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ADOPTION OF PRO VITAMIN A CASSAVA VARIETIES IN SOUTH-EAST AND SOUTH-SOUTH NIGERIA

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ABSTRACT
The study determined the level of adoption of pro vitamin A cassava varieties among farmers by investigating the technological attributes, level of adoption and influence of the technological attributes on the adoption. Four stages of random sampling procedure were used to select 480 cassava farmers. The data obtained were analyzed with rating scale and a probit regression model. The study revealed that the technological attributes of pro vitamin A cassava as viewed by farmers was positive ($\bar{x}$ = 3.7). Though the level of adoption of the varieties was high, some constraining factors such as high cost/scarcity of stem, inadequate information, amongst others were more or less retrogressive to the total adoption goal of vitamin A varieties. The study also revealed that high yield, early maturity, yellow root, accessibility and affordability influenced adoption. The study therefore recommended that both government and the pro vitamin A cassava developers should improve the nutritional information about the technology to sensitize farmers more and readily made available the stems of these cassava varieties to farmers to enable them take full advantage of the benefit of the innovation in Nigeria.

***Keywords**: Pro Vitamin A Cassava varieties, Farmers, Adoption, Technology Analysis*

INTRODUCTION

HarvestPlus project in 2013, collaborated with the International Institute of Tropical Agriculture (IITA), National Root Crops Research Institute and the International Center for Tropical Agriculture (CIAT) initiated crop development activities, with respect to bio-fortification in Nigeria (Onyeneke *et al*., 2018). Their work led to the approval and release of certain improved crop varieties in the Nigeria space, like the pro-vitamin A bio fortified cassava in 2011 (the most frequently used in this region). In an effort to boost the vitamin A micro nutrient availability in Nigeria, fortification of various staple such as cassava food meals was approved in 2000 (NRCRI. 2014; Ogbuokiri *et al*., (2014). Vitamin A deficiency retards growth; increases risk of disease, and can cause reproductive disorders (NRCRI, 2014). Improving cassava production with Pro Vitamin A could significantly improve nutrition and overall health, especially among poor communities (www.harvestplus, 2013). Genetic improvement of cassava by natural selective breeding is a very promising first line intervention; newly improved pro vitamin A cassava varieties with yellow roots have been released by the Nigerian government, stepping up efforts to tackle the problem of vitamin A deficiency especially in children (NRCRI, 2011; Egesi *et al*, 2014; Effiong *et al*., 2015). Pro vitamin A cassava varieties help to reduce the incidence of vitamin A deficiency in the rural communities (Etuk and Umoh, 2014). The first three pro vitamin A cassava varieties were released in 2011 by the National Variety Release Committee of Nigeria as UMUCASS 36, UMUCASS 37, and UMUCASS 38; and are recognized as IITA genotypes TMS 01/1368, TMS 01/1412, and TMS 01/1371 while the last three varieties released later were UMUCASS 44, UMUCASS 45 and UMUCASS 46 (NRCRI, 2014). The project works with national partners and the private sector to ensure that the pro-vitamin A-rich varieties reach resource-poor farmers in Nigeria (Abdoulaye *et al,* 2015).

Earlier studies by Bansode and Kumar, (2015) showed that, there is a strong and positive relationship between adoption and technological attributes of pro vitamin A cassava such as high yielding, early maturity, resistant to diseases, light yellow root, drought tolerant, early bulky/ canopy, stay green and are suitable to African environment and resistant to cassava mosaic virus (CMV) and so is cultivated by over 500,000 farmers. 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 today. Formulation of different food products from these cassava varieties will also help to enhance its consumption (Ayinde *et al*., 2016). Technology adoption by farmers is an essential pre-requisite for the economic prosperity in Nigeria. Ayinde et al. (2016) reported that in the past, producer cooperatives and state farms were the main users of the improved agricultural technology. However, in recent years, individual 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 much other research on adoption, this study, therefore, seeks to examine Influence of technological attributes of pro vitamin A cassava on adoption of the technology

Objectives

i. examine the technological attributes of pro-vitamin A cassava varieties by cassava farmers;
ii. determine the adoption level of pro vitamin A cassava varieties by cassava farmers; and
iii. identify constraining farmers militating against adoption of pro vitamin A cassava among cassava farmers in the study area.

Hypothesis. There is no significant relationship between the level of adoption of pro vitamin A cassava varieties and the technological attributes of the technology in the study area.

Methodology

The study was conducted in south-east and south-south Nigeria. In south-east, farming is the predominant occupation of the people, majority of who are small-holder farmers while in south-south, resident population (65%) are engaged in agricultural activities while (35%) of them are into oil activities. The population of the study consisted of cassava farmers in the study area purposively selected from Imo and Anambra States representing south east and Akwa Ibom and Delta states representing south-south Nigeria. This was because pro vitamin A cassava had been massively disseminated in those areas. Multistage sampling technique was used in selecting the sample size of 480 respondents cumulatively chosen from the four states. The first and second stages involve purposive selection of eight agricultural zones and twenty-four blocks from the four states. In the third stage, forty-eight circles were randomly selected from the blocks. Finally, ten pro vitamin A cassava farmers were randomly selected from the

circles, giving one hundred and twenty respondents from each state and a total of 480 respondents from Imo, Anambra, Delta and AkwaIbom States, Nigeria in 2018. A well-structured questionnaire and Focus Group Discussion (FGD) were used to elicit information from the respondents to achieve the study objectives which were in sub-sections. Objective one was measured on a 5 point rating scale. In using the 5 point rating scale, a mid-point was obtained, which gave a mean score of 3.0. For the purpose of decision making, an upper limit was established. This implied that any mean score response above the upper limit was adjusted to indicate acceptable attributes of pro vitamin A cassava by farmers. Objective ii was measured on a seven point likert rating scale adoption analyses and as was used by Okoye *et al*. (2018). Respondents with mean score of 3.00 and above imply increased probability of adoption while respondents with mean score less than 3.00 imply probability of not adopting. To determine the mean likert level =Xs = ΣX. Xs of each item were computed by multiplying the frequency of each response pattern with its appropriate nominal value and dividing the sum with the number of respondent to the items. This can be summarized with the equation below:

$Xs = \frac{\Sigma fn}{nr}$

Where;

$\bar{X}$ = Mean score

Σ = Summation

f= Frequency

n= Likert nominal

n_r= number of respondents

$\overline{X} = \frac{0+1+2+3+4+5+6=}{7} = \frac{21}{7}$ = 3.0

While the hypothesis was analyzed using probit regression model.

Results and Discussion

Technological Attributes of Pro Vitamin A Cassava Varieties

The result in Table 1 showed the technological attributes of pro vitamin A cassava by farmers in the study area. The overall result on a 5-point scale was positive with a grand mean of $\bar{\mathbf{x}}$ = 3.7 which was greater than the decision mean cut-off of 3.00. The overall view of farmers on technological attributes of pro vitamin A cassava were high yielding ($\bar{\mathbf{x}}$ = 4.11), early maturity , ($\bar{\mathbf{x}}$ =4.13), resistant to disease , ($\bar{\mathbf{x}}$ =4.03), yellow root ($\bar{\mathbf{x}}$ =4.04), drought tolerant ($\bar{\mathbf{x}}$ =3.98),

decays easily ($\bar{x}$ =4.03), soil selection ($\bar{x}$ =4.01), accessibility ($\bar{x}$ =2.79) and compatibility ($\bar{x}$ =3.66) with early maturity having the highest mean score of $\bar{x}$ = 4.13. The implication is that the positive knowledge of the attributes of the technology among farmers virtually ran across the study areas and is a crucial factor in adoption. This is in line with the findings of Njoku *et al,* (2014) who noted the farmer-preferred traits. In addition, Imo state had a grand mean score of $\bar{x}$ = 3.6, Anambra State was $\bar{x}$ = 3.7, Delta state was $\bar{x}$ = 3.5 while AkwaIbom state had a grand mean score of $\bar{x}$ = 3.8. The positive knowledge of the attributes of the technology among farmers virtually runs across the study areas and is a crucial factor in adoption. Earlier studies by Bansode and Kumar (2015) and Harvestplus (2013), showed that there was a strong and positive relationship between adoption and technological attributes of pro vitamin A cassava and are suitable to African environment and resistant to cassava mosaic virus (CMV) and so is cultivated by over 500,000 farmers.

Table 1: Technological attributes of pro vitamin A cassava varieties by farmers

Variables	Imo(n=120)		Anambra (n=120)		Delta(n=120)		Akwa Ibom (n=120)		Pooled (n=480)	
	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD
High yielding	4.01	.128	4.20	.401	4.12	.356	4.11	.663	4.11	.4352
Early maturity	4.00	.2401	4.23	.424	4.02	.329	4.26	.561	4.13	.4054
Resistant to diseases	3.90	.3975	4.15	.3585	4.16	.4490	4.01	.6284	4.05	.4805
Yellow root	3.67	.7021	4.33	.4733	4.03	.3771	4.03	.5020	4.04	.5956
Drought tolerant	4.01	.2749	4.07	.4703	3.95	.3137	3.88	.7839	3.98	.5062
Decays easily	4.06	.2354	4.14	.3502	3.98	.1285	3.92	.6022	4.03	.3814
Soil selection	4.01	.1586	4.08	.2645	3.98	.1568	4.09	.5864	4.01	.3076
Accessibility	2.45	.7970	2.20	.602	2.59	1.192	3.94	.7252	2.79	1.091
Compatibility	4.00	.2401	4.06	.2687	3.52	.6858	3.08	1.185	3.66	.8005
Grand mean	**3.6**		**3.7**		**3.5**		**3.8**		**3.7**	

Source: Field survey, 2019.

*Decision >3.00 indicate acceptable attributes; <3.00 indicates unacceptable attributes.

Level of adoption of pro vitamin A cassava varieties

Table 2 shows the mean scores distribution of the level of adoption of pro vitamin A cassava varieties in the study area. The overall level of adoption of pro vitamin A cassava by the

respondents in South-East and South-South Nigeria on a 7-point scale was high with a grand mean of ($\bar{x}$ =3.04) which is greater than the decision mean cut-off of 3.00 with UMUCASS 36/TMS011368 having the highest mean adoption score of ($\bar{x}$ =3.29) and standard deviation of (± = 5.986), followed by UMUCASS 37/TMS1011412 ($\bar{x}$ =3.26) and (± = 1.885) and UMUCASS 44/TMS070220 ($\bar{x}$ =3.23) and (± = 3.578) in south east and south south, Nigeria. On the other hand, UMUCASS 38/TMS1011371 ($\bar{x}$ =2.99) and (± = 1.164) and UMUCASS 46/TMS1070539 ($\bar{x}$ =2.88) and (± = .3821) were at the trial stage while UMUCASS 45/TMS1070593 ($\bar{x}$ =2.60) and (± = 4.926) was at the evaluation stage in south east and south south, Nigeria. This implies that quality of the varieties could have driven the adoption process in the locations. This finding is in accordance with the report of Abdoulaye *et al,* (2015) who stated that several factors could drive the adoption process.

Table 2: Level of adoption of pro vitamin A cassava varieties in the study area

	Imo		**Anambra**		**Delta**		**AkwaIbom**		**Pooled (480)**	
VARIETIES	**$\bar{x}$**	**SD**	**$\bar{x}$**	**SD**	**$\bar{x}$**	**SD**	**$\bar{x}$**	SD	**$\bar{x}$**	**SD**
UMUCASS36,TMS011368	3.01	2.933	3.47	1.260	3.05	.3794	3.63	1.414	3.33	5.986
UMUCASS37TMS1011412	3.06	1.468	3.35	1.581	3.01	2.933	3.65	1.558	3.31	1.885
UMUCASS38TMS1011371	3.05	3.794	3.12	1.413	2.09	1.260	3.68	.5249	3.23	3.578
UMUCASS44TMS070220	2.81	2.923	3.02	.8760	2.91	.3326	3.23	.5239	3.00	1.164
UMUCASS45TMS1070593	2.07	.4213	3.00	2.943	2.21	.1574	2.94	.2933	2.99	4.926
UMUCASS46TMS1070539	2.77	.2353	2.95	2.933	2.69	.1285	3.13	.5239	2.99	3.821
Grand mean	**2.99**		**3.15**		**2.83**		**3.37**		**3.10**	

Source: Field Survey, 2019 *Decision >3.00 indicate adopted; <3.00 not yet adopted

*Decision >3.00 indicate acceptable attributes; <3.00 indicates unacceptable attributes.

Constraining factors-against adoption of pro vitamin A cassava varieties

The constraining factors against adoption of pro vitamin A cassava in Table 3 shows that the overall result on a 5 point rating scale had a grand mean score of 3.4 which is greater than the decision mean cut-off of 3.0 with inadequate fund ($\bar{x}$ = 4.72). The finding is in agreement with the work of Bai, Remadevi, Bala and Janard, (2010) who observed that inadequate capital is one of the major developmental challenges facing farmers in Nigeria. Other serious constraints were high cost/scarcity of stem, high cost of labour/farm input, herdsmen/ cattle menace, undesirable traits due to instability of vitamin A during processing, dissemination approaches, marketing problems, inadequate information about the technology and poor extension contacts. The implication is that these factors are more or less retrogressive to the dissemination and total adoption goal of the vitamin A varieties. Similarly, Olatade *et al.* (2016) and Onyeneke *et al*. (2018) identified; access to credit, access to market and to a lesser extent, size of farmland, access to labour supply as limiting factors to adoption of the bio-fortified vitamin A cassava varieties in Oyo state. According to Bouis *et al.*, (2017) mineral content retention of the cassava varieties is a less desirable trait because the vitamin A oxidizes over time and also reduces based on the type of processing used due to severe heating processing methods such as boiling at high temperatures, roasting, frying and it can lead to large losses of carotenoids and isomerization.

Table 3: Constraining factors against adoption of pro vitamin A cassava varieties

Perceived factors	**Imo(n=1220**		**Anambra**		**Delta(n=120)**		**AkwaIbom**		**Pooled**	
	$\bar{x}$	**SD**	$\bar{x}$	**SD**	$\bar{x}$	**SD**	$\bar{x}$	**SD**	$\bar{x}$	**SD**
High cost/scarcity of stem	3.93	.5142	3.95	.3136	4.18	.4488	4.00	.7447	4.46	.5365
Dissemination approaches	2.81	.8916	2.17	.5550	2.29	.6785	3.72	.9973	3.99	1.004
Marketing problems	4.13	.4086	2.30	.7053	2.11	.4986	2.00	1.107	3.64	1.137
Poor extension contact	4.03	.2879	3.94	.3252	2.28	.6633	2.43	1.255	3.17	1.103
Undesirable traits	4.23	.4247	3.99	.2048	3.58	.9489	3.34	1.191	4.00	.8673
High cost of labour/farm inputs	4.30	.4602	3.99	.2048	4.07	.3831	3.70	1.017	4.24	.6346
Inadequate information	3.64	.9148	3.87	.4839	3.59	.9393	2.17	1.286	3.46	1.039
Inadequate fund	4.66	.4763	4.96	.2389	4.65	.4787	4.63	.7092	4.72	.5204
Herdsmen/cattle menace	4.08	.3469	4.01	.0913	4.05	.2188	4.08	.6022	4.05	.3672
Grand mean	**3.4**		**3.1**		**3.2**		**3.2**		**3.4**	

Sources: ***Field survey, 2018*** *Decision >3.00 indicates serious factor; <3.00 indicates unserious factor.

Influence of technological attributes of pro vitamin A cassava on adoption of the technology

The Probit estimates of level of adoption of pro vitamin A cassava and the technological attributes of the technology are presented in Table 4. Five out of seven explanatory variables were significant at 1%, 5% and 10% alpha level of probability. The result revealed that high yielding of the technology was statistically significant at 5% level of probability and was directly related to the adoption of pro vitamin A cassava. This direct relationship means that better technological attributes will lead to an increase in the adoption of pro vitamin A cassava in the study area. This result is in tandem with the reports of IITA, (2017). Nwakor (2010) also corroborate with the result by stating that improved cassava varieties have high yielding, rapid growth and early maturity attributes which attract farmers to adopt.

The coefficient of early maturity was also significant at 5% level of probability and directly related to the adoption of pro vitamin A cassava. This implied that as the technological attributes in the variables of early maturity increases, the adoption of the pro vitamin A cassava becomes higher and more positive. This implied that majority of farmers adopt technologies that mature early in order to harvest, consume, dispose and also make profit. This result confirm with the reports from IITA, NRCRI and HarvestPlus, (2016) which stated that pro vitamin A cassava varieties mature early within 10 to 12 months. The coefficient of yellow root colour of pro vitamin A cassava was positive and significant at 10% level of probability in the study area. This implied that yellow colour of pro vitamin A cassava varieties attract farmers to adopt the technology. According to Ayinde *et al.* (2016), the roots of these varieties are yellow compared to other white improved cassava varieties and also contain moderate levels of pro-vitamin A that can take good care of vitamin A deficiency among the growing population. This yellow trait enhances adoption of the technology in the study area.

The coefficient of accessibility of pro vitamin A cassava was positive and significant at 1% level of probability in the study area. The implication of these is that a unit increase in the accessibility of the pro vitamin A cassava will also increase the level of adoption and usage of the technology in the study area. This finding agrees with the research findings of Ekweanya, (2017) that a unit increase in the accessibility of a technology increases the unit of transfer of the technology by making it easier to utilize. It also agrees with the findings of Abdoulaye *et al*., (2015) which stated that accessibility of pro vitamin A cassava varieties was found to have

a positive influence on adoption of bio-fortified cassava in Oyo State due to the proximity to research institute like IITA and higher dissemination of information thus increasing adoption of improved technology.

The coefficient of affordability of pro vitamin A cassava was significant at 5% and positively related to the level of adoption of pro vitamin A cassava in the study area. This implies that an increase in the affordability of pro vitamin A cassava among farmers would lead to the adoption of pro vitamin A cassava in the study area. This is an indication that the technological attributes of the technology influences the level of adoption and usage of pro vitamin A cassava. A technology that is costly will not be easily adopted compared to an affordable and less expensive type.

Table 4: Probit Estimates Analysis of the influence of technological attributes on the level of adoption of pro vitamin A cassava in the study area

Variables	**Imo**	**Anambra**	**Delta**	**AkwaIbom**	**Pooled**
High Yielding	1.341	.445	3.426	1.300	1.258
	(2.01*)	(.126)	(.641)	(5.69***)	(2.05**)
Early Maturity	1.271	.415	2.271	7.409	1.752
	(3.35***)	(2.14**)	(1.331)	(2.82**)	(2.56**)
Yellow root	1.277	.482	2.504	1.702	.656
	(2.73**)	(117)	(.350)	(2.79**)	(2.02*)
Accessibility	.452	2.170	1.910	2.071	.669
	(.000)	(.3431)	(3.666***)	(5.26***)	(3.922***)
Affordability	.540	1.712	1.815	1.387	2.120
	(.032)	(6.212***)	(5.24***)	(.465)	(2.343**)
Complexity	1.003	2.453	2.351	1.785	.701
	(2.87**)	(.002)	(.117)	(.022)	(.5984)
Compatibility	1.147	1.147	2.358	2.753	.797
	(.819)	(.819)	(.623)	(3.39***)	(.3354)
Chi Square (X^2)	**26.197*** **	**29.180*** **	**40.752*** **	**0.000*** **	**55.272*** **
Log likelihood	**83.728**	**128.726**	**73.635**	**53.001**	**419.28**
Pseudo R^2	**0.501**	**0.523**	**0.414**	**0.651**	**0.622**

Source: Field Survey, 2018. Keys: Significant at 1% ***, Significant at 5% **, Significant at 10% * level of probability

Conclusion

The study examined the adoption of pro vitamin A cassava varieties by farmers in south-east and south-south Nigeria. Pro vitamin A cassava attributes have a lot of bearing on farmers' adoption of the technology. Though the level of adoption of the six varieties was high, some constraining factors such as inadequate funding, high cost/scarcity of stem, high cost of labour/farm input, herdsmen/ cattle menace, undesirable traits due to instability of vitamin A during processing, dissemination approaches, marketing problems, inadequate information about the technology and poor extension contacts are more or less retrogressive to the total adoption goal of the vitamin A varieties in the study locations. High yielding, early maturity, yellow root, accessibility and affordability influenced adoption. The study hereby recommended that both government and the technology developers should improve nutritional information about the new cassava to sensitize the farmers more and readily made available the cassava stems to farmers to take full advantage of the benefit of the innovation in Nigeria.

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