Determinants of adoption of vitamin A bio-fortified cassava variety among farmers in Oyo State, Nigeria

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Summary

The success of any agricultural innovation depends on its adoption by farmers. The study evaluates the determinants of adoption of vitamin A bio-fortified cassava variety among farmers by investigating the level of adoption and determinants of adoption among farmers. Three stages of random sampling procedure were used to select 240 cassava farmers. The data obtained were analyzed with descriptive statistics and a logit regression model. The study revealed that the level of adoption of vitamin A bio-fortified cassava variety is low (38.72%). The study also revealed that access to media, contact with extension agents, access to vitamin A bio-fortified cassava stem, amongst others, are the determinants of adoption of vitamin A bio-fortified cassava variety in the study area. It is therefore recommended that awareness about the new cassava technology should be prioritized to sensitize the farmers, and stems of these cassava varieties should be readily made available to farmers to take advantage of the benefit of the innovation.

Keyword: adoption, evaluation, vitamin A bio-fortified cassava, Oyo State

Introduction

One of the goals of Nigerian agriculture development programs and policies is to increase agricultural productivity for the accelerated economic growth. Productivity increases in agriculture can reduce poverty by increasing farmers' income, reducing food prices and thereby enhancing increments in consumption (Diagne et al., 2009). Cassava production plays a key role in alleviating poverty in Nigeria, as it is virtually impossible that an average household will not consume a cassava product in a day (Okpukpara, 2006). Therefore, cassava is an important factor in food security, poverty alleviation, ruralurban drift, and reducing unemployment, among others (Okpukpara, 2006). Based on that, Nigeria released two improved cassava varieties (vitamin A bio-fortified Cassava) in an effort to maintain its lead as the world's largest producer of the root crop and improve incomes of farmers (IITA, 2013).

The two varieties of vitamin A bio-fortified cassava that were released were UMUCASS 42 and UMUCASS 43. They performed well in different cassava production regions of Nigeria with a high yield, high dry matter, and a good disease resistance. The roots of these varieties are yellow and contain moderate levels of pro-vitamin A that can take good care of vitamin A deficiency among the growing population. Vitamin and mineral deficiencies affect more than two billion people worldwide, causing illness, disability and mortality. The problem is most severe in developing countries, where a third of the children under the age of five suffer from vitamin A deficiency and one fifth of maternal deaths are attributed to iron deficiency anemia during pregnancy (Micronutrient Initiative, 2009). It is reported that 25% of children under the age of six in Nigeria suffer from vitamin A deficiency, while 69% of children under five in Nigeria have iron deficiency anemia (Micronutrient Initiative, 2004). Forty-seven per cent of Nigerian women aged 15 to 49 suffer from iron deficiency anemia. Vitamin A and iron deficiencies have several negative health and economic consequences, including early mortality and reduced productivity. Vitamin A deficiency (VAD) leads to night blindness, corneal scarring and blindness in children under the age of five (Rice et al., 2004; Stein et al., 2005).

The new yellow root cassava varieties have the potential of providing up to 25% of daily vitamin A requirements of children and women. Since the presence of pro-vitamin A (β-carotene) in the new cassava could improve the nutritional status of the consumers, there is therefore a need to evaluate the adoption of these newly bred crops. Since cassava is a major staple food crop in Nigeria, consumption of this β- carotene cassava can help in combating vitamin A deficiency, which is a serious public health problem in many parts of the World. Formulation of different food products from these cassava varieties will also help to enhance its consumption (Bai et al., 2010; Sagar et al., 2009 and Omodamiro et al., 2011). Technology adoption by farmers is an essential pre-requisite for the economic prosperity in Nigeria. Ayinde et al. (2013) reported that in the past, producer cooperatives and state farms were the main users of the improved agricultural technology. However, in recent years, individual

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farmers have started to adopt and use the improved technologies including machineries and planting of improved seed varieties. However, many farmers show different attitudes towards the adoption of these agricultural technologies and this has greatly affected the availability of food in the economy. To further corroborate many other research on adoption, this study, therefore, seeks to identify the socioeconomic characteristics of adopters and non-adopters in the study area, determine the adoption level of vitamin A cassava among farmers, and examine the determinants of adoption among cassava farmers.

Materials and methods

The study was carried out in Oyo State, Nigeria. The state comprises thirty-three local government Areas which are grouped into four Agricultural Development Project (ADP) zones. The state lies between longitude 3° and 5° E and latitude 7° and 8° N, and covers an area of approximately 26,500 km^2. The state enjoys a tropical humid climate with two climatic seasons. The climate in the state favours the cultivation of crops like maize, Yam, cassava, millet, rice, etc. The data were collected using a three-stage random sampling techniques. All four zones are noted for cassava production. The first stage involved random selection of one local government area from each zone; the second stage involved a random selection of six villages from each local government area, while the third stage was a random selection of 10 respondents in each village to give a total of 240 respondents, which constituted the sample size for the study.

Data collected were processed using Microsoft Excel and STATA was the analytical software used for the analysis.

Analytical technique

The data collected were analysed with descriptive statistics, t-test was used to test for difference in socio-economic characteristics between adopters and non-adopters while logit regression model were used for the determinants of adoption. The factors that influenced adoption of vitamin A bio-fortified cassava varieties were examined using the binary logistic regression method. The classification was done to identify farmers that had planted at least one vitamin A bio-fortified cassava variety as adopters (1), and those that had not planted the vitamin A bio-fortified cassava varieties as non-adopters (0). The probability that a farmer would adopt was postulated as an interplay of some socioeconomic, demographic characteristics and institutional factors. Therefore, the Cumulative Logistic Probability Model is econometrically specified as:

$$P_i = F(Z_i) = F\left(\beta + \sum \beta_i X_i\right) = \frac{1}{1+e^{-Z_i}}$$

Hosmer and Lemeshow (1989) pointed out that the logit Model could be written in terms of the odds and log, which enables one to understand the interpretation of the coefficients. The odds imply the ratio of the probability (Pi) that a farmer would adopt to the probability that the farmer would not adopt:

$$(1 - P_i) = \frac{1}{1+e^{Z_i}}$$

$$\frac{P_i}{(1 - P_i)} = \frac{1 + e^{Z_i}}{1 + e^{-Z_i}} = e^{Z_i}$$

The natural Log Is given as:

$$Z_i = \ln\left(\frac{P_i}{1-P}\right) = \beta + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_i X_i$$

If the disturbance term (U_i) is taken into account, the Logit Model becomes:

$$Z_i = \beta + \sum_{i=1}^{n} \beta_i X_i + U_i$$

The decision to adopt improved cassava varieties by the farmers was significantly influenced by some socioeconomic factors, which conforms to the report of Omonona et al. (2006) and (Afolami et al., 2015). The variables include; X_1 = age of household head (years); X_2 = household size; X_3 = gender of household; X_4 = main occupation; X_5 = education of household head (years); X_6 = farming experience (years); X_7 = media; X_8 = contact with ADP extension agent; X_9 = access to vitamin A bio-fortified cassava stems; X_{10} =Income from other crops; X_{11}=association membership; X_{12}=ownership of farm land.

Results and discussion

Socioeconomic characteristics of respondent

Socioeconomic characteristics of farmers are major factors that contribute to most of their production choices. Moreover, they are mostly responsible for the rational decisions made during the production process. The results of the socioeconomic characteristics of farmers in the study area are presented in Table 2. The table showed that 40 percent of farmers in the study area have between 21-30 years of experience. According to Assefa and Van den Berg (2010), Mphinyane and Terblanché (2005), experience is important in adoption decision making. Education is also important in deciding upon the adoption; it is expected that an educated farmer may be more inclined to adopt a new technology (Nyaupane and Gillespie, 2009). 41.7% of the farmers have secondary education, only 22.5 per cent have tertiary education. Sources of stem for planting also showed that majority of the farmers use stems stored from previous season. This possibly indicates that their level of adoption is low in the study area.

Table 1. Socioeconomic characteristics of respondents

Farming experience	**Freq.**	**Percentage**
≤ 10 years	6	2.5
11 – 20	58	24.2
21 – 30	96	40
31 – 40	60	25
41 – 50	20	8.3
Total	**240**	**100**
Education	**Freq.**	**Percentage**
Male	218	90.8
Female	22	9.2
Total	**240**	**100**
Level of Education	**Freq.**	**Percentage**
No formal education	18	7.5
Primary education	68	28.3
Secondary education	100	41.7
Tertiary education	54	22.5
Total	**240**	**100**
Source of Planting Materials	**Frequency**	**Percentage**
By purchase	6	2.5
Stored ones from previous harvesting	160	66.7
Government through extension agents	22	9.2
Cooperative Society	2	0.8
Friends and farming groups	34	14.2
Total	**240**	**100**

Source: Field Survey, 2015. *significant at 10%, **significant at 5% & ***significant at 1%

Estimating the level of adoption of vitamin A bio-fortified cassava by the farmers

Despite the potential of vitamin A bio-fortified cassava variety to increase productivity and improve farmer's welfare, the adoption level of vitamin A bio-fortified cassava in the study area was 38.72%. This signifies a low level of adoption. This may be due to the low awareness of the cassava varieties among local farmers. It may also be a result of low access of farmers to vitamin A bio-fortified cassava stems in the study area.

Determinants of adoption of vitamin A bio-fortified cassava varieties

The factors that influenced the adoption of improved cassava varieties were examined using the binary logistic regression model (Afolami et al., 2015). Farmers that had planted improved variety during the investigation period were classified as adopters, and those that have engaged in the cultivation of traditional cassava varieties at the time of the survey were classified as non-adopters. The results from the logit model used in examining the factors that affect the adoption of vitamin A cassava varieties were obtained using a maximum likelihood estimation technique and are presented in Table 2. An additional insight was also provided by analyzing the marginal effects, which was calculated as the partial derivatives of the non-linear probability function, evaluated at each variable sample mean in line with Greene (2008), and also adopted by Afolami et al. (2015). The results from the logit model revealing the factors affecting the adoption of vitamin A, bio-fortified cassava varieties in the study area showed log-likelihood of -37.94, the pseudo coefficient of multiple determination (R^2) of 0.60 shows that 60% of the variation in farmers' decision to adopt vitamin A, bio-fortified cassava varieties in the study area was collectively explained by the independent variables. The LR (Chi^2) of 156.91 were all significant at Chi-square ($Chi^{2)}$), statistic of 91.39 was highly significant ($p < 0.001$) suggesting that the model has a strong explanatory power. This implies that the overall model had a good fit and the explanatory variables used in the model were collectively able to explain the farmers' decisions regarding the adoption of vitamin A bio-fortified cassava varieties in the study area. Among the variables, access to media, contact with extension agent, access to vitamin A bio-fortified cassava stem, and income from other crop production significantly increased the probability of adoption. Information about the improved variety is a necessary requisite to adoption, a farmer cannot adopt a technology without being aware of it (Diagne and Demont, 2007), therefore, access to media creates awareness and hence increases the probability of adoption.

Contact with the ADP extension agents had a positive and significant influence on the decision to adopt yellow cassava varieties. This is likely because contact with the ADP extension agents improves the level of the farmer's knowledge, exposure, as well as information on farming activities. This result is consistent with the findings of Orebiyi et al. (2005) and Ayinde et al (2010). Accessibility to yellow cassava stem and income from other crops also had a positive and significant influence on the decision to adopt yellow cassava variety, even though a farmer is aware of a technology; access to seed is also paramount in the adoption process. As noted by Dontsop -Nguezet et al. (2011), access to seed is a necessary condition for the adoption of a technology. Diversification into other crops can also generate and increase the farmers' income. Thus, income from other crops can positively influence the adoption with a significant level of 10% ($p < 0.1$).

This implies that the tendency of a farmer to adopt will increase by 6.43% if the income of the farmer increase.

Media can create awareness and hence increase the probability of adoption. Through the use of various forms of media, information about the available sources of inputs and prices can be passed to the farmers. Further, information can also be passed from one farmer to another. This has been found to positively and significantly (at $p < 0.05$) influence adoption of vitamin A bio-fortified cassava variety in the study area. Farmers who are exposed to the media have a likelihood of increasing the adoption of improved cassava varieties by 16.89% in the study area. This result is also in conformance with the findings of Afolami et al. (2015) who found that the use of radio increases the adoption of improved cassava varieties.

Farming experience was also negative and significant. This implies that the propensity to adopt decreases as experience in farming, measured by the number of years put into farming activities, increases. This could be due to the fact that farmers become more adapted to certain ways of doing things, and the process of adopting a new innovation is always difficult. The farmers that farm on a rented land also tend to have a higher probability of adopting a yellow cassava variety. This could be attributed to the desire to achieve a higher output per hectare in the study area. Farming, as the major occupation, is negatively significant at $p < 0.1$, which is consistent with the finding of Diagne and Demont (2007), and Afolami et al. (2015). Full time farmers spend more time on their farms and have less time to attend meetings and gatherings. The negative implications of this result could be the result of the farmers missing out information about the improved cassava varieties, since they do not attend meetings/trainings, therefore lacking the knowledge about the improved cassava varieties.

Table 2. Determinants of vitamin A bio-fortified cassava varieties adoption

Number = 240; LR $chi^2(18)$ = 156.91; Prob>Chi 2 = 0.000; Log-Likelihood = -37.94; Pseudo R^2 = 0.5959			
Variable	Coefficient	P>/Z/	Marginal effect
Household size	0.018	0.726	0.002
Main occupation	-3.219 ***	0.001	-0.121
Education (years)	0.045	0.436	0.002
Farming experience (years)	-4.431***	0.002	-0.359
Farmland ownership	-2.208*	0.070	-0.005
Age (years)	0.024	0.439	0.001
Contact with ADP extension agents	3.458***	0.000	0.159
Access to vitamin A bio-fortified cassava stem	3.801***	0.001	0.165
Gender	-0.301	0.738	0.002
Income from other crops	0.643*	0.008	0.003
Media	1.689**	0.008	0.011
Association membership	0.597	0.074	0.060**
Constant	-30.900	0.870	

Note: *** = ($p < 0.1$) Significant at 10 %, ** = ($p < 0.05$) Significant at 5 %, * = ($p < 0.01$) Significant at 1% Source: Field Survey Data, 2015.

Conclusion and recommendations

The study evaluates the adoption of vitamin A bio-fortified cassava variety among farmers in Oyo State. The study showed that adoption of this technologically improved cassava variety is very low among farmers. Determinants of adoption include; access to media, contact with extension agent, access to vitamin A bio-fortified cassava stem and the income from other crop production. The study hereby recommends that improved awareness about the new cassava technology should be prioritized to sensitize the farmers. Furthermore, stems of these cassava varieties should be readily made available to farmers to take advantage of the benefit of the innovation. Farmers should be encouraged to diversify their income to increase their socioeconomic status, and regular extension visits by the extension agents should be prioritized in order to educate the farmers.

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