 2015).

Potential users of technologies may not adopt at once new technologies that have superior characteristics compared to their practices (Geroski, 2000; Sunding and Zilberman, 2001). This research is, therefore, significant as it will provide empirical data on impact of the adoption of motorized oil palm fruit bunch harvester by oil palm farmers in Cross River State. The specific objectives were to:

i. ascertain the stages of adoption;
ii. determine the differences in time of harvesting of adopters and non-adopters of motorized fruit bunch harvester; and
iii. identity perceived factors militating against the adoption of MFBH.

The null hypothesis for this study is stated thus:

There is no significant difference in the cost of harvestingbetween adopters and non-adopters of MFBH.

Methodology

The study was carried out in Cross River State, a coastal state in the South-Southgeopolitical zone. The state occupies a landmass of 20,050.00 square kilometers with a total population of 2,888,966 persons (National Population Commission, 2006). It shares borders with Benue State to the North, in the East by Cameroon Republic, West by Ebonyi and Abia States and to the South by AkwaIbomState and the Atlantic Ocean (Cross River State Ministry of Lands and Survey, 2006). The people of the state are engaged in farming, trading, fishing, hunting, tailoring, and post-harvesting processing particularly in the rural areas (Ndifon and Bassey, 2003).

The major crops grown include yams, cassava, cocoyam, maize, rice, vegetables, citrus, bush mango, oil palm, cocoa, etc. There are three key language groups in Cross River State – Efik, Ejagham and Bekwarra. Customary festivals pertaining to farming activities are observed in most part of the State annually to celebrate the rich harvest season (Ndifon and Bassey, 2003). A total of 450 oil palm farmers participated in the training and demonstration of motorized fruit bunch harvester in 2012 (CADP, 2012).

Two-stage, purposive and random sampling technique was adopted for sample selection. These techniques were adopted to give all the farmers equal chance of being selected for the study. In the first stage, random sampling technique was used to select 40% of the population (Farmers that participated during the training and demonstration of MFBH). In stage two, purposive sampling technique was used to select adopters and non-adopters. The sample size of 180 respondents was obtained through the selection formula stated as:

$$n = 40/100 \times 450 = 180$$

Where n = sample size

Primary data were used for the study, obtained through structured interview schedule. Data collected were analyzed using percentages, mean count, cost estimate, difference in difference and paired t-test.Objective one was analyzed using percentage distribution. Objective two was achieved by determining operator's time for harvesting a bunch. This was done for operators with MFBH and operators using sickle chisel (Bamboo Pole and Knife). The mean time of the operators with MFBH and those without were subjected to independent t-test at 5 percent level of significance to ascertain whether their time was significantly different. The formula for the t-test statistic is stated as:

$$t = \frac{X_1 - X_2}{\sqrt{\frac{S_1^2}{n_1} + \frac{S_2^2}{n_2}}}$$

Where t = t – calculated

X_1 = Mean cost of harvesting of adopters as group 1

X_2 = Mean cost of harvesting of non-adopters as group 2

S_1^2 = Variance of group 1

S_2^2 = Variance of group 2

n_1 = Total number of adopters of MFBH

n_2 = Total number of non-adopters of MFBH

Objective three was achieved using four-point likert scale with 2.5 mean decision rule to measure their responses. Multiple responses were recorded. For the factors that they strongly agree = 4, agree = 3, disagree = 2, strongly disagree = 1. The likert scale formula is stated as:

$X = \Sigma f/n$. Where

X_2 = Mean score of each factor

Σ = Summation of

f = Total scale score (that is 4, 3, 2 or 1 multiple by number of respondents' responses under the same scale)

n = Total number of respondents (Vogt, 1999).

The null hypothesis was tested by first determining the cost of harvesting for adopters and non-adopters.Cost of labour, therefore, is

$$C_L = n_b \times w + S_V$$

Where C_L = Cost of labour

n_b = Number of bunches harvested

S_V = Salvage value which was calculated using straight line method.

The depreciation was calculated for the bamboo and knife and that of the MFBH.

Cost of harvesting using MFBH was calculated thus:

$$C_F = (C_P \times n_P) + (C_e \times n_e)$$

Where: C_F = Cost of fuel

C_P = Cost of petrol

C_e = Cost of engine oil

n_P = Number of litres of petrol

n_e = Number of litres of engine oil

The cost of operation of harvesting with the motorized fruit bunch harvester is therefore; the sum of the cost of labour, fuel and salvage value. That is

$$C_H = C_L + C_F + S_V$$

Where:

C_H = Cost of harvesting

C_L = Cost of labour

C_F = Cost of fuel

S_V = Salvage Value

If the harvester is the owner of the MFBH he or she is paid per bunch harvested and can harvest over 200 bunches in a day, which depends on the strength of the operator, organization of the farm, topography, nature of the farm, among others.

The mean cost outcome was analyzed using percentage change, difference in difference and paired t-test approaches. The percentage change was used to evaluate and compare the variable outcome of operators with MFBH and those without. A positive value from the percentage change is an increase, while negative value is a decrease. The difference in difference estimator is defined as the difference in mean outcome in operators or adopters of MFBH minus the difference in mean outcome in operators without MFBH or non-adopters before and after adoption. An inverse and significant outcome difference value implied adoption impact on the beneficiaries with MFBH (Simonyan and Omolehin, 2012; Bassey, 2016).

The level of significance of the outcome difference was tested using paired t-test at 0.05 level of significance. The formula for percentage change in outcome is stated as:

$$\%\ \text{Change in Outcome} = \frac{\text{Outcome after} - \text{Outcome before}}{\text{Outcome before}} \times 100$$

Where Outcome after = Outcome in cost after adoption

Outcome before = Outcome in Cost before adoption

The model specification for the difference in difference using in-the-box approach is stated thus:

$$DD = \Sigma[Y_1^T] - \Sigma[Y_0^T] - (\Sigma[Y_1^C] - \Sigma[Y_0^C])$$

Where DD = Difference in difference, which is the outcome difference between adopters and non-adopters

Σ = Summation sign

Y_1^T = Mean cost of harvesting of adopters after adoption of MFBH

Y_0^T = Mean cost of harvesting of adopters before adoption of MFBH

Y_1^C = Mean cost of harvesting of non-adopters after adoption of MFBH

Y_0^C = Mean cost of harvesting of n

$$t = \frac{X_1 - X_2}{\sqrt{\frac{S_1^2}{n_1} + \frac{S_2^2}{n_2}}}$$

X_1 = Mean cost of harvesting of adopters as group 1

X_2 = Mean cost of harvesting of non-adopters as group 2

S_1^2 = Variance of group 1

S_2^2 = Variance of group 2

n_1 = Total number of adopters of MFBH

n_2 = Total number of non-adopters of MFBH

Results and Discussion

Respondent's Stages on the Adoption of Motorized Fruit Bunch Harvester

Table 1 shows the distribution of the respondents based on their stages in the adoption of oil palm motorized fruit bunch harvester. Majority (50%) of the respondents were using motorized fruit bunch harvester in their farms at the time of this research. Twenty percent were at the trial stage. This implies that majority of the respondents were at the adoption stage in the use of oil palm motorized fruit bunch harvester recording 50% rate of adoption.

This finding is in consonance with Gerosko (2000) who posited that different firms or individuals, with different goals and abilities are likely to adopt a new technology at different times. Also, Ekong (2010) stated that adoption is essentially a decision-making process and this differs from one farmer to the other.

Table 1: Distribution of Respondents according to their Stages on the Adoption of MFBH (n = 180)

Stages	Frequency Percentage (%)
Awareness	116.11
Interest	13 7.22
Evaluation	22 12.22
Trial	36 20.00
Adoption	90 50.00
Rejection	8 4.45

Source: Field Survey, 2018

Harvesting Time of Adopters and Non-adopters

Table 2 reveals that, the mean time for harvesting a fresh fruit bunch was two minutes, 30 seconds for adopters, while the non-adopters recorded a mean harvesting time of four minutes, 30 seconds. This result is similar to Aramide, *et al*.(2015), that with the use of mechanized harvester the overall average time of harvest per bunch and the speed of harvest are one minutes, 50 seconds and 40 Fresh Fruit Bunches (FFB) per day.

Furthermore, the calculated t-value of 6.25 was far greater than the critical t-value of 1.645 at 0.05 percent level of significance. With this outcome, it means that the average harvesting time of oil palm fruit bunchby farmers that adopted the motorized fruit bunch harvester was significantly different from that of oil palm producers without MFBH. This result is in consonance with Aramide, *et al.* (2015) that the time of harvest for motorized harvester is 60% lower, and the speed of harvester is over 50% higher than bamboo pole and knife. For oil palm producers to keep down their production costs, utilization of motorized fruit bunch harvester is one of the ways of reducing cost of production.

Table 2: Independent T-test Analysis of Impact of Motorized Fruit Bunch Harvester on Harvesting Time

Variables	n	X	S^2	t-cal
Adopters	25	2.30	1.17	
				6.25
Non-adopters	25	4.30	2.0	

Source: Field survey, 2018

Problems Militating against the Adoption of Motorized Fruit Bunch Harvester

Table 3 shows the perceived problems militating against adoption of oil palm motorized fruit bunch harvester. The farmers were asked to assess the problems as they affect them in their adoption decision process. Based on the 2.5 mean decision rule, farmers responses to the issues raised were all perceived as constraints to adoption of MFBH.

The implication of the research resultsis that, high cost technology (MFBH) reduces adoption. This is in consonance with Ekong (2010), that an innovation may be perceived as having advantages over the currently used practice but may not be adopted because of its high cost. Generally, the higher the cost of an innovation the more slowly it is adopted. Furthermore, from this,inadequate handling skill was ranked second, this is similar to other research result that education has significant impact on farmer'sefficiencyin production. Farmer's literacy levels usually influence their decision making and the adoption of innovation by famers, which may bring about increase in productivity (Okunmadewa, 2002).

High cost of MFBH (x=3.20), inadequate handling skills (x=3.10), small farm size (x=3.90), non-availability of spare parts for repairs and servicing (x=3.82),among others were perceived as constraints militating against adoption of MFBH. This concurs with Aramide, *et al.*(2015) that high cost of technology, non-availability of spare parts , among others are factors militating against adoption of technology.

Cost of Harvesting of Adopters and Non-Adopters

Table 4 shows the impact of motorized fruit bunch harvesters on cost of harvesting using difference and percentage change in cost. The result reveals that the difference between mean

Table 3: Problems militating against the adoption of MFBH

S/n	Problems	VGE (4)	GE (3)	VLE (2)	NA (1)	Cum	CA	R
1.	High cost of MFBH	80 (320)	54 (164)	44 (88)	2 (2)	574	3.20	1st
2.	Inadequate Extension services follow-up after training	40 (160)	58 (174)	68 (136)	14 (14)	484	2.70	7th
3.	Inadequate handling skills	90 (360)	50 (150)	6 (12)	34 (34)	556	3.10	2nd
4.	Lack of government support	78 (312)	21 (63)	36 (72)	45 (45)	492	2.73	6th
5.	Fluctuation of selling price of MFBH	40 (160)	86 (258)	33 (66)	21 (21)	505	2.81	5th
6.	Non-availability of spare parts for repairs & servicing	84 (336)	22 (66)	34 (68)	40 (40)	510	2.83	4th
7.	Small Farm Size	61 (244)	44 (132)	68 (136)	7 (7)	519	2.90	3rd

Multiple responses were recorded.
Source: Field Survey, 2018
VGE = Very Great Extend (4); GE = Great Extend (3), VLE = Very Little Extend (2), NA= Not- All (1), CUM = Cumulative, CA = Cumulative average and R= Ranking

cost of harvesting of adopters before and after adoption was -N11.88 (Nigerian currency). This implies reduction in cost of harvesting, the non-adopters before and after adoption of MFBH by adopters witnessed mean change in cost of N7.16. The difference between the two categories (adopters and non-adopters) was – 4.72. Since the value is negative implies that motorized fruit bunch harvester impact on cost of harvesting.

The percentage change in cost of harvesting for adopters revealed – 0.37%, which implies reduction and that of non-adopters revealed 0.23% change implying increase in the cost of harvesting before and after adoption of MFBH by adopters. One of the reasons for farmers' adoption of technology to mechanize their farming operations is to minimize the cost of production. The finding justifies fulfillment of oil palm farmers' desires and the reason for recording 50% adoption rate in the study area

The level of significance of the mean cost difference was tested by using paired t-test at 0.05 percent level of significance. Table 5 shows t-calculated value of 4.62 greater than the critical value of 1.645. This implies significant difference in the mean cost of harvesting of fresh fruit bunches (FFBs). Therefore, the hypothesis of no significant difference was rejected. The outcome of the analysis is similar to research outcomes that using motorized, fruit bunch harvester would be able to reduce 50% of its labor requirement in the harvesting operation (Abdul, *et al*., 2008).

Table 4: Result of Difference in Difference Estimate of Impact of Adoption of MFBH on Mean Cost of Harvesting

Variables	Mean Cost After	Mean Cost Before	Mean Difference	DD
Adopters	20.28	32.16	-11.88	
				-4.72
Non-adopters	37.08	29.92	7.16	

Percentage change in mean cost of adopters = -0.37, while non-adopters = 0.23
Source: Field survey, 2018
DD = Difference in difference

Table 5: Result of paired t -test analysis of difference in mean cost of adopters and non - adopters

Variables	Mean Difference	DD	S_2	t-cal
Adopters	-11.88		25.71	
		-4.92		4.62
Non-adopters	7.16		13.38	

Source: Field survey, 2018

Conclusion and Recommendations

The study concluded that utilization motorized fruit bunch harvester have the potential for reducing the harvesting time for oil palm producers. Also, MFBH can reduceproduction cost.Furthermore, the overall average time of harvest per bunch and the speed of harvest is lower and higher respectively for users of MFBH. Therefore, adoption of MFBH will be of immense benefits to oil palm producers.

The following recommendations were made:

1. Government subsidy is needed to help reduce the cost of motorized fruit bunch harvester. This will enhance adoption;
2. Spare parts be made available to farmers as to enhance adoption; and
3. Adequate extension services and follow-up after training on MFBH be encouraged. This will help to increased adoption rate.

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