Adoption of improved processing technology among African locust bean processors in south-west, Nigeria

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A B S T R A C T

The paper investigated the effect of socio-economic and institutional factors on the adoption of improved locust bean processing technology in South-West, Nigeria. Specifically, the study described the socio-economic characteristics of the locust bean processors, examines the level of awareness and adoption of the improved locust bean processing technology in the study area and determines the effect of socio-economic and institutional factors on the adoption and intensity of use of improved locust bean processing technology in the study area. A multi-stage sampling procedure was used to select 360 respondents used for the study. The data were analyzed using descriptive statistics and the Cragg's (double-hurdle) model. The result of the study showed that majority (84%) of the locust bean processors were female with an average age of 48 (±11.36) years. Majority (97%) of the respondents were married with an average household size of 8.25 (±4.32) persons. The result showed that 44.2% were aware while 55.8% were not aware of the technology in the study area. The results from the Cragg's double hurdle model show that in the first hurdle, age, experience, access to credit and awareness positively influenced the decision to adopt the improved locust bean processing technology while in the second hurdle, education and income positively influenced the intensity of the use of the improved locust bean processing technology. It is therefore recommended that Relevant stakeholders, agencies and government should made available credit facilities which will enable the locust bean processors acquired the technology in no distant time.

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Introduction

The African locust bean tree is a leguminous perennial tree, which are mainly grown in the tree and processed seed is being used as a condiment for soup. It is a source of natural nutritious condiment, which features frequently in the traditional diet of the people (Fagbemi, 1989). The processed African locust bean seed is being called by different local names in different localities; it is referred to as "Iru" in Yoruba, "Dawadawa" in Hausa and "Ogiri" in Igbo (Diawara *et al.,* 2000; Odunfa and Adewuyi, 1985).

Apart from the flavoring attribute of the processed locust bean, it also contributes significantly to the intake protein, carbohydrate, calcium, phosphate, iron content and essentials riboflavin and ... *et al.,* 2007; Popoola and Galaudu, 2000; Beaumont, 2002; Oladele *et al.,* 1995; Musa, 1991; Odunfa and Adewuyi, 1985). It was estimated that about 200,000 tons of African locust beans seeds are gathered each year in Nigeria alone, as well as large quantities are produced in the savannah region of Oyo, Osun and Kwara States of Nigeria (Onnyi *et al.,* 2004). In Nigeria, it serves as food buffer during lean period while reliable income accrued to the farmers involved in harvesting and marketing of the product (Campbell-Platt, 1980; Keay, 1989).

However, the locust bean seed are still being extracted from the wild by the peasant farmers in Nigeria. In the past, processing of locust bean seed was largely in home (family yard) in a crude way and handled by local women. Although, the production has not increased substantially due to problems associated with the traditional production process. The traditional processing method of the locust bean seed were reported to be cumbersome and tiring as it entails a lot of rigorous process ranging from days to weeks and were also considered to be very labor intensive. The traditional processing method includes boiling in water for over 12 hrs. which were considered very exhaustive, followed by cooling and washing, boil cotyledons in water, drain through raffia sieve, spread while hot in wide calabash tray, stack strays together and wrap with jute bag, then ferment for 36 hours, add salt and mould into desire shape and finally sun dry (Farayola *et al.*, 2012). The traditional method was very laborious in nature however. This led to concern about the design of a comprehensive improved technology that can perfectly process the African locust bean without aisle and without losing the flavoring attribute, it contains. The Federal Institute of Industrial Research (FIIRO) has designed the improved technology for processing locust bean over a decade ago. In studies conducted on modern method of processing locust bean, it was noted that the boring routine practice in cooking time was reduce by use of pressure cooker which reduced the rigor of 12 hours of boiling to just 2 hours. Dehuller and separator – dual purpose equipment has drastically reduced the traditional method of production of between 4 days – 6 days to 4 hours; having production capacity of 1500 kg (Audu *et al.*, 2004).

Although, several studies (Olapade-Ogunwole *et al.*, 2011; Farayola *et al.*, 2012; Adejumo *et al.*, 2013; Akintan *et al.*, 2013; Adejumo *et al.*, 2014) have been conducted on locust bean processing and marketing in Nigeria. All this study focused on the economic return to locust bean processing through traditional methods. No study had empirically examined the adoption and use of improved technology among the locust bean processors in South West region of Nigeria and this inform the need for this research work. This study specifically described the socio-economic characteristics of locust bean processors and examined the effect of socio-economic and institutional factors influencing the adoption of improved locust bean processing technology among the processors in South West, Nigeria.

Methodology

Area of study

The study was carried out in South-Western region of Nigeria. The South-West represent a geographical area covering between latitude 6° North and 4° South. It comprises six states, which include: Ekiti, Oyo, Osun, Ondo, Ogun and Lagos State. The region is bounded in the north by Kogi and Kwara States, in the South by Atlantic Ocean, in the west by Republic of Benin and in the East by Edo and Delta State. The South western region of Nigeria can boost of different varieties of tree crops as the climatic conditions support the production of various tree crops including African locust bean. A large proportion of the African locust bean consumed in Nigeria were being processed in the South West region of Nigeria, hence the choice of the study area for the study.

Sampling procedures and sample size

Multistage sampling procedures were employed for the study. The first stage involved purposive selection of three States including Oyo, Ondo and Osun States due to availability of many locust bean processors in the State. The second stage involved the purposive selection of two Local Government Areas because of the concentration of African locust been trees in the areas. The third stage involved random selection of three communities from each of the selected LGAs. At the fourth stage, twenty processors were purposively selected from each community to make a total of 360 (three hundred and sixty) respondents. Primary data were used for the study. The primary data were sourced from cross-sectional survey of locust bean processors in the study area with the aid of well-structured questionnaire to cover information about the socioeconomic characteristics of respondents, awareness and level of adoption of the technology. Data were collected during the period of June 2018- December 2018.

Analytical techniques

The data were analyzed using descriptive and Cragg's (double-hurdle) model

Descriptive statistics

Descriptive statistics were used to describe the socio-economic characteristics, awareness and level of adoption of the locust bean processors in the study area.

The Cragg's model two-step estimation procedure

The Cragg's model was chosen for this study because it relaxes the restrictive assumption of the Tobit model that the factors influencing the discrete decision (adoption decision) and the continuous decision (intensity of use) as well as their effects are the same. Hence, in the Cragg's model, the coefficients of the dependent variables of the first and second hurdle are different.

The first step analyses the factors influencing the decision of processors to adopt improved locust bean processing technologies, while the second step deals with the intensity of use of the adopted improved locust bean processing technologies.

Step 1: *Probit model for the discrete adoption decision*

For the probit model, we assume that the decision of the 'i'th processor to adopt a technology or not depends on an unobservable utility index Y_i^*, that is determined by the explanatory variables, and that the higher the value of this utility index the higher the probability that the farmer will adopt the technology. The adoption probability (dependent variable) Y_i is limited between the values of 1 and 0.

$$Y_i = \begin{cases} Y_i^* \text{ if } Y_i^* > 0 \\ 0 \text{ if } Y_i^* \leq 0 \end{cases}$$

The probit model is expressed as:

$$\text{Prob}(Y^* > 0) = F(X'\beta) = \Phi(X'\beta) = \int_{-\infty}^{X'\beta} \emptyset(Z)dZ$$

Where; $F(X'\beta)$ = cumulative degree of freedom of the standard normal distribution.

$Y_i^* = X'\beta + e_i$
$X'\beta = \beta_0 + \beta_1 AGE + \beta_2 EXPER + \beta_3 EDUYRS + \beta_4 ACCRDT + \beta_5 FINCOME + \beta_6 HHSIZE + \beta_7 LNDWNSHP + \beta_8 ASSN + \beta_9 PERCEPTN + \beta_{10} RISK + \beta_{11} AWARE + \beta_{12} ACCMKT + \beta_{13} EXTN$

Where; Y = decision to Adopt (1= Adopt, 0= not Adopt)
AGE is Age (years)
EXPER is Experience (years)
EDUYRS is Years of Education (years)
ACCRDT is Access to credit (1=yes fertile; 0=yes)
INCOME is Income (₦)
HHSIZE is Household size (#)
LNDWNSHP is Land ownership (3=purchased; 2=leased; 1=borrowed; 0=inherited)
ASSN is Association membership (1=member; 0=non-member)
PERCEPTN is Perception (1=positive; 0=negative)
RISK is Risk affinity (#)
AWARE is Awareness (1=aware; 0=not aware)
ACCMKT is Access to market (1=yes; 0=no)
EXTN is Extension contacts (#)

Step 2: *Model for the continuous decision (intensity of use using uncensored observations)*

The second hurdle model uses the truncated regression model to determine intensity of improved locust bean processing technology used.

$$E(Y|Y^* > 0) = X'\gamma + \sigma\lambda\left(\frac{X'\gamma}{\sigma}\right)$$

Here the Cragg's model makes use of uncensored observations i.e. the observations with zero adoption level were not cut out of the observation, thus giving a better representation of the population.

$X'\gamma = \gamma_0 + \gamma_1 AGE + \gamma_2 EXP + \gamma_3 EDUYRS + \gamma_4 ACCRDT + \gamma_5 FINCOME + \gamma_6 HHSIZE + \gamma_7 LNDWNSHP + \gamma_8 ASSN + \gamma_9 PERCEPTN + \gamma_{10} RISK + \gamma_{11} AWARE + \gamma_{12} ACCMKT + \gamma_{13} EXTN$

Where; Y = Intensity of use
AGE is Age (years)
EXP is Experience (years)
EDUYRS is Years of Education (years)
ACCRDT is Access to credit (1=yes fertile; 0=yes)
INCOME is Income (₦)
HHSIZE is Household size (#)
LNDWNSHP is Land ownership (3=purchased; 2=leased; 1=borrowed; 0=inherited)
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Results and Discussion

Socio-economic characteristics of the respondents

The socio-economic characteristics of the locust bean processors in the study area is presented in Table 1. The mean age of the respondents was 48.00 (±11.36) years, which indicates that majority of the locust bean processors were in their active and productive years. This result conforms with Olapade-Ogunwole (2011) and Farayola *et al.* (2012). The processing of locust bean in the study area tends to be dominated by women, as 84% of the processors sampled were female. This is in agreement with Farayola *et al.* (2012) and Adejumo *et al.* (2013). 97% of the respondents were married which shows that they are responsible and might utilize family labor in their enterprise. The average years of formal education was 12.72 (±4.87) which shows that the average locust bean processors are literate and is expected to help in adoption of the improve technology in the study area. This agrees with the result of Adejumo *et al.* (2013) and Akintan *et al.* (2013).

The average household size was 8.25 (±4.32) which indicates that they had a relatively large household size. Thus, the use of family labour is possible in the processing of locust bean in the study area. About 78% of the respondents do not have access to credit in the study area, which might be due to the small scale farming they

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practice and might also be due to lack of collateral needed to obtain loan. The average years of processing experience was 16.84 (±8.76) years which indicates that the majority of the respondents have been into locust bean processing for many years and are thus expected to have the necessary experience to boost their production in the study area. Majority (73%) of the respondents were into one form of cooperative society or the other. This agrees with Farayola *et al.* (2012) and Adejumo *et al.* (2013).

Table 1. Socio-economic characteristics of locust bean processors.

Variables		Locust bean Processors
Age (years)		48.00 (±11.36)
Female (%)		84.00
Married (%)		97.00
Formal education (years)		12.72 (±4.87)
Household size (#)		8.25 (±4.32)
Access to credit (%)		78.00
Years of experience (years)		16.84 (±8.76)
Cooperative (%)		73.00

Source: Data Analysis, 2018.

Level of awareness

The level of awareness of respondents about the improved locust bean processing technology were presented in Table 2. The result shows that 44.20% were aware while 55.80% were not aware of the improved technology in the study area. This shows that considerable proportion of the respondents are aware of the technology in the study area and are thus expected to adopt the technology in the study area.

Table 2. Distribution of respondents by awareness.

Awareness	Frequency	Percentage (%)
Yes	159	44.20
No	201	55.80
Total	360	100.00

Source: Data Analysis, 2018.

Level of adoption

The level of adoption of the improved locust bean technology were presented in Table 3. About 41.10% of the locust bean processor have adopted the technology while majority (58.90%) is yet to adopt the technology. This indicates that the traditional method of processing locust bean is still prevalent in the study area, hence the need to intensify the level of awareness of the improved technology enlightens them the benefit to be accrued to them by adopting the technology for locust bean processing.

Table 3. Distribution of respondents by level of adoption.

Level of adoption	Frequency	Percentage (%)
Adopted	148	41.10
Not-adopted	212	58.90
Total	360	100.00
Source: Data Analysis, 2018		

Effect of socio-economic and institutional factors on decision to adopt and intensity of adoption of the improved locust bean processing technology

The first hurdle (Table 4) shows the effect of socio-economics and institutional factors on the adoption of improved locust bean processing technology. Socio-economic factors such as age, experience and awareness significantly influence the decision to adopt the improved technology while the institutional factor like access to credit affecting the decision of the processor to adopt the improved technology in the study area. Age was positively significant at 1% level of significance. This implies that an increase in age will increase the probability of adopting the technology by 0.277 units. This indicates that older processors have higher probability of adopting the improved technology in the study area. Years of experience in processing were positively significant at 5% level of probability. This shows that there is a positive correlation between years of experience in processing and adoption of the improved technology. This implies that the higher the increase in years of experience, the likelihood of adopting the improved technology in the study area. Awareness was positively significant at 10% level of significance. This indicates that an increase in

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the level of awareness will increase the likelihood of adopting the improved technology by 0.183 units. Access to credit was positively significant at 5% level of probability. This shows that the more the respondents have easy access to credit, the likelihood of adopting the improved technology increases by 0.741% in the study area.

The second hurdle (Table 5) shows that education, income and land ownership was positive and significant with respect to intensity of use of the improved locust bean processing technology. Education was positive and significant at 5% level of probability. This shows that number of years of formal education increases the probability of intensifying that is continue usage of the improved locust bean

processing technology in the study area. The implication of this is that the more the level of education acquired by the processors, the more it becomes easy to identify the simplicity of the technology, hence they continue to intensify the use of the improved technology in the study area. Income was positive and significant at 1% level of significant. This shows that there is positive correlation between income and intensity of use of the improved technology in the study area. This implies that the more the increase in income realized by the locust bean processors from the use of the technology, the more they likely to intensify and continue the usage of the improved locust bean technology in the study area.

Table 4. First hurdle (decision to use).

Variables	Coefficients	Std. Error	T-value
CONSTANT	6.659***	0.439	15.16
AGE	0.277***	0.054	5.12
EXPERIENCE	0.337**	0.136	2.4
EDUCATION	0.006	0.011	0.54
ACCESS TO CREDIT	0.741**	0.325	2.28
INCOME	0.025	0.029	0.86
HOUSEHOLD SIZE	0.033	0.026	1.26
LAND OWNERSHIP	0.030	0.053	0.56
ASSOCIATION	0.001	0.003	0.33
PERCEPTION	0.008	0.013	0.61
RISK	0.030	0.052	0.57
AWARENESS	0.183*	0.095	1.92
ACCESS TO MARKET	0.400	0.375	1.06
EXTN. CONTACT	0.022	0.078	0.28
LRchi²	12.39		
Log likelihood	-57.391		
Prob > chi²	0.05832		

*, **, *** Significant at 10, 5 and 1%, respectively
Source: Data Analysis, 2018

Table 5. Second hurdle (intensity of use).

Variables	Coefficients	Std. Error	T-value
CONSTANT	0.005	0.335	0.01
AGE	0.006	0.015	0.40
EXPERIENCE	0.004	0.157	0.02
EDUCATION	2.097*	1.276	1.65
ACCESS TO CREDIT	0.004	0.157	0.02
INCOME	0.221***	0.033	6.69
HOUSEHOLD SIZE	4.529	3.599	1.25
LAND OWNERSHIP	1.066	2.100	0.50
ASSOCIATION	0.005	0.021	0.23
PERCEPTION	1.822	6.050	0.30
RISK	4.529	3.599	1.25
AWARENESS	0.027	0.052	0.51
ACCESS TO MARKET	0.531	0.745	0.71
EXTN. CONTACT	0.048	0.594	0.08
LRchi²	16.89		
Log likelihood	-68.8563		
Prob > chi²	0.05728		

*, **, *** Significant at 10, 5 and 1%, respectively
Source: Data Analysis, 2018

Conclusion and Recommendations

The study found out that processing of African locust bean is women dominated enterprise in the study area. In addition, the study concluded that the level of awareness of the availability of the improved locust bean processing technology is very low. The results from the Cragg's double hurdle model show that in the first hurdle, age, experience, access to credit and awareness positively influenced the decision to adopt the improved locust bean processing technology while in the second hurdle, education and income positively influenced the intensity of the use of the improved locust bean processing technology. Hence, the following recommendations were made based on the findings of this study:

  i. There should be an increase in the level of awareness of the use of the improved locust bean processing technology.
  ii. Relevant stakeholders, agencies and government should made available credit facilities which will enable the locust bean processors acquire the technology in no distant time.

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