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# ADOPTION OF ROOT AND TUBER TECHNOLOGIES AMONG FARMERS (AGRICULTURAL DEVELOPMENT PROGRAMME -ADP)

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**Abstract**

This paper analyzed the adoption rate of root and tuber technologies in Anambra state Agricultural Development Programme. Specific objectives were to ascertain the root and tuber expansion programme (RTEP) technologies, find out the extension methods and level of access to extension services among members of farmers based groups and to assess the farmers' awareness on various varieties of root and tuber technologies. Three hypotheses were formulated to test the effect of variables on the adoption rate. Stratified random sampling techniques were used to determine the sample size of 112 including the farmers and RTEP staff. Findings showed that various varieties and technologies promoted in the area by RTEP were ABANA 85, ADAKA 96 and EKPE 88 for Yam, while TMS 305SS, TMS 30 and TMS 30572 for Cassava and White P. 179 and RED P. 162 for Potatoes. Comparatively the income levels of the farmers remained unchanged but they expressed satisfaction with the use of RTEP technologies.

Keywords: Root–and-Tuber expansion, sustainability, technology, agricultural development.

**Introduction**

Roots and tubers mostly notably cassava, sweet potato, yam and potatoes (Solanum/Irish) are some of the most important primary crops. They play critical roles in the global food system, particularly in the developing world, where they rank among the top 10 food crops (Philips *et.al.*, 2004, Nweke 2004). By 1997, the production of roots and tubers in developing countries had an estimated annual value of more than 41Billion U.S dollars and this is nearly one fourth the values of the major cereals (World Bank, 2004). Roots and tubers contribute to the energy and nutrition requirements of more than 2 billion people. They constitute an important source of income in rural and marginal areas and have multiple uses, most notably as food security crops, regular food crops, cash crops and more also are increasingly used as livestock feed and raw material for industrial purpose, (Anazodo, 1989).

Historically, the production of roots and tubers in Nigeria has been restricted to assuring food security (Adewumi et al., 2005). Due to lack of participatory policy making and institutional development, virtually all succeeding government neglect their product (Asoegwu and Asoegwu, 2007) and trade in favour of oil (crude oil) and cash crops such as tea, coffee, cotton, and cocoa (Nweke, 2004). This however, long neglect of roots and tubers led to prolonged use of (not necessarily high yielding) traditional varieties and production techniques.

According to FAO (2000), Nigeria produces roughly 46% of all the root and tuber crops in Africa, being the biggest producer of cassava and yam. FAO (2000), maintained that root and tuber crops contribute more than 600 calories per capital per day in countries like, Angola, DRC, Congo-Brazzaville, Central African Republic, Mozambique, Ghana, Cote d'Ivoire, Rwanda, Togo and Benin. Despite the importance of roots and tubers in Africa, African and Nigerian food/Agricultural policy over the last half a century has fail on achieving growth and self-sufficiency (Ekpere, 1995) in cereals such as wheat, rice and maize. Growth rates in roots and tubers over this period largely driven by expansion programme as opposed to yields resulting from technological innovations such as improved varieties and production techniques (Nweke, 2004).

Phillips *et al*, (2004) observed that, demand for cassava in Nigeria is increasingly gaining market presence as a result of its increased use as processed food, with rural and urban consumption patterns becoming increasingly similar. Cassava appears to be a food of

choice even in the face of alternative food options in urban areas (I.I.T.A, 2011). This means that it is finally challenging its stigma as a less desire crop.

Nigerian government in their effort to encourage farmers and increase roots and tubers crop production came up with Root and Tuber Expansion Programme (RTEP). According to Ugwu, *et al* (1996), RTEP was designed by the Food and Agricultural Development Organization in conflict with the Federal Government of Nigeria following the completion of Cassava multiplication Project (CMP). They further, put it that, the International Fund for Agricultural Development (IFAD) approved a credit of 23.05million U.S. Dollars to the Federal Government of Nigeria for RTEP. The main thrust of the programme was to consolidate gains made under the Cassava Multiplication Programme (CMP) in order to enhance national food security and income for poor farmers.

According to the RTEP implementation manual (PIM, 2001 and NADP, 2003), the programme focuses on available low-cost technologies that can be easily adopted by poor farmers, a combination of improved cassava, yam, direct potatoes and cocoa yam varieties, given the high cost of inputs and the restricted access to credit by small scale farmers. Hence, RTEP aims at exposing farmers to improved root and tubers crops production and processing techniques designed to fit into the existing root and tuber based farming systems in Nigeria.

Information on the adoption rate of root and tuber technologies among farmers' organization is limiting. It is useful to evaluate the adoption rate of root and tuber technologies among farmers-based organization. Therefore, this study was designed to; (1) assess the farmers' awareness and various varieties of root and tuber technologies, (2) assess the adoption of the RTEP technologies among farmers in different zones in Anambra State and (3) evaluate the level of adoption of improved varieties for cassava, yam and potato

**Hypotheses**

$Ho_1$: There is no significant relationship between farmers' socio-economic characteristics and level of adoption of RTEP technologies.

$Ho_2$: There is no significant relationship between the farmers' access to extension services and adoption of RTEP technologies.

$Ho_3$: There is no significant relationship between value-addition (processing) among the farmers and the overall outcome of the RTEP.

**Research Methodology**

The methodology used in this study is presented under the following subheading research design, area of the study, population of the study, sample size and sampling techniques, administrations of questionnaire, data collection and data analysis.

**Research Design**

This study is a descriptive survey which aims to evaluate the adoption rate of root and tuber technologies in Anambra State Agricultural Development Programme. Research survey according to Olofin, (2003), consists of asking questions, collecting and analyzing data from supposedly representative members of the population at a single point in time with a view to determining the current situation of that population with respect to one or more variables under investigation.

**Area of the study**

This study was conducted in Anambra state which is located in the South East zone of Nigeria. It is located on latitude of $6^0$ $12^1$ N and longitude $7^0$ $34^1$ E. It has a land mass of about 4.2 million (Anambra State Ministry of Information, 2006). Anambra state has 21 local government areas including Awka South where the State capital, Awka is located. The key economic activities of the inhabitants of the State include; farming, trading and civil service. The major crops produced in the state include yam, cassava, maize and rice. ADP which covers the entire state operates through three (3) geo-political structures.

**Population of the study**

The population of this study consists of all registered farmer-based groups (cooperatives) involved in the programme under ADP and all the staff of RTEP-ADP Anambra state. According ASADEP (2009), a total of 76 farmers groups (covering 14 processing groups and 62 out growers and multiplication groups) were registered and participated all over the state with members strength of each group ranging from 15 – 25 members. Out of 257 members spread across the zones (Table 1), 90 farmers-based groups and 22 staff of RTEP-ADP in the state were only considered for the population of the study based on the sampling technique.

**Table 1: Farmers-based groups root and tuber expansion programme in Anambra State.**

| Geo-Political Zone | Name of the group | No of members | Percentage % |
|---|---|---|---|
| Anambra zone | Anambra East<br>Anambra West<br>Ayamelum<br>Oyi | 80 | 31% |
| Awka Zone | Anaocha<br>Awka North<br>Awka South<br>Dunukofia<br>Njikoka | 67 | 26% |
| Onitsha Zone | Ekwusigo<br>Idemili North<br>Idemili South<br>Ihiala<br>Ogbaru<br>Onitsha North<br>Onitsha South | 110 | 43% |
| **Total** | | 257 | 100% |

**Sample size and sampling techniques**

The three (3) geo-political zones were purposively sampled in the state. Three (3) out of the ten farmer groups in the selected zones were randomly selected of which thirty (30) farmers were randomly selected from each of the three (3) groups. This gave a total of ninety (90) farmers participating in RTEP added to 22 staff of RTEP-ADP. Hence, a total of one hundred and twelve (112) respondents were considered for the study as the sample size.

**Sources of data**

Primary data were sourced through the administration of structured questionnaire, and personal interaction with RTEP coordinator in the state and other field staff. While secondary data were obtained through extensive review of relevant textbooks, journals, seminar papers as well as data collected on household socio-economic characteristics, inputs and output levels.

**Description of data collection instrument**

Structured questionnaire was the major data instrument open-ended and multiple choice questions were administered to the respondents and staff of RTEP–ADP. Though,

personal interaction with the field coordinator of the RTEP, additional information that helped in this finding was provided.

**Validation and reliability of data**

The validity of the measurement according to Ugwu, *et al.*, (1996) refers to the degree in which an instrument measures what its supposed to measure, while reliability is concerned with the degree in which a test instrument consistently measure what it measured. The measuring instrument used in this study was carefully designed in a systematic way that enabled sound opinion, factual and interpretative information pertinent to the purpose and objective of the study from the respondents.

On the validity and reliability of this study, a pilot study was conducted in Awka South using 10 respondents (members) of cooperative societies in the study area. This allows appropriate conducted test instruments to be used in the main study after considering the observed limitations. Hence, the final instrument that ensured sound and compatible data collection and analytical tools were used in this work.

**Method of data analysis**

Data collected during the field survey were descriptively analyzed using simple percentage and frequency distribution models.

**Hypothesis testing**

Linear regression model of the ordinary least square (OLS) approach was used to test the hypothesis so as to ascertain the effect of socio- economic characteristics of farmers-based group on the level of adoption of RTEP technologies. The model is implicitly specifies as follows:

$Y = f(x_1, x_2, x_3 \ldots\ldots Xn + ei)$ …… eq (1)

The model is explicitly specified as follows,

$Y = a + B_1 X_1 + B_2 x_2 + B_3 X_3 + B_4 X_4 \ldots\ldots B_K X_K + ei$ …… eq (2)

The double log form of the model is specified thus:

$\text{Log } Y = \alpha + B_1, \text{Log } x_1, + B_2 \text{Log } x_2 + B_3 \text{Log } X_3 \ldots\ldots\ldots B_K \text{ Log } x_K + ei$ ……. eq (3)

Where;

**α**= intercept, **y**= Level of adoption, $\mathbf{B_1 - B_q}$ = Regression co-efficient, **ei** = Error term designed to capture the effects of unspecified variables in the model., $\mathbf{X_1}$ = Age of farmer

(yrs), $\mathbf{X_2}$ = Sex, (0 = male, 1 = female), $\mathbf{X_3}$ = Marital status , $\mathbf{X_4}$ = Level of education (yrs), $\mathbf{X_5}$ = Household size (number of persons),

The α and Bs are the parameters for estimation and the error terms. The regression analysis using SPSS computer package determine the order of importance of the explanatory variables in explaining the variation observed in the dependent variables. The t-test was also performed to test the significance of each of the explanatory variables at the alpha levels of 5%.

Pearson correlation model at 5% significant level was used to test the hypotheses so as to ascertain the relationship between the farmers' access to extension services and the level of adoption of RTEP technologies. Decision was made based on the results between -1 and 1. A result of -1 means that there is a perfect negative correlation between the two values, while a result of 1 means that there is a perfect positive correlation between the two variables. A result of 0 means that there is no linear relationship between the two variables.

**Results and discussion**

The socio–economic characteristics of the respondents surveyed were carried on the selected agricultural cooperatives or farmers groups in the study area. Information presented on Table 2 reveals 51.1% of the respondents were male and 48.9% female. The majority of the respondents were observed to be married with 61.1% response. The age bracket of majority of the respondents fell between 21 – 60 years. Table 3 further revealed that, 31.1, 37.8, 12.2 and 18.9% of the respondents had their primary, secondary, tertiary and no formal education respectively. Also, 48.9% of the respondents have been members of their groups for a period of 4 to 10yrs. Most farmers groups have membership size ranging from 10 to 20, 38.9% of the respondents are into farming and business or trading. While 31.1% of the respondents have the family size between 1 and 5, 45.6% have a family size between 6 and 10 and 12.2% of them had none.

On the land area owned by farmers, 21.1% of the respondents owned a land space between 0 to 1.9 ha, 43.3% owned between 2 to 3ha, 20% of them owned between 4 – 5ha and 15.6% owned from 6 ha and above. In view of the above observations, it therefore implies that, majority of the respondents are married male and most of them aged between 41 – 60 years showing the level of soundness and maturity on the calibre of members (farmers) to effectively run their farm activities with little or no supervision. More also, implies that,

their educational level is not a barrier for them to read and write. In all, their socio – economic status is assumed to be at a significant that can positively impact their economic activities in the study area. This is in agreement with the earlier reports of Ekwere and Edem (2014) that significantly high value of coefficient of determination (R2= 0.922) that reflected a high relationship between the dependent variable and the independent variables of socio – economic status. Approach and level of access to extension services by farmers in the area was observed as low.

The regression analysis of data revealed that significantly low degree of relationship existed between the adoption of RTEP and the socio-economic traits of age, education, gender, marital status, occupation, household size, and land size owned. Also, 22% of the variation in the adoption rate is explained by the changes in variables in the model.

With regards to the effect on individual farmers, it further suggests that, change in education and marital status could lead to either increase or decrease in the farmers' level of RTEP Technologies adoption. As shown on the Table 3, RTEP technologies most commonly promoted by the ADP in the area include: Yam - ABANA 88, ADAKA 96 and EKPE 88 with 31.8, 27.3 and 9.1% respectively. For Cassava; that rate of TMS 305SS adoption was 50%, TMS 30 was 13.6%, whereas only 22.7% for TMS 30572. On the varieties of Potatoes; it was revealed that Potatoes WHITE P.179 and RED P.162 were promoted by the farmers, with 22.7% preferring WHITE P.179 while 54.5% confirmed RED P. 162. Also, RTEP–ADP yam varieties like ABANA 85, ADAKA 96 and EKPE 30 were mostly adopted by the farmers in the area.

**Table 2: Socio-economic characteristics of the Respondents in Anambra**

| Variables | | Frequency (f) | Percentage (%) |
|---|---|---|---|
| **Gender** | Male | 46 | 51.1 |
| | Female | 44 | 48.9 |
| **Marital Status** | Single | 14 | 15.6 |
| | Married | 55 | 61.1 |
| | Divorced | 9 | 10 |
| | Widow/widower | 12 | 13.2 |
| **Age Distribution** | 1 – 20 years | 19 | 21.1 |
| | 21 – 40 years | 27 | 30.9 |
| | 41 – 60 years | 35 | 38.9 |
| | 61 and above | 9 | 10 |
| **Educational Qualification** | Primary | 28 | 31.1 |
| | Secondary | 34 | 37.8 |
| | Tertiary | 11 | 12.2 |
| | No formal education | 17 | 18.9 |
| **Duration of Membership** | 1 – 3yr | 25 | 27.8 |
| | 4 – 10yrs | 44 | 48.9 |
| | 11 – 16yrs | 19 | 21.1 |
| | 17yrs and above | 2 | 2.2 |
| **Membership Size** | 10-15 | 40 | 44.4 |
| | 16 - 20 | 40 | 44.4 |
| | 21 - 40 | 6 | 6.7 |
| | 41 and above | 4 | 4.4 |
| **Occupation** | Farming only | 8 | 8.9 |
| | Farming/Trading | 27 | 30 |
| | Farming/Civil servant | 13 | 14.4 |
| | Farming/Schooling | 7 | 7.8 |
| | Farming/Business | 35 | 38.9 |
| **Household Size** | 1-5 | 28 | 31.1 |
| | 6-10 | 41 | 45.6 |
| | 11-15 | 10 | 11.1 |
| | None | 11 | 12.2 |
| **Land Area Owned** | 0 – 1.9 ha | 19 | 21.1 |
| | 2 – 3 ha | 39 | 43.3 |
| | 4 – 5 ha | 18 | 20 |
| | 6 ha and above | 14 | 15.6 |

**Table 3. Rate of RTEP technologies adoption in the study area.**

| VARIABLES | Freq. | % |
|---|---|---|
| **Improved varieties for Yam** | | |
| ABANA 85 | 7 | 31.8 |
| ADAKA 96 | 6 | 27.3 |
| EKPE 88 | 2 | 9.1 |
| All of the above | 4 | 18.2 |
| None of the above | 3 | 13.6 |
| | **22** | **100** |
| **Improved varieties for Cassava** | | |
| TMS 305SS | 11 | 50.0 |
| TMS 30 | 5 | 22.7 |
| TMS 30572 | 3 | 13.6 |
| All of the above | 3 | 13.6 |
| None of the above | - | - |
| | **22** | **100** |
| **Improved varieties for Potatoes** | | |
| WHITE P. 179 | 5 | 22.7 |
| RED P. 162 | 12 | 54.5 |
| All of the above | 5 | 22.7 |
| None of the above | - | - |
| | **22** | **100** |

Table 4 revealed that 54 (60%) of the respondents were aware of various varieties of root and tuber technologies available in the state, while 36 (40%) were not. On the exposure to agronomic practices by the RTEP in the study area, it was further revealed that, 13 (14.4%) used recommended spacing method, 30% adopted sole cropping, 23.3% used fertilizers, while 17.8% used herbicides and 3.3% used pesticide. And on their reasons for adoption preference, it was also revealed that 30% based adoption to high yielding, 40% of them based on high dry matter content, whereas 16.7% was due to disease resistant and 13.3% adopted the technology due to high product quality. This implies that, the majority of

the respondents in the study are actually aware of the various varieties of root and tuber technologies available in the area.

Furthermore, Table 4 results clearly showed that 13 (14.4%) of the respondents income level before they adopted RTEP technologies was very high. while 22 (24.4%) of them had high income level. Others were: Moderate, 44.4%; 12.2% earned low income level before the adoption, and 4.4% had very low income before the adoption of the technology.

**Table 4. Distribution of respondents based on the farmers' awareness and preference for various varieties of root and tuber technologies in the study area.**

| VARIABLES | Freq. | % |
|---|---|---|
| **Which among these agronomic practices are you exposed to?** | | |
| Recommended spacing | 13 | 14.4 |
| Sole cropping | 27 | 30.0 |
| Use of fertilizer | 21 | 23.3 |
| Use of herbicides | 16 | 17.8 |
| Use of pesticides | 3 | 3.3 |
| All of the above | 10 | 11.1 |
| | **90** | **100** |
| **Are you aware of improved varieties available at the RTEP?** | | |
| Aware | 54 | 60.0 |
| Not Aware | 36 | 40.0 |
| | **90** | **100** |
| **Which among these could be reason for adoption?** | | |
| High yielding | 27 | 30.0 |
| High dry matter content | 36 | 40.0 |
| Disease resistant | 15 | 16.7 |
| High product quality | 12 | 13.3 |
| | **90** | **100** |
| **How was your income level before you adopted RTEP?** | | |
| Very High | 13 | 14.4 |
| High | 22 | 24.4 |
| Moderate | 40 | 44.4 |
| Low | 11 | 12.2 |
| Very Low | 4 | 4.4 |
| | **90** | **100** |

Table 5 revealed that, 11.1, 24.4, 43.3, 16.7 and 4.4% of the respondents were actually practicing recommended spacing, sole cropping, applications of fertilizer, herbicides, and pesticides respectively. On the failure of some to adopt the improved technologies promoted by RTEP, it was revealed that, 44.4, 38.9 and 16.7% of the respondents were attributed this to High cost of the technology, none availability of the technology in the study area and superiority of their old practice to the new technology respectively. This implies that majority of the respondents actually adopted these improved technologies, but few who did not, but based their reason to the high cost of the improved technology. Also, the respective challenges faced the implementation and sustainability of the RTEP programme in the study area were; Rodent Termite, Cassava Mosaic, Cassava Mealy Bug, Bacteria B. and Grasshopper at hindrance rate of 13.6, 59.6, 13.6, 9.1 and 4.5%. Again on the degree of severity of this challenge, the majority of the respondents firmly agreed that, these problems to some extend affected their income level and overall performance of the RTEP programme by 50%. This implies that RTEP suffered from insects infestation and this directly affects the overall performance of both farmers and RTEP staff.

**Table 5: Distribution of respondents based on the adoption rate as well as factors that affect adoption of RTEP Technologies by the farmers.**

| VARIABLES | Freq. | % |
|---|---|---|
| **Which of the following agronomic practice have been exposed to?** | | |
| Recommended spacing | | |
| Sole cropping | 10 | 11.1 |
| Use of fertilizer | 22 | 24.4 |
| Use of herbicides | 39 | 43.3 |
| Use of pesticides | 15 | 16.7 |
| All of the above | 4 | 4.4 |
| | - | - |
| | **90** | **100** |
| **Which of them have you adopted?** | | |
| Recommended spacing | 6 | 6.7 |
| Sole cropping | 20 | 22.2 |
| Use of fertilizer | 35 | 38.9 |
| Use of herbicides | 23 | 25.6 |
| Use of pesticides | 6 | 6.7 |
| All of the above | - | - |
| | **90** | **100** |
| **If you have not adopted any of these technologies, what are your reasons?** | | |
| High Cost | 40 | 44.4 |
| Not available | 35 | 38.9 |
| Not superior to my practice | 15 | 16.7 |
| None of the above | - | - |
| | **90** | **100** |
| **Which among these pests/diseases do you frequently encounter and assumed a problem?** | | |
| Rodent Termite | 3 | 13.6 |
| Cassava Mosaic | 13 | 59.1 |
| Cassava mealy Bug | 3 | 13.6 |
| Bacteria b. | 2 | 9.1 |
| Grasshopper | 1 | 4.5 |
| | **22** | **100** |
| **Have this posed a serious challenge thereby affecting the income and overall performance of RTEP?** | | |
| Strongly Agree | 1 | 4.5 |
| Agree | 11 | 50.0 |
| Disagree | 3 | 13.6 |
| Strongly Disagree | 7 | 31.8 |
| | **22** | **100** |

The analysis results of Table 6, revealed the relatively low degree ($R^2$=0.081) of relationship between the dependent variable and the independent variables; age, education, gender, marital status, occupation, household size, membership size, duration of membership, land size owned. This implies that 22% of the variation in the adoption rate is explained by the changes in variables in the model. The F-test is not significant, showing that the joint effect of variables in the model on the adoption rate of RTEP Technologies is not significant. This however, suggests that a change in these variables will not lead to the farmers' preference for adoption of RTEP Technologies. This result is in variance with the report of Oni (2004), that land size owned by farmers significantly influenced the adoption of modern technology.

**Table 6. Regression Result for factors that influence the adoption of RTEP technologies**

| Item | Coefficient | Standard Error | T-Statistics |
|---|---|---|---|
| Constant | 2.824 | .623 | 4.535 |
| Age | -.124 | .123 | -1.001 |
| Gender | -.117 | .221 | -.531 |
| Marital Status | .243 | .139 | 1.748 |
| Education | -.149 | .114 | -1.302 |
| Occupation | .056 | .080 | .707 |
| Household Size | .004 | .125 | .028 |
| Land Size | -.044 | .125 | -.352 |
| Duration of membership | .033 | .172 | .192 |
| No. of Cooperative members | .178 | .157 | 1.134 |

The correlation analyses revealed a low positive relationship between Cooperative capital and members' equity (r = 0.041, n = 90, p = 0.703).This implies that there is no significant relationship between the farmers' access to extension services and adoption of RTEP technologies. Also no significant relationship existed between the farmers' socio – economic characteristics and adoption of RTEP technologies.

## Conclusion

Approach and the level of access to extension services by farmers in the area were observed to be low. Adoption of RTEP technology for commercial farming by farmers-based groups in Nigeria will no doubt lubricate the wheels of economic activities of the country. This is because technology constitutes the engine for economic growth. It is absolutely necessary if the economy of Nigeria is to be revitalized. It must be emphasized that without appropriate knowledge, engineers and technologists can do very little. Hence, considerable attention has to be paid to the training of engineers, technologists extension agents, end users and allied personnel involved in every aspect of commercial farming in Nigeria. The roles of the government, financial institutions, the research institutes, the private sector and other interest groups must be carefully and effectively carried out if the dream of developing sustainable commercial roots and tuber farming in Nigeria is to be realized.

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