ADOPTION OF PALM OIL PROCESSING TECHNOLOGIES IN OSUN STATE, NIGERIA

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ABSTRACT

This study was carried out in order to determine the specific factors that significantly influence adoption of palm oil processing technologies in the study area. A simple random sampling technique was used in the selection of one hundred and twenty palm oil processors. Data were collected, using structured questionnaire, and analyzed, using double hurdle regression model, multiple regression analysis, tobit regression model and likert type scale. Findings revealed that processors were mostly female (78.63%), with mean age of 45.6 years and 68.37% had low literate. The respondents had mean processing experience of 22 years,0.10 .they also had low access to credit facilities and it was discovered that 32.48% of the processors had contact with extension agents. The study reveals that quite a number almost 50% of the respondents didn't belong to processors association which could deter the access to credit and other production benefit they could get from government and NGOs. The study also revealed that adopters of palm oil processing technologies had increase in both their income and output. Respondents reported that the technologies were compatible, complex and very expensive, while accessibility to credit facilities was another serious constraint facing the processors. It is therefore recommended that credit scheme should be instituted and made available to processors by government and other financial institutions.

Key Words: Palm oil, Processor, Technology, Credit

INTRODUCTION

One of the significant problems being faced by the world is inability to produce sufficient food for the rising population. Due to the daily increase in the world population and insufficient production of food and other agricultural produce, the population of undernourished people has been on the rise. According to Food and Agriculture Organization (FAO) of the United Nations, the situation is worsening in South America and most region of Africa. Africa remains the continent with the highest prevalence of undernourishment (PoU), affecting almost 21percent of

the population (more than 256 million people). The situation is also deteriorating is South America, where the prevalence of undernourishment (PoU) has increased from 4.7 percent in 2014 to a projected 5.0 percent in 2017. Asia's decreasing trend in undernourishment seems to be slowing down significantly. The projected PoU for Asia in 2017 is 11.4 percent, which represents more than 515million people. Without increased efforts, the world will fall far short of achieving the SDG target of eradicating hunger by 2030 (FAO, 2018)

It is generally agreed that the Oil Palm (Elaeis guineensis) originated in the tropical rain forest region of West Africa. The main belt runs through the southern latitudes of Cameroon, Cote d'Ivoire, Ghana, Liberia, Nigeria, Sierra Leone, Togo and into the equatorial region of Angola and the Congo (FAO,2007). The oil palm is a perennial crop that originated in the tropical rain forest of West Africa. It spread to South America in the 16th century and to Asia in the 19th century. During the 1970s, Asia overtook Africa as the principal oil palm producing region in the world. In recent decades, the domestic consumption of palm oil in West Africa has increased more rapidly than its production. After centuries as the leading producing and exporting region, West Africa has now become a net importer of palm oil (Olagunju, 2008). Oil palm is the most important source of oil and produces more oil per hectare than any of the oil producing crops. The primary products of the oil palm are palm oil (from the monocarp) and palm kernel oil obtained from the kernels (seeds). Palm oil contains carotene, a precursor of vitamin A, a high prized energy vitamin rich food used for cooking in oil producing countries of Africa. Palm oil and palm kernel oil provide raw materials in the manufacture of soaps and detergents, margarine, candle, confectionery, epoxy resins, bakery trade, lubricants, pomades and cosmetics. Other uses include palm kernel cake obtained from the crushing of palm kernel to extract oil. It serves as additives in livestock feed manufacture (Ayodele, 2010).

The increase in demand for oil palm products has necessitated the introduction of improved technologies in oil palm production. Considering the vital significance of oil palm to the nation, it is pertinent to study its processing technologies. Palm oil processing involves two major types of technology, which are tradition or manual technology and modern or mechanical technology. To improve palm oil processing and meet up with the rising population, adoption of appropriate processing technology is very important. However in Nigeria, 80% of palm oil processors come from dispersed smallholder who harvest semi-wild palm fruits and use manual processing techniques, a processing technique that is labour intensive and highly inefficient, with a low palm oil extraction rate and high free fatty acid(ffa) content that can be up to 30% in some instances (Orewa *et al*.,2009; Ugwu, 2009). Poor processing is a major cause of post-harvest losses in the world with special emphasis on developing countries such as Nigeria (FAO, 2004). It is in this regards that the Nigerian Institute for Oil Palm Research (NIFOR) was established in the early 1960s after being renamed from West Africa Research Organization (WARO) to NIFOR. Since then, the institute has taken several steps as a research institute to improve the processing of palm oil in Nigeria. NIFOR, for instance, had made some efforts to improve on the traditional milling methods by producing Small-Scale Palm Oil Processing Equipment (SSPE) (Ugwu, 2009). With the introduction of adequately improved technologies, the quality of our palm oil will certainly improve, the drudgery aspect of production will be get rid of and there will surely be increase in the production rate to meet our domestic needs and possibly be back as an oil exporting country.

It has also been confirmed that the rate of output of the traditional processing is very low compared to the industrial processing. Orewa *et al* (2009) showed that traditional methods in Nigeria, on the average, yield about 4% crude palm oil of fresh fruit bunch (FFB) compared to

18% - 23% achieved by industrial and intermediate scale technologies. It is obviously challenging to ensure that all palm oil processors (who are majorly small scale processor) make used of improved processing facilities due to the financial constraint and high cost of most of these improved processing technologies. But, the challenges do not end here, as the goal of improving and increasing palm oil processing can only be fully accomplished with the adoption of this technologies. Small scale farmers in Nigeria, produce over 80% of the total production of palm oil, using traditionial methods (Orewa *et al.*, 2009; Ayodele, 2010). With the significant domination of small scale processor in palm oil processing, who are most likely not to be buoyant financially, optimum adoption of improved processing technologies will be practically difficult without the government intervention, support and empowerment. Also, due to the literacy level of farmers (small scale processors), they might find it difficult to change their processing techniques from the traditional method which they are expert at, to improved processing method (industrial method) which they might have slight knowledge about. Though, this can be easily solved with the help of extension agents, if they are actively involved in the process of increasing the adoption of improved palm oil processing technologies at all facets of the country. An efficient processing technique increases the quality and quantity of food available for consumption and trade (Ahmed 2001).

Having recognized that small scale palm oil processing is inefficient (Omoti, 2004) and unprofitable, the study is to analyse the rate of adoption of improved palm oil processing technologies and factors influencing the adoption rate. The research will enlighten the government and various parastatals on challenges being faced by palm oil processors. This will help the processors to overcome the difficulties and confidently adopt the improved palm oil processing technology for optimum palm oil production.

Therefore this study seeks to determine the adoption of improved palm oil processing technologies in South-west Nigeria. Specific objectives of the study include to; identifies the level of adoption of improved palm oil processing technologies in the study area, determine the factors influencing the adoption of improved palm oil processing technologies in the study area, describe the effects of adoption of improved palm oil processing technologies on output and income of processors in the study area and estimate the constraints militating against adoption of improve palm oil processing technologies in the study area.

Materials and methods

The data used in this study were primary data collected by means of structured questionnaire administered on a random sample of 117 processors in Osun state, which is a major palm oil processing area in Southwestern Nigeria. A three stage sampling technique was used for the study. The first stage involved the purposive selection of three local government area, which are; Orolu, Ila and Ejigbo Local Government Areas. At the second stage, three communities with palm oil processors were purposively selected across each local government and lastly, which is the third stage, different processors were selected using snow balling technique. The analytical tools used in this study were descriptive statistics, Double-hurdle model, Multiple regression analysis, Z-test statistic and Likert type scale analysis

Results and Discussion

The socio-economic characteristics of the respondents considered in the study area include age, sex, marital status, household size, level of education e.t.c.

Age Distribution of the Respondents

The result of age distribution of the respondents in Table 1 showed that 26.50% of the respondents are in the age bracket 41-50years, 25.64% of the respondents are in the age bracket 31-40years and 14.53% are not more than 30 years, 11.11% are in the age bracket 51-60years,

and 22.22% of the respondents are above 60 years. The mean age of the respondents in the study area is 45.6years which implies that the palm oil processing is gaining relevance among the middle-aged people in the study area.

Table 1: Distribution of Respondents by Age

Age	Frequency	Percentage
<=30	17	14.53
31-40	30	25.64
41-50	31	26.50
51-60	13	11.11
Above 60	26	22.22
Mean = 45.6		
Total	117	100.00

Source: Field Survey, 2019

4.1.2 Gender distribution of the respondents

The result of the gender distribution of the respondents as reported in Table 2 revealed that 78.63% were females and 21.37% were males. The result indicated that majority of the respondents were female.

Table 2: Distribution of Respondents by Gender

Gender	Frequency	Percentage
Male	25	21.37
Female	92	78.63

Total	117	100.00

Source: Field Survey, 2019

4.1.3 Marital status of the respondents

The result of marital status in Table 3 revealed that 70.09% of the respondents are married, 5.13% is single, and 21.36% are widowed, while 3.42% are divorce. The high percentage of married people is an indication of more responsible palm oil processors in the study area.

Table 3: Distribution of the Respondents by Marital Status

Marital status	Frequency	Percentage (%)
Single	6	5.13
Married	82	70.09
Divorce	4	3.42
Widow	25	21.36
Total	117	100.00

Source: Field Survey, 2019

4.1.4 Distribution of Respondents by Education Level

The result on Table 4 shows that 44.45% of the respondents had secondary education, 19.66% of the respondents had primary school education, 31.62% had no formal school education and 4.27% had adult education. This result indicates that the respondents are educated.

Table 4: Distribution of Respondents by Education

Education	Frequency	Percentage
No formal Education	37	31.62

Secondary Education	52	44.45
Primary Education	23	19.66
Adult Education	5	4.27
Total	117	100.00

Source: Field Survey, 2019

4.1.5 Distribution of Respondents by Household Size

The result in Table 5 reveals the distribution of respondents by the size of their household. It shows that 61.54% of the respondents having household size of not more than 5 members, 33.33% of the respondents have their household size ranged between 6-10 and 5.13% of the respondents have household size above 10members. The mean households' size is 5.5, indicating that respondents' households in the study area had a moderate family size.

Table 5: Distribution of Respondents by Household size

Household size	Frequency	Percentage
<=5	72	61.54
6-10	39	33.33
Above 10	6	5.13
Mean = 5.5		
Total	117	100.00

Source: Field Survey, 2019

4.1.6 Distribution of the Respondents by Experience

Table 6 reveals that 24.79% of the respondents years of processing experience fell between 16-25 years, 29.91% of the respondents equally indicated that their experience in processing of oil palm stood between 6-15 year while about 22% claimed that theirs is between 26-35 years, only 7.69% of the respondent have processing experience of not more than 5 years.

The mean experience was 22 year this indicated that most of the respondents have a cognitive experience in palm oil processing in the study area.

Table 6: Distribution of Respondents by Experience

Experience	Frequency	Percentage
<=5	9	7.69
6-15	35	29.91
16-25	29	24.79
26-35	26	22.22
Above 35	18	15.39
Mean = 22		
Total	117	100.00

Source: Field Survey, 2019

4.1.7 Distribution of Respondents by sources of Palm fruits

Table 7 shows the distribution of responses on the sources of palm fruit for processing. The table reveals that 57.26% of the respondents obtained their palm fruit from their personal farms and about 43% of the respondents buy palm fruit from other farmers. The result indicated that most of the respondents obtained their palm fruit from their farms.

Table 7: Distribution of Respondents by Sources of Palm fruit

Sources of Palm fruit	Frequency	Percentage

I buy palm fruit from other farmers	50	42.74
I have oil palm farm of my own	67	57.26
Total	117	100.00

Source: Field Survey, 2019

4.1.8 Distribution of Respondents by Ownership

About 70.94% of the respondents claimed that they inherited their processing plant, 24.79% claimed that the plant was leased to them and only 5% of the respondent claimed that the processing plant was purchased. The result indicated that most of the respondents inherited their processing plant.

Table 8: Distribution of Respondents by Ownership

Ownership	Frequency	Percentage
Inheritance	83	70.94
Purchased	5	4.27
Leasing	29	24.79
Total	117	100.00

Source: Field Survey, 2019

4.1.9 Distribution of Respondents by Association membership

The result presented on Table 9 shows that 50.43% of the respondents belong to palm oil processors membership association while 49.57% of the respondents indicated that they didn't belong to such an association. The result indicated that quite a number of the respondent didn't

belong to processors association which could deter the access to credit and other production benefit they could get from government and NGOs.

Table 9: Distribution of Respondents by Association membership

Association	Frequency	Percentage
No	58	49.57
Yes	59	50.43
Total	117	100.00

Source: Field Survey, 2019

4.1.10 Distribution of Respondents by Extension Contact

Table 10 revealed that most (67.52%) of the respondents claimed that they had no contact with the extension agents while 32.48% of the respondents claimed that the have contact with extension agent in the study area. The result indicated insufficient extension services in the study area this might eventually affect productivity of palm oil processing and especially in the area of quality control.

Table 10: Distribution of Respondents by Extension Contact

Extension Contact	Frequency	Percentage
No	79	67.52
Yes	38	32.48
Total	117	100.00

Source: Field Survey, 2019

4.1.11 Distribution of Respondents by Distance to plant

The result presented on Table 11 showed that most (39.31%) of the respondents indicated that the distance from their homestead to processing plant lies between 100-500meters, about 23% of the respondents indicated that theirs is between 50-100metere and 500-1kilometers respectively. The average distance to processing plant was estimated to be 523meters, this indicated that most of the respondents have their processing plant not too far from their respective homes.

Table 11: Distribution of Respondents by Distance to plant

Distance	Frequency	Percentage
10 – 50m	17	14.53
50 – 100m	27	23.08
100 – 500m	46	39.31
500m – 1km	27	23.08
Total	117	100.00

Source: Field Survey, 2019

4.1.12 Distribution of Respondents by Awareness of technologies

Table 12 reveals that 83.76% of the respondents were aware of the processing technologies of palm oil in the study area while about 16% of the respondents claimed that they were not aware of some processing technologies in the study area. The result indicated that awareness of some of these technologies is needed to ensure maximum adoption of these technologies for better productivity.

Table 12: Distribution of Respondents by Awareness of technologies

Awareness	Frequency	Percentage

No	19	16.24
Yes	98	83.76
Total	117	100.00

Source: Field Survey, 2019

4.2 Constraints to the adoption of processing Technologies

The result as presented on Table 13 shows that more than 70% of the respondents indicated that high cost of processing technology poses a threat to the adoption of processing technology of palm oil in the study area. Most (97.44%) of the respondents identify inaccessibility of the technology as a major constraint in adoption of these technology, about 97% also indicated that these technologies are sometime too complex for them to operate. Also the table shows that 94.02% of the respondent indicated that inadequate credit facilities remains a major constraint to adoption of these technologies, more than 70% of the respondents also identify bad road as a major problem to adoption of the processing technologies in the study area and lastly, 79.49% of the respondents indicated that inadequate capital remain a serious problem to adoption of processing technologies in the study area.

Table 13: Constraints to the adoption of processing Technologies

Source: Field Survey, 2019

Variables/Statement	Yes		No		RANK
	Frequency	%	Frequency	%	
Inaccessibility	114	97.44	3	2.56	1st
They are complex to use	113	96.58	4	3.42	2nd
Inadequate credit facilities	110	94.02	7	5.98	3rd
High cost of processing	103	88.03	14	11.97	4th
inadequate capital	93	79.49	24	20.51	5th
Bad feeder roads	83	70.94	34	29.06	6th

4.3 Level of Adoption of Palm Oil Processing Technologies

Table 14 shows the parameter estimate of the adoption of palm oil processing technologies in the study area. The following variable are statistically significant and thereby influence adoption of palm oil processing technologies in the study area; years of schooling, years of processing experience, technical knowledge, and awareness of processing technologies.

The coefficient of years of schooling was positive and significant at 10% level, this implies that an increase in the number of years spent in school, the probability of adopting processing technologies will increase. The result indicated that education is paramount in adoption of innovation.

Also, palm oil processors years of experience in the business showed a positive and statistically significant sign at 1% level, the result implies that a unit increase in the years of experience of the respondents will increase the chance of adopting processing technologies in the study area.

In like manner, the coefficient of Technical knowledge was found significant and positively related to adoption of processing technologies in the study area. The result indicated that a rise in the Technical knowledgeof these technologies will increase the likelihood of adopting processing technologies by the respondents.

Lastly, awareness of processing technologies was found influencing adoption of these technologies at 1% level, this implies that a unit increase in awareness will increase the likelihood of adopting the technologies in the study area.

Table 14: Parameter Estimate of the level of adoption of processing Technologies (Tier 1)

Adoption	Coefficient	Std. Err.	z	P>|z|
Age	0.0134352	0.0161239	0.83	0.405
Schooling	0.0027307	0.0015089	-1.81	0.070*
Household size	0.0372698	0.0534213	-0.70	0.485
Experience	0.1349449	0.0467821	2.88	0.004***

Technical knowledge	0.7566895	0.1020278	7.42	0.000***
Awareness of technologies	0.7520807	0.0709757	10.60	0.000***
ExtensionContact	-0.2479681	0.2567736	-0.97	0.334
Membership of Organisation	0.0624954	0.2447987	0.26	0.798
Constant	.7361766	0.0668707	11.01	0.000***

Source: Field Survey, 2019

The result presented on Table 15 shows the estimation of the tobit regression used to determine the level of adoption of the processing technologies of palm oil in the study area. An index was generated as the ratio of the number of technologies adopted by the respondents to the total number of technologies available and this index ranges between 0 and 1. However, the following variables were positively related to the level of adoption of processing technologies in the study area; age, household size, technical knowledge and association membership.

The age of the respondents has a positive coefficient; this implies that an increase in age of the respondents will increase the chance of adoption rate of these palm oil processing technologies in the study area by 0.003%.

The household size of the processors has a positive coefficient and it is statistically significant at 10% level which implies that a unit increase in the household size will lead to an increase in the chances of palm oil processor adopting processing technologies by 0.010%.

Also, the table revealed that technical knowledge of the processing technologies showed a significant influence on the adoption rate of the technologies. This implies that an increase in the technical knowledge of the available technologies will increase the probability of adopting these technologies.

Lastly, the coefficient of membership of association has a positive coefficient and it is statistically significant at 1% level which implies that a unit increase in the membership of

processors association will lead to an increase in the chances of palm oil processor adopting processing technologies by 28.09%.

Table 15: Parameter Estimate of the level of adoption of processing Technologies (Tier 2)

Intensity	Coefficient	Std. Err.	z	P>|z|
Age	0.0029455	0.0015104	1.95	0.051**
Household size	0.0101208	0.0061486	1.65	0.100*
Schooling	0.0030553	0.003083	0.99	0.322
Experience	0.001881	0.0014722	1.28	0.201
Technical knowledge	0.1396477	0.0466259	3.00	0.003***
Awareness	-0.0438346	0.0402362	-1.09	0.276
Extension contact	0.0062066	0.0289365	0.21	0.830
Association	28.08904	3.182159	8.83	0.000***
Constant	0.8025344	0.0842964	9.52	0.000***

Source: Field Survey, 2019

4.4 Effect of adoption of palm oil processing on output and income

Four functional forms: Exponential, Semi-log, Linear and Double log were fitted for the collected data. The Semi-log was chosen as the lead equation based on econometrics and statistical criteria such as functional form with highest magnitude of coefficient of determination (R^2), the number of estimators that are statistically significant, the least value of standard error and appropriateness of the signs of the explanatory variables. The data obtained were tested based on the assumption of normality of data. Table 10 shows the adjusted R^2 of 51.38% which

indicated that about 55.38% change in palm oil output is explained by the following explanatory variables: adoption of technologies, the rate of adoption of these technologies and the processing experience in palm oil processing.

The following were positive and had a direct relationship with the dependent variable (output) in the study area: adoption of technologies, the rate of adoption of these technologies and the processing experience in palm oil processing. The coefficient of adoption of technologies, the rate of adoption of these technologies and the processing experience of the respondents were positive and statistically significant in the model. The result indicated as adoption of these various processing technologies increases there is increase in the output of the respondents in the study area.

Table 16: Effect of adoption of palm oil processing on output

Output	Coefficient	Std. Err.	z	P>|z|
Adoption	0.7966381	0.416217	1.91	0.058*
Adoption level	1.195461	0.3093269	3.86	0.000***
Experience	0.0470198	0.0148893	3.16	0.002***
Constant	2.56037	0.6920493	3.70	0.000***

Diagnostic test

R-squared = 0.5138

F(3, 113) = 9.91

Prob> F = 0.0000

Source: Field Survey, 2019

Conclusion

Most processors were middle age, married women. Factors such as years of schooling, processing experience, technical knowledge of the technologies, Age, household size, association membership and awareness of these technologies were significantly influenced level of adoption of processing technologies in the study area.

Based on this study the following were recommended:

- Concerned stakeholders should assist in the provision of credits facilities at affordable interest rate for these processors as to increase their scale of production.
- More men should be encouraged to participate in processing facilities

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