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Full Length Research Paper

Factors driving the adoption of cooking banana processing and utilisation methods in Nigeria

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As part of efforts in realising her aim of introducing cooking banana into Nigeria, the International Institute of Tropical Agriculture (IITA) mounted training and awareness campaigns on its utilisation in collaboration with Shell and Agip Oil companies between 1991 and 1997. This study looked into the adoption profile of the utilisation methods and the factors that may have influenced it. Data were collected from a random sample of 232 respondents from 24 villages in southeast Nigeria. Results showed an overall adoption level of 79.5%. The highest adoption levels were obtained for those utilisation methods similar to local and traditional methods of plantain consumption and lowest for non-traditional uses. The extent or intensity of adoption by the respondents ranged from 1 processing method to 7, with an average of 3. As a proportion of the number of utilisation methods on which training was given, the intensity of adoption ranged from 12.5% to 100% with a mean of 52.2%, meaning that the respondents have adopted more than 50% of the total number methods on which they received training. The major factors which have strongly influenced the adoption process were the level of educational attainment, social status, primary occupation, intensity of training received, availability of commercially-produced plantain products in the market/area, trialability as well as the number of desirable attributes of the utilisation methods.

Key words: Cooking banana, adoption, processing methods.

INTRODUCTION

Plantain is among the most important food crops in sub-Saharan Africa (SSA), and serves as one of the major staples to more than 70 million people in the region (Swennen, 1990, Tollens, 1995; Vuylsteke, 1995; Robinson, 1996; Ferris, 1997; Frison, 1997; Craenen, 1998b; Gauhl et al., 1998). Cardaba, Bluggoe, Fougamou, Nzizi and Pelipita were the most common cooking banana cultivars introduced (PBIP, 1995; Ortiz et al., 1995; Ferris et al., 1997). As part of the efforts in realising her mission of enhancing food security, income and well-being of farmers in SSA, the International Institute of Tropical Agriculture (IITA) introduced black sigatoka-resistant cooking banana (*Musa* spp, ABB genome) into southeast Nigeria from Asia in the late 1980s. In SSA, black sigatoka (a fungal leaf spot disease) has become a threat to plantain production (Vuylsteke, 1995; Ahiekpor et al., 1996; Ferris et al., 1996; 1997; Craenen, 1998a), causing yield reduction of more than 50%, and at times, total crop failure (Stover, 1983; INIBAP, 1987; Dadzie, 1998). Apart from its resistance to black sigatoka, cooking banana has other important attributes which include lodging/wind resistance, drought tolerance, early ratooning capacity, short duration, as well as high bunch yield (Bayeri et al., 1999; Dadzie, 1998; Ferris et al., 1997; Singh and Uma, 1996). It is also less seasonal in production. Above all, due to its hardiness, it has the potential of surviving in areas where plantain and sweet banana do not (Singh and Uma, 1996). These rare qualities make it potential

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alternative to plantain consumers and farmers in West Africa where two-thirds of SSA's plantain production is obtained (Swennen, 1990; Swennen and Ortiz, 1997). Results of preliminary studies on the crop by Ferris et al. (1996) and Akele (1996) reveal that farmers initially exhibited some reluctance in accepting it. The major reason for this was lack of information and knowledge on how to utilise the cooking banana-fruit as well as poor market value. Some of the farmers mistook it for dessert banana as the fruit looked like that of local banana, though fatter. However, if cooking banana were to be accepted into the farming system by the people, farmers and consumer must be familiar with its utilisation systems and methods. This is necessary for it to fully serve as potential alternative to plantain consumers and farmers. In other to address this problem, IITA, in collaboration with Shell Petroleum Development Corporation (SPDC) and Nigerian Agip Oil Company (NAOC) undertook the generation and transfer of cooking banana postharvest and utilisation technologies to farmers. This led to development of a number of cooking banana processing/utilisation methods, which were taken to the farmers and other end-users. These methods, some of which are similar to the traditional ways of utilising plantain, were disseminated to farmers and consumers through training, workshops/seminars, agricultural shows, food exhibitions, farmers' days and demonstrations.

However, since the introduction of this innovation (cooking banana utilisation systems), no attempt has been made to evaluate its success or otherwise. In particular, no steps had been taken to establish its acceptability or adoption by the farmers and consumers in the area. This is a crucial issue because one major criterion for assessing the suitability of a new technology or an innovation in an area is the level of its acceptability or adoption among the target group, which establishes the extent of its compatibility with existing and local system. Apart from improving the efficiency of technology generation, studies on adoption of agricultural technology provide bases for assessing the effectiveness of technology transfer as well as its suitability to local environment (CIMMYT, 1993; Inaizumi et al., 1999). The main aim of this paper is to assess the adoption status of cooking banana processing and utilisation methods by farmers and consumers in Southern Nigeria and establish the forces that have influenced the adoption process in order to provide guide for future decisions regarding the introduction of postharvest techniques and innovations of new crops to farmers and consumers.

METHODOLOGY

Study area

In collaboration with SPDC and NAOC, IITA-Onne station undertook the training of farmers and consumers on the processing/utilisation methods of cooking banana. The training was carried out among farmer groups/co-operatives. About 11 of these groups were trained by IITA, in partnership with NAOC and SPDC. IITA-AGIP training was conducted from 1991 to 1996 while that of IITA-SHELL ran through 1994 to 1997. Some of the training was also conducted by IITA alone between 1994 and 1997. These farmer-groups/co-operatives spanned 10 Local Government Areas (LGAs) in four States: Abia, Delta, Imo, and Rivers. The study was thus limited to these States.

Table 1. Distribution of respondents by state.

State	Distribution of respondents	
	Number	Percentage
Abia	5	2.2
Delta	14	6.0
Imo	29	12.5
Rivers (5)	184	79.3
Total	**232**	**100**

Sampling procedure

In each group, a list was compiled of members who took part in the initial training, and who had received training from the participants. Based on the number of participants and their trainees, a total of 232 respondents were selected randomly from 24 villages. The distribution of the respondents by State is presented in Table 1 below. The highest proportion of 79% was obtained in Rivers State. SPDC and NAOC, the two major collaborators with IITA in the training exercise, are located in Rivers State where their activities on community development and agricultural extension services are concentrated.

Data collection and analysis

A structured questionnaire was designed and used in the collection of data from the respondents. Information collected included respondents' socio-economic characteristics; consumption of cooking banana and plantain, as well as consumption stages and forms of cooking banana and plantain. Other questions were on number of training sessions attended, the methods of processing/utilising cooking banana that were taught at the training sessions, steps involved in the preparation of the products and the most laborious step/task. Information was also obtained on the products taught which the respondents had practised more than once, and those they had not practised at all. In addition, data were collected on major problems encountered in utilising cooking banana in the various methods as well as the assessment of quality attributes of the varying methods of utilisation. Data collection lasted from May 1998 to February 1999.

Data analysis was based on descriptive statistics such as percentages, frequencies and means, while tables and charts were used in presenting results. Factors influencing the adoption of cooking banana processing/utilisation techniques were assessed by means of regression analyses. Percentages were used in the estimation of the levels of adoption of processing/utilisation methods. Regression analyses were based on Probit/Logit and the ordinary least square (OLS) models. Factor influencing adoption decisions were evaluated using Probit/Logit models, while intensity of adoption (number of utilisation methods taught that were adopted) was assessed using the OLS.

Definition of terms

Processing/utilisation method: Processing method (recipe) is a sequence of activities and ingredients involved in the preparation of a particular food product, while utilisation method is the form of consuming or utilising the product (i.e., cooking banana food product). The two were used interchangeably.

Adoption of cooking banana processing/utilisation method: The first time an individual prepares or utilises cooking banana in a particular method/form is considered a trial, which may result in the continuation or the rejection of the processing or utilisation method. Where the individual is satisfied with the result of a particular utilisation method, the person will go ahead and continue practising the method, otherwise, he or she will stop. Therefore an "adopter" of a cooking banana processing or utilisation method is an individual who has practised any of the processing/utilisation methods more than once after training. The level of adoption is measured in terms of the proportion of individuals who have processed/utilised a particular cooking banana product at least twice after training. This was done for each of the processing/utilisation methods. The number of methods being practised, compared to the total number taught, was used to assess the intensity of adoption.

The regression models

a) Theoretical model

Probit/Logit model: The analysis of farmers' adoption decision regarding cooking banana utilisation and processing methods gave a qualitative dependent variable, and therefore was based on the probit (the standard cumulative distribution function) and logistic (from logit) models. These models are popularly employed in explaining farmers' adoption and diffusion decisions (Zegeye, 1990; Nweke, 1996; Baidu-Forson, 1999; Burton et al., 1999). The two models were employed in this study in determining forces that influenced the respondents'/farmers' decision regarding the adoption or otherwise of cooking banana utilisation methods. According to Aldrich and Nelson (1984) and Nweke (1996), the probit model is given by:

$$Y_i^* = F(X_i^{!}\beta) = \int_{-\alpha}^{(X_i^{!}\beta)} \frac{1}{\sqrt{2\prod}} \exp(-s^2/2)ds \text{.....(I)}$$

For $-\alpha < (X_i^{!}\beta) < \alpha$

Where: Y_i^* is the probability that the ith farmer/consumer adopts cooking banana processing and utilisation method, zero otherwise; while X is the n x k matrix of explanatory variables. β is the k x 1 vector of parameters to be estimated; while s is a random variable distributed as a standard normal deviate, i.e., s is N (0, 1). In other words, the probability of a positive decision (Yi = 1) is the area under the standard normal curve between -α and $X_i^{!}\beta$. According to Zegeye (1990), the larger the value of $X_i^{!}\beta$, the more likely adoption is to take place. The parameters of the probit model are estimated through the maximum likelihood methods (Zegeye, 1990; Aldrich and Nelson, 1984) as follows:

$$L = \prod_{i=1}^{n} [F(X_i^{!}\beta)]^{Y_i^*} [1 - F(X_i^{!}\beta)]^{1-Y_i^*} \text{.....} \quad \text{(II)}$$

Where L is the likelihood function; and n is the number of observations.

The logistic distribution (of logit) is closely associated with the standard normal cumulative function of the probit (Aldrich and Nelson, 1984; Liao, 1994; Nweke, 1996). According to Aldrich and Nelson (1984), the generalised logistic distribution function of the logit model is:

$$Y_i^* = F(X_i^{!}\beta) = \frac{\exp(X_i^{!}\beta)}{[1 + \exp(X_i^{!}\beta)]} \text{.....} \quad \text{(III)}$$

where Y_i^* represents the probability that the farmer/consumer decides to adopt at least one of the cooking banana utilisation methods, given certain knowledge of X_i, the explanatory variables. From Aldrich and Nelson (1984), the corresponding maximum likelihood function L for the estimation of parameters under the logit model is:

$$L = \prod_{i=1}^{n} \left[\frac{\exp(X_i^{!}\beta)}{1 + \exp(X_i^{!}\beta)}\right]^{Y_i^*} \left[\frac{1}{1 + \exp(X_i^{!}\beta)}\right]^{1-Y_i^*} \text{.....} \quad \text{(IV)}$$

Where n is the number of observations.

The significance of the individual coefficients is tested by the ratio of the estimated coefficient and its corresponding standard error (asymptotic t-value). The significance or fit of all or a subset of the coefficients is assessed through the log likelihood ratio test (LRT), which is the Chi-square distributed with k degrees of freedom, where k is the number of parameters in the model less the constant (Zegeye, 1990), calculated thus:

$$LRT = -2\log\lambda = -2(\log L_{min} - \log L_{max}) \quad \text{(V)}$$

where: L_{min} = log likelihood value for the constant only, and
L_{max} = log likelihood when all variables are included

There is positive relationship between the dependent variable and the explanatory variables if the value of the statistic exceeds the chosen critical value (Aldrich and Nelson, 1984).

An easy and most useful way of interpreting the logit model, however, is the odd ratios (Liao, 1994). It defines the probability of adoption relative to non-adoption, which, according to Burton et al. (1999), is given by:

$$\frac{Y_i^*}{1 - Y_i^*} = \exp(X_i^{!}\beta) \quad \text{(VI)}$$

Authors have noted that either the probit or the logit model is valid because neither dominated the other on purely statistical grounds (Polson and Spencer, 1991). Supporting this, Liao (1994) remarked that one can move from one set of estimations to the other. He noted that if one multiplies a probit estimate by a factor, one gets an approximate value of the corresponding logit estimate. This factor, according to Aldrich and Nelson (1984) is believed to be $\pi/\sqrt{3}$ = 1.814; while Ameniya (1981) proposed a trial and error value of 1.6. Commenting, Manyong et al. (1996) pointed out that despite slight differences in coefficients, probit and logit models can be substituted for each other since they lead to the same recommendations. Nevertheless, Liao (1994) stressed that in cases with an extremely large number of observations and with a heavy concentration of observations in the tails of the distribution, logistic models are more appropriate.

Table 2. Definition of variables specified in the regression function of the determinants of adoption of cooking banana processing/utilisation methods in Nigeria.

Variable	Type	Description
Dependent variables		
Prepared	Binary	Adoption of cooking banana processing/utilisation method: 1 (yes) if respondent has practised any of the methods more than once, 0 (no) if otherwise.
Nopreprd	Continuous	Intensity of adoption of cooking banana utilisation methods: Number of utilisation methods taught which respondent has prepared more than once.
Explanatory variables		
Gender	Binary	Gender of respondent: 1 if male; else 0
Mstatus	Binary	Marital status of respondent: 1 if married; else 0
Age	Continuous	Age of respondent (years)
Hhead	Binary	1, if respondent is head of the household; else 0
Hhsize	Continuous	Respondent's household size (no. of people eating from the same pot)
Feduc	Continuous	Level of education (no. of years spent in formal education by respondent)
Occup	Binary	Respondent's primary occupation: 1 if farming; else 0
Sstatus	Binary	Social status: 1, if respondent is titled; else 0
Numeatcb	Continuous	No of times household has eaten cooking banana in last one month
Numeatpb	Continuous	No of times household has eaten plantain in last one month
Totalcb	Continuous	No of forms cooking banana is mostly eaten by the household
Totalpl	Continuous	No of forms plantain is mostly eaten by the household
Trained	Binary	1, if respondent received training on cooking banana utilisation methods; 0 otherwise
Training	Continuous	No of times respondent received training on cooking banana utilisation methods
Npdtrain	Continuous	No of cooking banana utilisation methods respondent got training on
Notprep	Binary	1, if respondent has not practised any of the utilisation methods at all; else 0
Complpdt	Binary	1, if aware of any plantain product produced commercially; else 0
Propcbmk	Proportion	Proportion of produced cooking banana product sold (parts out of ten)
Assgood	Continuous	No of attributes of cooking banana utilisation methods assessed good

Linear model (OLS): The extent of adoption of cooking banana utilisation methods or intensity of adoption (represented by the number of methods adopted by the respondents) yielded continuous dependent variables and an array of continuous and discrete explanatory variables. The analysis was thus based on the ordinary least square (OLS), using the linear model (Celis and Bliven, 1991). Following Celis and Bliven, the generalised linear model is as follows:

$$Y_i = a_i + \sum_j b_{ij} X_j \qquad \text{(VII)}$$

Where:
a_i = intercept;
Y_i = number of utilisation methods practised more than once by the ith respondent/farmer;
b_{ij} = coefficients; and
X_j = 1 to the jth explanatory variables.

b) Empirical model

The decision regarding whether or not to adopt any of the methods (i.e., to continue its application after the first attempt or not), as well as the intensity of adoption by the respondents, were regressed on two groups of variables, namely household/respondent-related and technology-induced. The household/respondent-related variables include the gender, marital status, age, and household size of the respondent or trainee. Others include the number of years of formal education, the primary occupation, as well as the social status. Also considered relevant to household variables are the households' eating habits regarding cooking banana and plantain as well as the number of conventional forms of utilising them. It is hypothesised that these household/respondent-related variables (described and presented in Table 2 below) would have significant influence on the respondent's decision whether or not to adopt any of the cooking banana utilisation methods taught, and the intensity of adoption.

The technology/innovation-induced variables are those that arose as a result of the initiation of the technology/innovation transfer. These include attendance to training on cooking banana utilisation methods, the number of training sessions attended by the respondent as well as the number of utilisation methods on which the respondent received training. Others include the trialability of the utilisation methods, the number of desirable attributes of the utilisation methods, availability of such products in the market, as well as the proportion of such utilisation methods produced for market. These variables are also described and presented in Table 2 below, and are expected to significantly influence the decisions of the respondents regarding the adoption or non-adoption of the methods taught to them. They are also expected to have a strong influence on the extent or degree of adoption of the utilisation methods among the adopters.

Table 3. Levels of adoption of cooking banana processing/utilisation methods.

Processing/Utilisation method	Distribution of respondents		Level of adoption (No. that adopted as % of No. trained)
	No. that got trained	No. that adopted	
Akara	104	34	32.7
Baby food	12	2	16.7
Boiled	42	41	97.6
Bread	41	3	7.3
Buns/Doughnut	17	7	41.2
Cake	102	10	9.8
Chin-chin	65	9	13.8
Chips	151	108	71.5
Chomchom	23	3	13.0
Biscuit	11	1	9.1
Dodo	96	85	88.5
Epiti/Ikpa	70	33	47.1
Flour	51	8	15.7
Fufu/Pounded	109	52	47.7
Wine/Juice	15	3	20.0
Moimoi	39	16	41.0
Meat-pie	5	0	0.0
Pancake	12	5	41.7
Pastries	3	0	0.0
Pottage	73	69	94.5
Raw/Dessert	5	1	20.0
Puff-puff	5	0	0.0
Soap	8	3	37.5
Roasted	5	2	40.0
All products/methods	215	171	79.5

RESULTS AND DISCUSSION

Level and intensity of adoption

Level of adoption

A total of 171 respondents, representing 79.5% of those that received training have adopted one or more of cooking banana utilisation methods (food products) taught. This gave the overall adoption level. This figure (79.5%) is impressive, realising that the crop is quite new and non-traditional to the farmers/consumers. In Benin Republic, a 7% adoption figure of *Mucuna* fallow system was considered promising by Manyong et al. (1999) when compared to other technologies previously introduced in the area. In an earlier study, the level of adoption of the cooking banana crop itself was put at 55% (Tshiunza et al., 1999). The high adoption level may be associated with the alternate ways of utilising the crop at the disposal of the respondents. The level of adoption of the respective methods varied greatly, ranging from zero to 97.6% (Table 3). The highest adoption levels were obtained for those methods that are similar to local methods of using or consuming plantain. The lowest levels were obtained for those utilisation methods that are not traditionally and closely associated with plantain. For instance, the level of adoption was about 98% for boiled cooking banana, 72% for chips, 88% for dodo and 94% for pottage (Table 3). The adoption level was relatively high for *fufu*, though not a common form of plantain utilisation in the region. Traditionally, some species of local banana are usually pounded into *fufu*, in combination mostly with cassava paste/*gari* or sometimes yam. On the contrary, the level of adoption for non-traditional uses was much lower: bread 7%, biscuit 9%, cake 10%, *chomchom* 13% and *chin-chin* 14% (Table 3). The low adoption level for the non-traditional uses may be the result of lack of requisite skills and facilities required in producing most of them. Again, farmers are likely to be less interested in snack food (cake, *chin-chin*, biscuits, etc.) than in basic food. In Benue State of Nigeria, Sanginga et al. (1999) reported higher adoption

levels for soybean utilisation methods that are locally oriented than utilisation methods not common to and easily applicable by the farmers. They obtained about 90% adoption levels for soybean *dadawa*, soybean *moinmoin,* and soybean *akara*, which are products the people commonly produce and consume using local beans such as locust beans and cowpea. The adoption levels for soymilk, soycheese, and soyflour that were not common to the people were very low. This implies that similarity to, and compatibility with existing systems, as well as the level of skill and labour involved and the availability of facilities may be among the factors that have influenced the adoption level across the different utilisation methods.

Table 4. Distribution of respondents (adopters) by number of processing/utilisation methods adopted

Number of utilisation methods adopted	% of adopters	Cumulative % of adopters
1	20.7	20.7
2	25.0	45.7
3	22.6	68.3
4	17.1	85.4
5	7.9	93.3
6	6.1	99.4
7	0.6	100
(Mean = 3)		

Table 5. Distribution of respondents (adopters) by number of processing/utilisation methods on which training was received.

Number of utilisation methods taught	% of adopters	Cumulative % of adopters
2	5.5	5.5
3	9.1	14.6
4	10.4	25.0
5	18.3	43.3
6	24.4	67.7
7	14.0	81.7
8	13.4	95.1
9	1.8	96.9
10	2.4	99.3
11	0.6	100
(Mean = 6)		

Intensity of adoption

Among the adopters, the intensity or degree of adoption (see earlier definition) varied, ranging from one product or utilisation method to 7 (Table 4), with an average of 3. About 21% have adopted only one method while only one respondent adopted up to 7. About 32% have adopted more than the average while only 6.7% have adopted more than 5 methods (Table 4). The figures may be considered low when compared with the number of products or utilisation/processing methods on which the respondents received training. The number of utilisation methods taught to the respondents ranged from 2 to 11 (Table 5) with a mean of 6. About 57% were taught on more than 5 methods (Table 5). The nature of the methods taught, as well as the level of facilities and skill involved may have influenced the extent of their adoption by the respondents. As a proportion of the number of utilisation methods on which training was given, the intensity of adoption ranged from 12.5% to 100% with a mean of 52.2% (Table 6). In other words, the respondents have adopted and/or are practising about 50% of the total number of methods on which they received training. About 65% have adopted 60% or less of the methods on which training was received. Only about 12% have adopted more than 80% of the methods on which they were trained (Table 6), while about 10% have adopted and/or practised all.

Table 6. Distribution of respondents (adopters) by intensity of adoption

Intensity of adoption (proportion of UMs taught being practised or adopted)	% of adopters (N = 164)	Cumulative % of adopters
<= 20%	11.0	11.0
21 – 40%	27.4	38.4
41 – 60%	26.8	65.2
61 – 80%	22.6	87.8
81 – 100%	12.2	100
(Mean = 52.2%)		

Note: UMs = Utilisation/processing methods

Determinants adoption

Decision to adopt

All the explanatory variables accounted for about 54% of the variations in the probability that a farmer/consumer would decide to adopt any of the utilisation methods (Table 7). The overall fit, expressed by the likelihood ratio test, is high and significant, with about 94% of right prediction. This demonstrates that the variables included in the model are relevant in influencing the adoption decisions of the farmers/consumers in the region regarding these methods. The respondents' level of education, social status, primary occupation, the level of training received, the presence of processed plantain products in the market, the number of good attributes, as well as non-trial of some of the methods were all

Table 7. Parameter estimates (based on probit and logit/logistic models) of the determinants of adoption of cooking banana utilisation/processing methods.

Explanatory variables	Coefficients/odd ratios			
	Probit		Logistic	
	Full model	Step-wise	Full model	Step-wise
Intercept	-2.1293	-2.2554	-	-
	(-1.724)*	(-2.565)***		
Gender	0.3032	-	1.6344	-
	(0.494)		(0.439)	
Age	-0.0088	-	0.9829	-
	(-0.407)		(-0.460)	
Hhead	-0.6752	-0.5313	0.2662	0.3428
	(-1.318)	(-1.412)	(-1.398)	(-1.528)
Feduc	-0.1502	-0.1107	0.7719	0.8358
	(-2.344)**	(-2.211)**	(-2.097)**	(-1.932)**
Occup	-0.8777	-0.6556	0.1929	0.3035
	(-1.605)*	(-1.371)	(-1.602)*	(-1.338)
Hhsize	0.0490	-	1.0993	-
	(0.693)		(0.761)	
Sstatus	0.6852	0.6859	3.5720	3.2286
	(1.329)	(1.633)*	(1.306)	(1.450)
Numeatcb	0.0669	-	1.1104	-
	(0.739)		(0.640)	
Numeatpb	0.0030	-	1.0117	-
	(0.100)		(0.199)	
Totalcb	0.0634	-	1.1117	-
	(0.545)		(0.500)	
Totalpl	-0.1008	-	0.7982	-
	(-0.939)		(-1.117)	
Trained	0.4701	-	2.1036	-
	(0.695)		(0.602)	
Training	0.9219	0.9283	4.9210	5.5936
	(2.494)***	(2.839)***	(2.177)**	(2.562)***
Notprep	1.8163	1.8584	24.3179	25.3831
	(3.357)***	(4.065)***	(3.147)***	(3.851)***
Complpdt	1.2532	0.9922	10.0301	5.4978
	(1.998)**	(2.247)**	(1.987)**	(2.090)**
Propcbmk	0.0131	-	1.0006	-
	(0.136)		(0.004)	
Assgood	0.0637	0.0729	1.1147	1.1325
	(2.047)**	(2.544)***	(1.897)*	(2.347)**
Statistics:				
No of observations	144	144	144	144
Chi^2	66.83	62.61	66.48	62.33
Prob > Chi^2	0.0000	0.0000	0.0000	0.0000
Pseudo R^2	0.54	0.51	0.54	0.51
Log likelihood	-28.1458	-30.2531	-28.3189	-30.3931
% of right prediction	-	-	93.57	-
Area of right prediction	-	-	0.9471	-

Note: Values in parenthesis = t-ratio equivalents; *** significant at P <= 0.01; ** significant at 0.01 < P <= 0.05; * significant at 0.05 < P <= 0.10; some variables were dropped due to collinearity, and perfect failures/success.

significantly related to the probability of adoption by the respondents (Table 7).

The level of education is significant and negatively related to the probability of adoption. This is contrary to most results from previous studies on farmers' adoption decision (Zegeye, 1990; Jha et al., 1991; Amara et al., 1999) especially for innovations that require some level of literacy/numeracy in application. More educated farmers are expected to be less averse to risks and thus, make more positive adoption decisions than the less educated. In addition, the more educated farmers are usually more favourably disposed towards dealing with difficulties that may arise from adopting innovations, as well as having more access to needed information. In this case, however, people with high level of education may look down on cooking banana consumption as being inferior. Some other authors have also reported a low probability of adoption with the level of education of the respondents (Sanginga et al., 1999; Adesina et al., 1999). The number of years spent in formal education ranged from zero to 21 with a mean of 5.7 ± 5.3 (Table 9). Farming as primary occupation has a negative and slightly significant relationship with the probability of adoption of any of the methods. This is also contrary to expectation since the majority of the respondents were farmers. Burton et al. (1999) reported a positive non-significant relationship between respondents who are primarily farmers and the probability of adopting organic horticultural farming techniques in the UK. However, the training on cooking banana utilisation methods received by the respondents was more on non-traditional uses, whose applications are not within the technical and material reach of the local farmers. Again, full-time farmers are likely to show more interest on issues bothering on primary production than on postharvest. More proportion of non-adopters (85%) than adopters (75%) had farming as their primary occupation (Table 9).

The social status of the respondents has a positive and slight significant relationship (step-wise) with the probability of adoption. In the rural communities, most of the titled men/women (e.g. Chiefs/*Lolos*, *Nzes*, etc.) normally belong to one or more sociocultural groupings, which are likely to have benefited more from the training. Again, most of them (respondents with social titles) are office holders of town/community unions, co-operatives, *esusu clubs*, and farmer-groups, and these socio-economic and cultural groups formed the framework for selecting the trainees. Membership of associations was strong and positive in influencing the adoption decisions of farmers regarding alley farming in Nigeria and Cameroon (Adesina et al., 1999). About 20% of the non-adopters were titled against 42% for the adopters (Table 9).

While there is non-significant positive relationship between the receipt of training and the probability of adopting any of the methods, the number of training sessions on processing/utilisation methods received by the respondents had a strong and positive relationship with the probability of adoption. Relevant extension education for farmers (which implies extension-farmer-contact) has been demonstrated to have a positive impact on innovation adoption (Adesina et al., 1999; Manyong et al., 1999; Manyong et al., 1996; Jha et al., 1991; Zegeye, 1990). Intensification of farmers' training on the proper methods of innovation/technology application increases the chances that they will find the innovation applicable and finally adoptable. The average number of training sessions received by the respondents was 2 for the adopters and 1 for the non-adopters (Table 9).

There is positive and strong relationship between the probability of adoption and non-trial of any of the utilisation methods on which training was received. Trialability of innovation is one of the factors that positively impact on farmers' adoption decisions because it increases its chances of being observed and assessed by the clientele. Manyong *et al.* (1999) remarked that the increased spread and adoption of *mucuna* fallow system in southern Benin was as a result of what farmers had seen through project demonstrations and on other farmers' fields. Innovations that can be tried in bits have higher chances of adoption than those that are not. Many methods of utilising cooking banana were taught to the farmers/consumers, and this gave them enough room for choice in the trial stage. About 75% of all the respondents have not practised at least one of the utilisation methods they received training on. The figure is 50% for non-adopters and 84% for the adopters (Table 9).

There is positive and significant probability of adoption where processed plantain products are commercially produced. Since cooking banana produces products as good as those from plantain, there is the possibility of switching from plantain as raw material to cooking banana, which is relatively cheaper and less seasonal in supply. Moreover, innovations with bright prospects for commercialisation usually command higher acceptability and adoption among the target group (Arnon, 1989; CIMMYT, 1993; Manyong et al., 1999). Since cooking banana products are capable of substituting for those of plantain in the market, where plantain products have a market, those of cooking banana are also expected to have a market, thereby inducing adoption. Though brown beans are not consumed in northern Nigeria, it is in high demand in the south which was cited as the major reason for the high adoption level for dry-season dual purpose brown cowpea by farmers in northern Nigeria (Inaizumi et al., 1999). More than 67% of the respondents indicated awareness of commercial production of plantain products. The figure was about 57% for non-adopters and 72% for the adopters (Table 9).

The number of attributes of the utilisation methods assessed as good by the respondents had a positive and strong relationship with the probability of adoption. That is, the more the number of desirable attributes for a

utilisation method, the more likely the farmers and consumers are to adopt the method. Innovations that present desirable attributes and command good perception by the target audience are known to command greater chances of adoption by the clientele (CIMMYT, 1993; Manyong et al., 1999). The adopters assessed about 96% of the total attributes as good (Table 9).

Though not significant, age and headship of households yielded negative relationships with the probability of adopting any of the utilisation methods. Many adoption studies have reported a negative relationship between age and farmers' adoption decisions (Zegeye, 1990; Jha et al., 1991; Baidu-Forson, 1999; Burton et al., 1999; Sanginga et al., 1999). Younger farmers are usually more receptive to innovations and new technologies than older farmers. The mean age of the respondents was 42 years for the adopters and 43 for the non-adopters (Table 9). The negative relationship of household headship with the probability of adoption is not surprising since more than 77% of the respondents were females (Table 9), and traditionally, except for unmarried or widowed females, males mostly head households (Sanginga et al., 1999). Even where females head households, favourable decisions regarding innovations and new technologies may be hindered because females are usually more conservative than males when it concerns change. They are not usually as receptive to innovations and new ideas as men are. About 49% of the households were headed by females, being more among the non-adopters (56%), than among the adopters (46%) (Table 9). It is not surprising therefore that the probability of adopting any of the utilisation methods is positive though non-significant, with male respondents. However, there were more women than men among the trainees with the notion that women, rather than men, spend more time in making decisions regarding food types and meals in the household. Nevertheless, in most instances, males, rather than females, exert a greater influence on meal types and choice in the family/household. There are non-significant positive relationships between household size, the number of times plantain and cooking banana are eaten in a month, and the number of forms of consuming cooking banana with the probability of adoption. Though not significant, their signs were not far from expectations, and household size has been frequently reported as having a positive impact on farmers' adoption/diffusion decisions (Adesina et al., 1999; Zegeye, 1990). Larger households usually have more mouths to feed, and are always eager to adapt techniques that present opportunities for more food and income. Also, for such techniques requiring labour, larger households usually are at an advantage since they guarantee a regular supply of rural farm/household labour (Zegeye, 1990). The size of respondents' households ranged from 1 to 31 with a mean of 8.6 ± 3.8 (Table 9). The mean household size was not significantly different between the adopters (8.7) and the non-adopters (8.2). Households' plantain and cooking banana-eating habits were expected to positively influence the adoption decision of the respondents regarding cooking banana utilisation methods. Even though some of the respondents reported that the number of times they ate cooking banana and/or plantain depended upon their availability, families that eat either cooking banana or plantain regularly are more

Table 8. Parameter estimates (based on OLS) of determinants of intensity of adoption of cooking banana processing/utilisation methods by farmers.

Explanatory variables	Coefficients	
	Full model	Stepwise
Intercept	-1.1111	-0.4915
	(-1.521)	(-0.959)
Age	0.0102	-
	(0.895)	
Hhead	-0.3242	-0.2673
	(-1.264)	(-1.172)
Feduc	0.0188	-
	(0.712)	
Occup	-0.4088	-0.4754
	(-1.457)	(-1.912)*
Hhsize	-0.0044	-
	(-0.129)	
Sstatus	0.1301	-
	(0.556)	
Numeatcb	0.0203	0.0264
	(0.688)	(1.015)
Numeatpb	0.0122	-
	(0.783)	
Totalcb	0.0279	-
	(0.513)	
Totalpl	-0.0525	-0.0479
	(-1.031)	(-1.016)
Training	0.2625	0.3228
	(1.872)*	(2.611)***
Npdtrain	0.3274	0.3032
	(4.714)***	(4.624)***
Complpdt	0.7218	0.8084
	(2.313)**	(2.725)***
Propcbmk	0.0178	-
	(0.427)	
Assgood	0.0422	0.0498
	(2.724)***	(3.666)***
Statistics:		
No of observations	129	129
R^2	0.44	0.43
F-value	5.89	11.14
Prob > F	0.0000	0.0000

Note: Values in parenthesis = t-ratio values; *** significant at P <= 0.01; ** significant at
< P <= 0.05; * significant at 0.05 < P <= 0.10.

Table 9. Summary statistic of variables affecting the adoption of cooking banana utilisation methods in Nigeria.

Variable	Statistic								
	All respondents (N = 232)			Adopters (N = 171)			Non-adopters (N = 58)		
	Mean	Std	%	Mean	Std	%	Mean	Std	%
Female respondents	-	-	77.2	-	-	77.8	-	-	77.6
Married respondents	-	-	90.4	-	-	90.6	-	-	89.5
Age of respondents	42.6	11.8	-	42.1	11.5	-	42.7	12.0	-
Head of household	-	-	49.4	-	-	46.2	-	-	56.1
Size of household	8.6	3.8	-	8.7	3.6	-	8.3	4.2	-
No of years of formal education	5.7	5.3	-	5.7	5.4	-	5.6	5.0	-
Farming as primary occupation	-	-	74.8	-	-	71.2	-	-	84.2
Respondents with social title	-	-	35.8	-	-	41.9	-	-	19.6
No of times of eating CB/month	3.5	4.8	-	3.7	4.9	-	2.7	4.6	-
No of times of eating PL/month	9.7	7.8	-	10.1	8.1	-	8.6	6.8	-
No of forms of eating CB	5.0	2.7	-	5.2	2.6	-	4.2	2.7	-
No of times of eating PL	5.9	2.5	-	6.0	2.5	-	5.9	2.4	-
Receipt of training on CB utilisation methods	-	-	92.4	-	-	100	-	-	70.4
No of training on CB utilisation methods received	1.4	0.9	-	1.6	0.9	-	0.9	0.8	-
No of CB utilisation methods received training on	5.5	2.0	-	5.7	1.9	-	4.5	1.9	-
Non trial of any of CB utilisation methods trained on	-	-	75.5	-	-	84.2	-	-	50.0
Aware of plantain products traded in the market	-	-	67.2	-	-	71.9	-	-	56.9
Proportion of produced CB product sold	0.9	2.6	-	1.0	2.8	-	0.4	1.7	-
Production of CB products for household use only	-	-	86.1	-	-	84.2	-	-	92.7
Production of CB products for sale only	-	-	4.5	-	-	6.2	-	-	0.0
No of attributes of CB utilisation methods assessed good	21.4	9.3	-	22.9	9.2	-	16.3	7.9	-
Proportion of attributes assessed good	96.1	9.5	-	96.2	9.3	-	95.7	10.2	-

Note: CB = Cooking banana, PL = Plantain.

likely to adopt any of the cooking banana utilisation methods since cooking banana offers a suitable and cheap alternative to plantain. Consumers with little disposition towards plantain and/or cooking banana may not be as ready to adopt any of the uses as those that consume either or both regularly. On the average, the respondents reported that they ate plantain 10 times monthly and cooking banana 4 times monthly (Table 9). The number of forms of consuming cooking banana is positive and non-significant, while the number of forms of plantain consumption is negatively non-significant. People that consume plantain in varied forms may not be under duress to seek alternatives.

The degree of commercialisation of cooking banana products (expressed by the proportion sold) is positively non-significant. Availability of product market has been identified as one of the important factors influencing farmers' adoption decisions (CIMMYT, 1993; Inaizumi et al., 1999). Among the adopters, more than 84% produced the cooking banana products exclusively for household use, while about 6% produced for sales alone. On the other hand, about 93% of the non-adopters were producing only for household consumption, while the remaining 7% sold about 60% to 70% of their products. None produced for sales only (Table 9).

Intensity of adoption

The variables explained about 44% of the variations in the intensity of adoption of the cooking banana processing/utilisation methods by the respondents, with an F value that is highly significant. Individually, however, only four variables in the full model, and five in the stepwise had significant relationships with the intensity of adoption (Table 8). Farming as a primary occupation is negative and significant only in the stepwise (Table 8). This is however contrary to expectation since majority of

the adopters were farmers. However, as earlier pointed out, training on cooking banana utilisation methods received by the respondents/adopters were mostly non-traditional uses, whose application are not within the technical and material reach of the local farmers. About 75% of the adopters had farming as their primary occupation (Table 9). The number of training sessions received by the adopters is positive and significant. The more one receives training and instructions on an innovation, the more informed the individual becomes, and as such, the more likelihood of increased interest and application/adoption. Extension education and training has been known to influence adoption decisions of farmers (Adesina et al., 1999; Baidu-Forson, 1999). Attendance at agricultural-related training/workshops/seminars provides farmers with the opportunity of receiving extension advice which has been found by Jha et al. (1991) to exert a strong, positive impact on the level of adoption of improved agricultural technologies in the Eastern Province of Zambia. In Northern Ghana also, Zegeye (1990) reported a strong positive effect of extension contacts with farmers on the adoption of improved varieties, intensity of fertiliser use and use of Bullock traction by farmers. The number of utilisation methods on which the adopters were trained is significant and positively related to the number of methods adopted. When an innovation has alternative ways of application, the chances of increased adoption is high as it presents more opportunities for trials and attempts by the target audience. On the average, the adopters received training from the institutions on 6 ways of utilising cooking banana. There is positive and significant relationship between the number of methods adopted and the availability of commercially produced plantain products in the areas. Almost all plantain products that are produced commercially are also produced using cooking banana. Cooking banana being relatively cheaper will be more attractive to the producers of plantain products. Commercial production of plantain products would likely lead to the increased utilisation of cooking banana (leading to increased adoption of the methods). Innovations that present bright prospects for market production usually attract increased interest and application by the target audience (Arnon, 1989; CIMMYT, 1993; Kormawa and von Oppen, 1997; Inaizumi et al., 1999; Manyong et al., 1999). There is a very strong and positive relationship between the number of utilisation methods adopted and the number of desirable attributes assessed as such by the adopters. Innovations and new technologies whose results possess attributes that have slim chances of positive assessment by the intending beneficiaries are not likely to command increased adoption. In Burkina Faso and Guinea, Adesina and Baidu-Forson (1995) obtained a strong and positive relationship between the probability of adoption of improved sorghum and rice varieties and a favourable perception and assessment of products/yield attributes by farmers.

CONCLUSION AND RECOMMENDATIONS

The study has examined the adoption profile of cooking banana utilisation methods as well as the forces that have influenced it. The crop was introduced by IITA in the late 1980's to provide an interim solution to the problem of black sigatoka attack on plantain. Though it was not among the traditional crops in the area, cooking banana fitted into the existing plantain cropping system. However, the farmers were not familiar with its consumption patterns. This motivated IITA, in collaboration with SPDC and NAOC to undertake the training of farmers and consumers on the various ways of utilising the fruit. From the results of this study, almost 80% of those who received the training were utilising the crop in one or more of the ways they were taught. This gave an overall adoption level of about 80%. The average number of utilisation methods adopted was about 50% of the average number on which the respondents were trained. The adoption profile was more in favour of those methods that are similar to, and compatible with traditional plantain uses than those methods that are non-traditional and exotic. This demonstrates the strong effects of compatibility and complexity in innovation adoption by farmers and consumers. The pattern of adoption, which favoured mostly those uses that are similar to plantain, is an indication that cooking banana has fitted well into the plantain consumption system and habit of the people.

Analyses of the factors driving the adoption process gave some levels of reliable statistical accuracy in that the factors considered were important in influencing the adoption decisions of the respondents. The strength of the impacts of the individual variables included in the models however differed. The level of educational attainment, social status, primary occupation, intensity of training on cooking banana utilisation received, availability of commercially-produced plantain products in the market/area, trialability, as well as the number of desirable attributes of the methods are some of the variables that were significant in shaping the decisions of the respondents regarding adoption and non-adoption of the methods. Many authors have made known the strong influence of education on the adoption and spread of innovation, many of them positive and some negative. The level of education had a strong negative effect on respondents' decision either to adopt or not to adopt any of the methods. This shows that not every innovation is initially favoured by people with a high level of education. Innovations that may be regarded as inferior by the elite may likely not be readily adopted by the more educated. Thus, there is a need for care regarding the category of people to whom innovations are initially introduced.

Extension education/training, which positively and strongly influenced the adoption of the utilisation

methods, is usually acquired through attendance at training and workshop/seminars that are organised by extension agencies and some times, research institutions. The creation of increased access for attendance at such gatherings by the innovation-target-group will positively increase the chances of successful introduction, adoption and final spread of the innovation. However, there is need for caution in ensuring that the right information and knowledge are disseminated and taught at such meetings. Dissemination of the wrong information concerning an innovation, or information that cannot be easily applied by the target group within their material and technical limitations will strongly disfavour adoption and the spread. The adoption figures were higher for those utilisation methods that are akin to local the ways of utilising plantain. In other words, the overall level of adoption of the cooking banana utilisation methods would have been much higher if the training organised by the institutions had first concentrated on those methods with which the farmers and consumers are familiar, and which are within their technical and material limitations. Thus, for this type of innovation that has many pathways due to technical and material requirements, future efforts at generation and introduction should commence with the less technical and demanding methods, and then gradually progress to those demanding more in skill and/or material. Again, since cooking banana presents utilisation methods that are akin to those of local plantain, farmers and consumers have existing bases for comparison and establishing compatibility with the existing system. Therefore, the training on, and the introduction of such innovations should be phased, starting from where the people are at the moment, technically and materially.

Farming as a primary occupation gave a significant negative probability of adoption. Though introduction of a farm innovation to full-time, rather than part-time, farmers has the potential to guarantee increased adoption, and probably its eventual spread, as full-time farmers are likely to have more farmer-friends than part-time farmers, innovations relating to postharvest aspects, and not to primary production may not be favoured. In other words, initial introduction of post-harvest innovations through primary producers or full-time farmers alone may result into a low adoption of such a technology, and even impede the primary sub-sector. Therefore, for training on, and introduction of innovations that border on postharvest, consideration of middlemen and processors/manufacturers (in addition to the primary producers or farmers) is essential. Apart from the probability of increased adoption and spread, this has the potential of increasing the demand for primary production, thereby creating a ready market for primary produce. This is of particular significance for cooking banana, which has a great potential for raw material for the production of a number of vital products. Trialability of innovation and possession of desirable attributes greatly influenced the adoption process. Innovations that result in desirable characteristics, and which can be tried in bits are readily adopted by the target group. Thus, the development of innovations and technologies that possess desirable attributes that fit into the peoples' farming and consumption systems, and which present alternatives for trial are of crucial importance in decisions regarding technology generation and transfer.

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