Adoption of Post Harvest Crop Processing Machines for Increased Cassava and Maize Production: A Food Security Measure for Poor Income Farmers in Rural Nigeria

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ABSTRACT

A bulk of harvested cereals, legumes and tubers are lost in Nigeria through poor harvesting, poor methods of threshing and limited facilities for drying and storage. A study was conducted to investigate the factors affecting adoption of small scale post harvest cassava and maize processing machines in rural Nigeria. A multi stage sampling technique was used for selection of respondents. Data were collected from 197 crop processors with structured questionnaire and focus group discussion (FGD). Inferential statistics were used for analysis of data. The study revealed that crop processing in Akwa Ibom State in rural Nigeria is dominated by small poor resource processors. Analysis with a probit model also revealed that income, labour availability, rural electrification, extension contact and spare parts are the factors influencing the adoption of cassava processing machines. Similarly, income, membership in cooperative societies, technical skills, urban and extension contacts, quantity of maize for processing and spare parts also influenced adoption of maize processing machines. Extension subject matter specialists in technical skills and maintenance of processing machines are required at the cell level in the farming communities.

Key Words: *Adoption, post harvest, machines, food security*

In the past decades and to present day, Nigeria has suffered a tremendous loss of food products due to lack of proper and adaptable processing and storage facilities. Losses have been estimated at 30-50% of production. A bulk of harvested cereal grains and tubers are lost due to poor methods of threshing, shelling and grinding and facilities for drying and storage. But the food processing sub-sector has the potential to enhance food production in African countries in general and in Nigeria in particular. Post harvest crop processing is carried out by the peasants with traditional methods as observed by *Ayoola and Idachaba (1990)*. In order to replace traditional methods of crop processing with improved ones, agricultural engineers and researchers designed and developed machines suitable for small scale post harvest processing of crops. Such equipment include: garri making equipment, palm kernel crackers, groundnut sheller, sugarcane crushers and grinding machines for cassava, maize, melon, soybean, etc.

The processing machines for cassava and maize have been made available to crop processors by International Institute for Tropical Agriculture (IITA) in collaboration with Akwa Ibom State Agricultural Development Programme (AKADEP). The introduction of these machines was to reduce drudgery by processors of these crops in the use of traditional tools for crop processing. Awareness on the machines has been created by the government agencies through vigorous campaigns over the years to educate the small scale processors on the benefits of using the machines. Cassava is the simplest largest source of calories produced in Nigeria and production is scale neutral. The following research questions were raised in the study: What are the socioeconomic characteristics of the adopters and non-adopters of the post-harvest processing machines? Are there relationships between socioeconomic characteristics of the processors and level of adoption of the machines? The study was therefore conducted to investigate the factors affecting adoption of small scale post harvest cassava and maize processing machine in rural Nigeria.

METHODOLOGY

The study was conducted in Akwa Ibom State located (Latitude 4^0 30' and 5^0 53' North and Longitude 7^0 25' and 5^0 28' East) in the southern humid rainforest zone of rural Nigeria. The mean annual rainfall is over 2000mm with a daily minimum mean temperature of 25.3^0C, a maximum mean temperature of 33.5^0C and a mean relative humidity of 85 percent. Over 60 percent of the population are engaged in agriculture with farm size ranging from 0.2-2 hectares.

The target population for the study comprised of processors, who had received training on crop processing. A multi-stage random sampling technique was used in the selection of respondents. There are six agricultural zones in Akwa Ibom State Agricultural Development Programme (AKADEP). From the six zones three (Abak, Etinan and Uyo) were randomly selected. From a list obtained from AKADEP Headquarter Office, two processing cooperative societies were randomly selected from each of the three zones making a total of 6 cooperative societies. Thirty three members of the cooperative were randomly drawn from each of the five cooperatives and 32 members drawn from one of the last six cooperatives making a total of 197 respondents that took part in the study.

Twenty copies of the questionnaire designed for the study were administered to 20 processors who did not take part in the actual study. At two weeks interval, the questionnaire were administered to the same sample with a reliability coefficient (r) of 0.81, indicating a high reliability of the instrument. The validated instrument was administered to 197 processors that were randomly selected for the study and supplemented with a focus group discussion (FGD). Inferential statistics were used to test the hypotheses of the study.

RESULTS AND DISCUSSION

Grinding machines for processing of cassava and maize were introduced to the farmers in Akwa Ibom State to enhance food production. The results of the study are as shown and discussed below. The results from a t-test calculated for the variables: age, education, income and sources of information for cassava processing machines shows that t-statistics calculated at 5% level of significance were 1.14, 0.74. 0.94 and 0.88 for age, education, income and sources of information which were less than their corresponding tabulated t-value of 2.228, 2.306, 2.145 and 2.306 respectively. This implies that there is no significant difference between adopters and non-adopters in these socioeconomic variables (Table 1). However, a significant difference was observed in marital status and household size with t-cal = 2.5 and 2.5 respectively and with both having a tabulated t-value of 2.44 at 5% level of significance.

The significant difference in household size (hhs) and marital status between adopters and non-adopters of cassava processing machines could be due to economic adjustment made by the farmers in order to cope with the current high cost of production. This again could be due to high cost of investment, lack of market information, high cost of raw materials, and inability to manage their projects well. But most of all, cassava is scale neutral crop in the study area (Table 2).

The hypothesis stated that there is no significant influence of socio economic factors on processors adoption of small scale post harvest crop processing machines was tested using the probit model. Table 3 shows the variables and related statistical result of independent variables observed from the analysis.

Factors influencing decision on adoption of cassava post harvest processing machines : The variables and related statistical result of independent variables obtained from the analysis are shown in Table 3. Some of the variables have positive coefficient indicating direct relationship of the independent variables to adoption of the probability model. Other variables have negative coefficient indicating inverse relationship of the independent variables to the adoption, which does not conform with the expected result. The relationship of the variable is presented below. The table reveals that income, labour, electrification and rural road network, spare parts and extension contact are significant determinants of adoption of cassava processing machines.

Income (INC): Income was found to be positively significant at 1% level of significance. The positive relationship between income and level of adoption of the processing machine conform with apriori expectation that increase in processors income is expected to ease financial constraint thereby enhancing the adoption of the processing machines. This result agreed with that of *Mundi and Exenma (2005)* who found a positive relationship between income level of farmers and adoption of new technology.

Labour availability (LBA) **:** Labour availability was also found to be significantly positive at 5% level of significance with adoption of the machines for processing cassava. This agreed with the findings of *Job, et al (2003),* who found that labour requirement

Table 1: t-test analysis showing differences between socioeconomic characteristics of adopters and non adopter of cassava processing machines

Variables		Mean	Std Dev	df	t-cal	t-tab	Remark
Age	adopters	13.67	8.25	10	1.14	2.228	NS
	Non-adopters	8.83	6.340				
Marital status	Adopters	20.5	4.74	6	2.50	2.447	**
	Non-adopters	13.25	8.0				
Household size	Adopters	20.5	4.79	6	2.50	2.447	**
	Non-adopters	13.25	3.4				
Education	adopters	16.4	15.44	8	0.74	2.306	NS
	Non adopters	10.6	8.38				
Income	Adopters	10.25	10.19	14	0.94	2.145	NS
	Non adopters	6.6	4.14				
Source of information	Adopters	13.67	15.5	8	0.88	2.306	NS
	Non-adopters	225	19.5				

Source: Computed from field data, 2006
** Sig. at 5% level

Table 2: t-test analysis showing difference between socioeconomic characteristics of adopters and non-adopters of maize processing machine.

Variables		Mean	Std Dev	df	t-cal	t-tab	Remark
Age	Adopters	5.5	6.6				
	Non-adopters	4.83	5.56	10	0.19	2.228	NS
Marital status	Adopters	8.25	7.41				
	Non-adopters	7.25	3.77	6	0.24	2.447	NS
Household size	Adopters	8.25	5.444				
	Non-adopters	7.25	3.10	6	0.32	2.447	NS
Education	Adopters	6.8	7.37				
	Non adopters	5.8	8.17	8	0.21	2.306	NS
Income	Adopters	4.13	3.09				
	Non adopters	3.63	3.02	14	0.33	2.145	NS
Source of information	Adopters	6.6	5.5				
	Non-adopters	5.8	3.04	8	0.13	2.306	NS

NS = Non Significant

was one of the determinants of adoption of water technologies. Labour could be a problem because of migration of young individuals to towns and during peak farming period. Moreover, modern processing methods may require semi skilled labour that may not be readily available.

Electrification and rural road (ELRD): Electrification and rural road were found to be significant at 5% level of significance. It has a positive coefficient 0.79858. This means that electrification and rural road network had direct relationship with the adoption of the machines. This conforms with a priori expectation. It therefore means that provision of road and rural electrification would consequently lead to increase in the level of adoption of the machines. This agreed with the findings of *Amechi (2005)* who found out in a study that provision of feeder roads brought some changes in agricultural activities of farmers in Anambra State. Provision of rural feeder roads ease transportation problems, reduce cost of transporting the produce and processed products. Therefore provision of electricity is very crucial as power would be available for the processing of the crops and at a reduced rate

Spare part (SPT) : Spare part was also a determinant of adoption of cassava processing machines. It was found to be positively significant at 10% level significance. Spare part is of utmost importance in adoption of machines. Availability of machines demands possibility of easy repairs in case of a breakdown. A focus group discussion (FGD) revealed that some of the machines broke down easily. The respondents even thought that inferior machines were installed for them.

Extension contact (EXT) : Extension contact had a negative but significant relationship with adoption of the processing machines. It was found to be significant at 5% level of significance. This result is contrary to that of *Ajayi and Okunola (2005)* who reported that contact with extension agent was found to have a

positive significant relationship with the adoption of few crop technologies. However, the result supported that of *Mundi and Ezenma (2005)* who observed that contact with extension agent is negatively and significantly related to adoption of recommended farm practices. This could be attributed to low morale of government employees or to poor and ineffective contact between the extension agents and processors as a result of the agents not being equipped properly on information for repairs and maintenance of the equipment. During focus group discussion relationship between the extension agents and the processors was mentioned as a problem.

In contrast, no significant relationship was established in the analysis between the adoption of cassava processing machines and such factors as age of processors, educational level, technical skill, market for the processed products, gender of the respondents, urban contact and quantity of crop for processing. These factors had negative relationship with the exception of membership in cooperative societies and urban contact which had positive relationship.

Factors influencing decision on adoption of maize post harvest processing machines.

Age (AGE) : Age of the respondents had a negative coefficient (-88285) and was statistically not significant. The mean age of the cassava machine respondents (48 years) signifies that most of them were still active and productive in processing business. However, increase in age would result in no increase in adoption. This is because the young ones are educated and desirous for a change unlike the older processors.

Table 3. Probit analysis of socioeconomic factors influencing decision on adoption of cassava post harvest processing machine

Variables	Regression coefficient	Std error	t-value
Constant	-.71869	.88827	-.809
AGE	-.88285	.12098	-.730
EDU	-.48951	.30920	-.158
INC	.25847	86727	2.980 ***
COOP	.39797	.28781	1.383
TES	-.44018	.32871	-1.339
LBA	.85007	.43363	1.960 **
MKT	-.38477	.40216	-.957
ELLD	.79858	.29031	2.751 **
UCT	-.46233	.35513	-.001
GENDER	-.32699	31383	-1.042
EXT	-.69147	.30178	-2.291 **
QNTY	-.14772	.31964	-.462
SPT	.59593	.31863	1.870 *

Significant at 1% ***, 5%**, 10%*

Educational lev1el (EDU): Educational level of the respondents had a negative co-efficient (-489651) and was not statistically significant. This means that educational level had an inverse relationship with adoption of the processing machines. The mean year of respondents in school was 8 years. According to *Udoh (1999)* an effective 8 year primary school education for most of the respondents will mean their being able to read and write at least in the local language which will significantly influence their understanding about the machines and hence adoption.

*Membership in cooperative society (COOP)***:** Membership in cooperative society had a positive co-efficient (.39797) but was not statically significant. This implies that increase in cooperative members would enhance adoption of processing machines. Those who belong to cooperatives have access to sources of information on innovation, can obtain loan and other farm inputs. Risk and uncertainly are also reduced as it is spread among the members *(Adetunji and Olagunju, 2002).*

Technical skill (TES) : Technical skill had a negative relationship and was not statistically significant. The result does not conform with apriori expectation. Technical skill is of utmost importance. Technical skill is needed to operate and service the machines. However, more persons with technical skills may not necessarily enhance adoption of the machines.

Table 4. Probit analysis of socioeconomic factors influencing decision on adoption of maize post-harvest processing machines

Variables	Regression Coefficient	Std error	t-value
Constant	-.71869	.88827	-.808
Age	-.00502	.00480	-1.046
Education	.01663	.01247	1.333
Income	.00001	.00000	2.245 **
Co-op	.47122	.17251	2.245***
TES	-.39733	.13689	-2.903***
MKT	.27651	.18486	1.496
LBA	.18050	.16862	1.070
ELRD	.37605	.15402	2.442**
UCT	.40553	.14197	-2.857***
GENDER	.06000	.14832	.405
EXT	.25459	.11446	2.224**
QNTY	.36576	.12191	3.000***
SPT	.35848	.11074	3.237***

Significant at 1%***, 5%**, 10*

Urban contact (UCT) : Urban contact had a negative co-efficient (-.46233) and was not statistically significant. This means that the processors had no urban contact. As observed by *Mundi and Ezenma (2005),* farmers (processors) are cosmopolite but failed to discuss their problems with early adopters, friends and

relatives in their neighborhood. As a result, they are not quite innovative in their agricultural practices.

Gender (GENDR) : Sex had a negative co-efficient (-32699) and was not significant. The implication of the negative co-efficient for sex is that an increase in either sex will not result in an increase in adoption of the machines. This could be because more female respondents are measuring up with their male counterparts in innovative programmes.

Quantity for processing (QNTY) : Quantity for processing had a negative co-efficient (-4248) and was not significant. This does not conform with apriori expectation. The finding is contrary to the report that additional cassava equipment were installed in Bendel State as a result of increased production of cassava tuber (*UNIFEM, 1989*).

Market (MKT): Market for the products had a negative co-efficient (-.38477) and was not significant. Expansion of market for products could stimulate production. The result of the analysis does not conform with apriori expectation. The result is contrary to the view expressed in *Spore (1990)* that once processors are sure of a market they would adopt improved technology.

This section deals with the socioeconomic variables that could influence adoption of maize post harvest processing machine. The results of the analysis are as shown in Table 4. The Table reveals that the age of processors of maize had a negative relationship with adoption of the maize processing machines and was not significant. However, level of education of respondents, labour availability, market for the processed products, gender had positive relationship with adoption but was not significant.

The variables that were significant in the analysis are income, cooperatives, technical skill, rural electrification and road network, urban contact and extension contact, quantity of maize for processing and spare parts. Income level of the respondents had a positive relationship with the adoption and was significant at 5% level of significance. The implications of respondents level of income, rural electrification and spare parts on adoption of technologies have been discussed in the previous analysis of adoption of cassava processing machines.

Membership in cooperative (COOP): Membership in co-operative is positive and significantly related to adoption of maize processing machine. It is significant at 5% level. This conforms with apriori expectation. Thus implies that participation in co-operative movement would enhance adoption of maize processing machines. Those who belong to co-operatives have access to sources of information; can obtain loan and other processing facilities. Risks and uncertainty are also reduced as it is spread among the members.

Technical skill (TES): Technical skill had a negative significant relationship with adoption of the machines. This is contrary to apriori expectations. Technical man power is needed to operate and service processing machines. Of course, inadequate technical manpower is among the factors that hinder mechanization of agriculture in Nigeria. However, since a machine can be used to process a large quantity of farm produce but few people with technical skill, more persons with technical skill may not necessarily increase adoption of the processing machines.

Urban contact (UCT): Urban contact had a negative but significant relationship with adoption. This means that urban contact had inverse relationship with adoption of maize processing machines. This indicates that processors are not having urban contact and the further away from the urban areas, the less their level of adoption. *Kyiogwon and Gudiji (2002)* observed that inhabitants in remote rural areas had less contact with urban centre where extension agents and inputs are much available. This could influence their level of adoption negatively.

Quantity of produce (QNTY): Quantity of produce for processing had a positive co-efficient (.36576) and was statistically significant at 1% level of significance. This implies that increase in quantity of produce for processing would eventually increase the adoption of the machines. This could be attributed to seasonality of maize production. As a result the machines are often required to process most of what is available at a short time.

Extension contact (EXT): Extension contact had a positive significant relationship with adoption of maize processing machine. It is significant at 5%. This implies that increase in extension contact would increase the probability of adopting the machines. Extension agent not only inform the processors but also encourage and motivate them to adopt an innovation. This result confirms the findings of *Nnadi and Akwiwe (2005)* who reported significant relationship between extension contact and the adoption of selected technologies. The need to increase extension contact in the case of maize processing machine is strongly emphasized since more farmers are quite aware of the use of the machines.

CONCLUSION

The development of micro processing machine has made easy the processing of crops, which include cassava and maize. These machines for processing cassava and maize were introduced by International institute for Tropical Agriculture (IITA) in collaboration with Akwa Ibom State Agricultural Development Programme (AKADEP) to processors. A study on adoption of these equipment reveals that extension agents were the major source of information to the processors. Awareness of these machines has been created but adoption level differed for the individual machines. The majority of the processors were operating on small scale, which could be due to the fact that rural people are generally poor and lack the resources to go into large scale processing. The major difference between adopters and non-adopters existed in the socio-economic factors of marital status and household size. There is need to address the following factors: sources of information, membership in co-operative society, income level and spare parts as these factors were associated with the adoption of both the cassava and maize processing machines. If the above factors and others are consistent the probability of adoption of the machines will improve.

As steps to alleviate the problems influencing adoption of crop processing machines is to accelerate the pace of adoption with the aim of promoting processing of the crops in rural areas, the following measures are recommended. The demand for foofoo, tapioca, garri, flour and starch is beyond the supply in the state and processors who had received training on processing of cassava into various products should be encouraged to accept processing of crops as a business. Consistent campaign and training of processors on the use of the equipment will surely increase adoption among processors. Extension workers on repairs and maintenance of processing equipment should be trained and encouraged to render the necessary assistance to small scale processors. The market for the finished products should be organized such that processors can have accurate information on retail price and marketing channels. The small-scale processors can come together to market their products.

REFERENCES

1. Adetunji, M. O. and Olagunju, F. I. (2002). Socio-economic characteristics of cooperative farmers in South-Western Nigeria. *Intl. J. Business and Common Market Studies*. **1** (1): 117-181
2. Amechi, N. F. (2005). Changing agricultural practices of farmers through agricultural development programmes (ADPs) in Anambra State, Nigeria. *Intl. J. Food and Agric. Res.* **2** (1&2): 117-137.
3. Ajayi, M. T. and Okunola, J. O. (2005). Impact of agricultural extension services on adoption of crop technologies in Ondo State, Nigeria. *South African J. Agric. Ext*. **34** (2): 181-187.
4. Ayoola, G. B. and Iachaba, F. S. (1990). Technology and Nigerian agricultural development. *J. Agric. Tech*. **2** (1): 59-75
5. Job, K. L., Gicuru, K. I. and Steven, K. B. (2003). Determinants of the adoption of water harvesting technologies in the marginal areas of Nakuni district, Kenya: The case of french and water pan technologies. *East Afr. J. Rural Dev.* **19** (1)
6. Kyiogwon, U. B. and Gudigi, A. (2002). Factors affecting the use of modern agricultural technologies in Washishi local Govt. area in Niger. State, Nigeria. *Intl. J. Business and Common Market Studies*. **1**(1): 30-45.
7. Mundi, N. E. and Ezenwa, P. C. (2005). Assessment of adoption determinants of improved oil palm technologies in Ovia North-East of Edo State, Nigeria. *Intl. J. Food and Agric. Res*. **2** (1&2): 167-174.
8. Nnadi, F. N. and Akwiwu, C. A. (2005). Rural women response to selected crops production technologies in Imo State of Nigeria: Global approaches to extension practice. *J. Agric. Ext*. **1** (1): 47-54.
9. SPORE (1990). Mechanization: A must for African Agriculture Technical Center for Agriculture and Rural Cooperation (CTA) no 6, pp 16.
10. Udoh, A. J. (1999). Personal, socioeconomic and infrastructural indices for poverty alleviation in Akwa Ibom State of Nigeria. South-*South J. Culture and Dev*. **1** (2): 110-125.
11. United Nations Development for Women, UNIFEM (1989). Root crop processing. New York. pp74.