ANALYSIS OF FACTORS INFLUENCING THE UTILIZATION OF IMPROVED ROOT AND TUBER CROPS TECHNOLOGIES IN EBONYI STATE, NIGERIA.

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Abstract
This study was carried to determine factors influencing the use of improved root and tuber crops technologies by farmers in Ebonyi State, Nigeria. These technologies were developed by National Root Crops Research Institute (NRCRI), Umudike and disseminated to farmers in the State to increase their production and income. Multi-stage sampling technique was employed in selecting the study locations and then the sample size for the study. A total number of 100 farmers from four circles in two bocks in the state were chosen and entervied with interview schedule. The data collected were analysed using both descriptive and inferential statistical tools. Results revealed that farmers in the study area were middle aged, and productive, mostly male and well educated. The studies further revealed that majority of the farmers in the study area were aware of the yam-based technologies and were adopting most of them. Cocoyam based-technologies had high rate of awareness but low rate of adoption. Sweetpotatoes base technologies on the other hand had both low rate of awareness and low rate of adoption. Technologies on cultural practices had both high rate of awareness and adoption among the farmers in the study area. Among the socioeconomic factors that influenced the adoption of root and tuber based technologies in the area, age, level of education, total farm land, contact with extension agents, as well as membership of farmers' groups, income and access to land were the most important variables to consider in the adoption process. It is therefore concluded that root and tuber crops technologies in the study area are quite known to the farmers and these farmers are willing to put them into use. The mass media method could also be employed to further disseminate these technologies since the people are well educated. The technologies are most likely to increase the income of the farmers as land is available to them for farming activities. Enlightenment campaigns on these technologies to further generate interest are advocated for.
Keywords: *utilization, improved technologies, root and tuber crops, farmers.*

Introduction

The term utilization of technologies means acceptance and decision to put the technology into practice as the best course of action available to a farmer (Ekwe, 2004). It is also the continued and sustained application of a technology as the chosen course of action by a farmer. Hence, utilization of technology in the context of this study is discussed to have the same meaning with adoption and constant use of technology. The relevance of developed agricultural technologies can be determined when they are properly adopted and used to increase production and income (Ironkwe, 2011) of the end users. Agricultural technology utilization by farmers is therefore an essential prerequisite for economic prosperity/development in developing countries. This is achieved through series of consideration: the economic viability, compatibility, relevance to existing practice, affordability practicability, feasibility and availability (Unamma, *et al*., 2004) of the technology. However, the farmers' personal characteristics and socio-economic status constitute critical factors in technology utilization process (Chukwu, 2007).

National Root Crops Research Institute (NRCRI), Umudike has the National mandate primarily to conduct research into the genetic improvement, production, processing, storage, utilization and marking of root and tuber crops of economic important in Nigeria. This is aimed at increasing the productivity and income of the farmers in the country. These crops comprise yams, cassava, sweet potato, cocoyam, ginger and Irish potato. According to Eke-Okoro (2011), root crops are the arable energy-rich underground plant structures developed from modified roots while tuber crops are those crops in which the edible energy-rich storage organs develop wholly or partly from underground stems. Thus, the storage organ of root crops is of root origin while that of tuber crops is of stem origin. The major root crops are cassava and sweet potatoes while the major tuber crops are yam cocoyam, potato and ginger. These crops are important for food and non-food uses and most of them are grown in every state in Nigeria. They are eaten as staple food in some rural areas and are marketed both in local and urban markets. Most of our rural farmers anchored their livelihoods on the production, processing and marketing of these crops. The crops can be processed into various food forms, while some are used in industries and confectionaries for manufacturing of industrial products.

Root and tuber crops play significant roles in the food economy of Nigerian. They are major source of dietary energy (FAO, 2005) and are staple food for people in the country. They can be eaten boiled, fried or in processed forms. Most of them act as cash and export crops, while some of them including cassava are used in textile and pharmaceutical industries. Cassava and sweet potato can be used as livestock feed and in ago-industries by providing starch and

ethanol (Alabi and Oviasogie, 2005). Cocoyam can be eaten in various forms, while the leaves and petioles are also used for preparing local vegetable based foods in south eastern Nigeria (Ndaeyo, *et al.*, 2001). Flour from root and tuber crops are used as substitute for whole wheat flour in baking and confectionary industries (FAO and IFAD, 2000), presently, research is going on in Nigeria on value addition of root and tuber crops (NRCRI, 2006, 2007) to encourage farmers to produce more and also make it possible for root and tuber crops to assume greater importance. Therefore, future of these crops would be determined by the extent of stronger research focus (Akoroda, 2011) and adoption of the outcome by the end users (farmers).

The root and tuber crops sector provides job opportunities and generate income for Nigerians. For instance, according to Nweke 1992 in Eke-Okoro (2011), root crops including cassava contribute about 40% of the household income in African. Currently, production, growth rate and yield of root and tuber crops in the country have expanded in areas cultivated due to innovation in technologies resulting to high yielding, pest and disease tolerant varieties of these crops. According to Akoroda (2011), the Nigeria's root crops systems have progressed appreciably in the last decade due to the combination of research, promotion of new varieties and the extension of the best field practices and the good efforts of government at federal, state and local government levels. However, the increased in root and tuber crops production noticed in the country in the recent time has not been meeting up with the rising food demand due to ever increasing population pressure observed in the country. To meet up with the demands, the NRCRI, Umudike, in collaboration with International Institute of Tropical Agriculture (IITA), Ibadan has developed more improved, high yielding, pest and disease tolerant varieties, and value addition of root and tuber crops. These improved varieties of the crops, together with their cultural/management practices, and processing methods have been transferred to farmers in the country through the activities of ADPs of various states in the whole federation for adoption and constant use. This is to help increase their production and income, enhance their livelihoods activities, improve food security and alleviate poverty in the country. This study was therefore conducted to determine the extent of awareness and adoption of these technologies, and also identify factors affecting their utilization in the study area.

Objectives

The specific objectives of the study are as follows:

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1. To examine the socio-economic characteristics of the root and tuber crop producing farmers in the area.
2. To determine the extent of awareness and adoption of root and tuber crops technologies among the farmers in the study area.
3. To identify constraints to the utilization of the technologies by the farmers in the State
4. To analyze the effects of some socio-economic factors on the use of the technologies.

Methodology

The study was conducted in Ebonyi State in Southeastern Nigeria. The state is zoned, based on ADP agricultural system delineated into three agricultural zones (Ebonyi North, Ebonyi Central and Ebonyi South). Out of these three agricultural zones in the State, Ebonyi North was randomly selected for the study. Multi-stage sampling technique was used in selecting the respondents for the study. In the first stage, two blocks out of six were randomly selected. Two circles were randomly selected from each of the selected blocks in the second stage. Finally, twenty five farmers were randomly chosen from each of the selected circles. A total number of 100 farmers were chosen for the study and interviewed with the aid of interview schedule. The data collected were analysed with descriptive and inferential statistical tools such as frequencies, percentages and Probit model. The Probit model was used to identify some of the socio-economic factors influencing the adoption of the technologies in the study area. The model was specified as:

$Yi^* = B^1 X_i \ldots\ldots Xn + E$

$Yi = 0$ if $Y_i^* \leq 0$

$Yi = 1$ if $Y_i \geq 0$

Where:

Y_i^* = An underlying latent variable that indexes use of the technologies.

Y_i = Observable dummy variable that indexes use of the technologies (used = 1, not used = 0)

B^1 = a vector of estimated parameter

$X_i X_n$ = Individual characteristics such as:

X_1 = Age of farmer in years

X_2 = Sex of farmer (male = 1, female = 0)

X_3 = Farming experience (number of years spent in farming)

X_4 = Household size (number of persons of working age in the household)

X_5 = Educational status (number of years spent in school)

X_6 = Total farm land (in hectare)

X_7 = Contact with extension agent (a dummy variable that takes a value of unity for contact and zero other wise).

X_8 = Membership of farmers association/cooperatives (a dummy

variable that takes a value of unity for member and zero otherwise)

X_9 = Annual income (in Naira)

X_{10} = Access to credit (a dummy variable that takes a value of unity for access and zero otherwise)

X_{11} = Access to land (a dummy variable that has a value of unity for access to land and zero otherwise)

E = the error term

All the variables in the model were expected to have positive and significant influence on the adoption of the technologies except age of the farmers.

Results and Discussion

Socioeconomic Characteristics of the Root and Tuber Crops Farmers in the Study Area.

The result of the Socioeconomic characteristics of the root and tuber crops farmers in the study area as shown in table 1 revealed that over 80.00% of the farmers were within the productive ages of 21 – 60 years. This implies that the farmers in a conscious attempt to provide the needed food to feed their families as well as making some earning from their farming activities engage in the cultivation of root and tuber crops.

Meanwhile, since root and tuber crops form the major staples in the study area, they are essentially food security crops, which means that their availability in a home, guarantees the family members that they have something to eat. These farmers within the age bracket of 21–60 are energetic and zealous to produce more food, so they are most likely to respond positively to technological change that will increase productivity and income.

Again, majority of the farmers in the area were men (74.00%). This shows that men acquire more sense of responsibility than women, in terms of family welfare and upkeep. For this reason, men work hard to make ends meet and the most common way of doing this is to engage in farming. On the other hand, women play complimentary roles in farming and family upkeep. This position of men makes them more likely to adopt new technologies as a way of improving their productivity.

On farming experience, all the farmers had over 10 years farming experience in root and tuber crops production. However, most of them had 11 – 20 years (34.00%) of farming experience only about 11% had over 30 years experience. This could be attributed to the fact that the technologies to improve the productivity of root and tuber crops farmers are relatively new compared with the methods used by the farmers, prior to the introduction of the new technologies. Again, due to poor level of infrastructural development in the rural communities, the potential farmers withdraw often from farming and migrate to the urban cities in order to enjoy better living standards. Only very few remain active in farming, leading to dwindling experience in farming.

The result also indicated that farmers maintained moderate sized households. About 70% of them had a household size of between 1 and 6 persons. This could mean that the farmers are gradually becoming conscious of the need to maintain a manageable household size or those they are responding to the harsh economic climate that is currently being experienced in the country. This situation is contrary to the existing belief that farmers usually have large household size so as to provide farm labour from the family members. Those days, hired labour for farm work is prevalent so there may not be any need for a farmer to increase his household size for purpose of farm labour. There is clear indication that the sensitization programme on the need to control child birth is achieving result among the root and tuber crop farmers in Ebonyi State.

It is worthy of note that farming is no longer an activity of the illiterates in the society, for all the root and tuber crops farmers in the study area were educated at various levels. Majority of them (67.00%) were educated up to tertiary level, 31% had Secondary education while only (2.00%) stopped at primary level. Education plays a very important role in the adoption process. High level of education as seen from this result is major factor that could increase the farmers to respond positively to the new technologies. When people are educated, they tend to be more zealous of additional knowledge to excel in any life endeavors.

Land availability is a serious issue in crop farming in Nigeria. However, the root and tuber crops farmers in the study area were not constrained by land availability as 84% of them had over 1 hectare of land at their disposal for farming operation. Of these, 29% of them had over 5 hectares of land for root and tuber crops farming. This implies that the farmers will be willing to adopt technologies that will expand production since land is apparently not a constraint.

Also the farmers were evaluated in respect of access to credit. The result of the study shows that 51.00% of the farmers had access to credit while the remaining (49.00%) had no access to credit. This means that credit could be a constraint to the farmers because insufficient credit will limit adoption of technologies, hence expansion of cropping area may be limited. Therefore, intervention measures for the farmers should target opening up access to financial facilities mostly from banks.

Further investigations reveal that most of the farmers (40.00%) had an income level of less than N100, 000 per annum. However, (22.00%) of them had incomes of over N7m. On the average, the farmers income was about N200, 000 – N300, 000, which means that attempt must be made to improve on the farmers' income, vis a vis the area of land available to them. Since 81% of the farmers had access to land, this land should be put in to good use by improving on the production methods aimed at increase yield and income.

Extent of Awareness and Adoption of Selected Improved Root and Tuber Crops Technologies in Ebonyi State.

As shown in Table 2, the appraised yam-based technologies included the yam varieties-white, yellow, water and Chinese yam, and yam minisett technique and value addition to yam. Most (95.00 %) of the respondents were aware of the white yam variety, as well as yellow yam variety (95.00%). These were followed by awareness for value addition to yam (91.00%), yam minisett technique (89.00%), water yam variety (60.00%) and Chinese yam (52.00%). Thus the least known yam-based technology is the Chinese yam variety. Similarly, the most (63.00%) widely adopted yam-based technology was the white yam variety, followed by yellow yam variety and yam minisett technique (62.00% each), value addition to yam (50.00%), water yam variety (28.00%) and Chinese yam variety (15.00%). Thus the least known and adopted yam-based technology were water yam and the Chinese yam varieties, implying that its low extent of adoption was a result of its low extent of awareness. Out of six yam-based technologies evaluated, all recorded high rte of awareness while four had high rate of adoption.

The same Table showed cocoyam-based technologies which included coco India, Ede ofe green, Ede ofe purple giant Ede ofe, Ukpon, Ghana, Ede ocha, Ede Uhie, Okorokoro minisett technique cocoyam flour, cocoyam crisp and cocoyam soup thickener. The cocoyam variety Ede ofe purple, had the highest (80.00%) extent of awareness. This was followed by giant Ede ofe (79.00%), Coco yam flour (68.00%) Ede ofe green (66.00%), Coco India (64.00%), cocoyam soup thickener (58.0%), cocoyam minisett (53.00%), Ede ocha (52.00%) and Ede ukpong (50.00%). The least known technology was Ede Ghana (31.00%), with regard to extent of adoption, the highest value was recorded by Ede ofe green (43.00%), followed by cocoyam minisett (41.00%), Ede ofe purple and giant Ede ofe (40.00% each), cocoyam soup thickeners (38.00%), cocoyam flour (36.00%) and Ede ukong (30.00%). The least adopted was Ede okorokoro. As shown in the table, the extent of adoption of the cocoyam-based technologies was generally low, with the highest as (43.00%). Out of 13 cocoyam-based technologies evaluated, 9 recorded high rate of awareness while all had low rate of adoption. This implies low uptake of the cocoyam-based technologies. This required further research to elucidate reasons for this and what is to be done to ameliorate the situation.

Furthermore the Table contained the sweet potato-based technologies comprising sweet potato verities TIS 8441, TIS 8164, TIS 87/0087, CIP Wagabolige, Ex-Igbariam, sweet potato flour, sweet potato chips as well as ginger-blended sweet potato drink. Extent of awareness was highest with sweet potato variety TIS 8441 (64.00%). This was followed by TIS 8164 (61.00%), sweet potato Chips (55.00%), TIS 87/0087 (48.00%), ginger-blended sweet Potato drink (37.0%) and Ex-Igbariam (32.00%). Variety CIP Wagabolige had the least extent of awareness (29.00%). The table, in addition revealed a generally low extent of adoption, with variety TIS 8164 having the highest (38.00%). This was followed by variety TIS 8441 (36.00%), sweet potato chips (28.00%), variety TIS 87/0087 (25.00%) and sweet potato flour (18.00%). The least adopted was Ex-Igbariam (15.00%). Out of eight sweet potato-based technologies evaluated, three recorded high awareness while all had low rate of adoption. This means that there is a low uptake of the sweet potato–based technologies by the respondents. There is, therefore, the need to intensify efforts in popularizing these technologies for increased adoption.

The Table also showed cultural practices such as land clearing, weeding 2-3 times, use of herbicides, disease control measures, recommended spacing, use of fertilizer, method of staking and mulching. The technology weeding 2-3 times had the highest (94.00%) extent of awareness. This was followed by use of fertilizer (93.00%), use of herbicides (91.00%), land clearing (87.00%) and recommended spacing (85.00%). Others were disease control measures (81.00%) and method of staking (75.00%), with mulching having the least (64.00%). The cultural practices, weeding 2-3 times and use of fertilizer, had the highest (70.0% each) extent of adoption, followed by disease control measures (69.00%), use of herbicides (68.00%), recommended spacing (67.00%) and land clearing (61.00%). The cultural practice with the least extent of adoption was mulching (43.00%). This implies that mulching is not a common cultural practice among the respondents as it is the least adopted by them. All the eight technologies under cultural practices evaluated recorded high rate of awareness while six had high rate of adoption among the farmers in the study area.

Results in Table 3 revealed that scarcity of planting materials (93.00%), lack of fund (92.00%), high cost of fertilizer (88.00%), crude farm implement, (73.00%) lack of input (60.00%), poor extension

contact (53.00%), among others are the major constraints militating against utilization of the technologies in the study area. The result of the Probit modal analysis determining the effect of socio-economic characteristic of respondents on the use of root and tuber crops technologies. The result showed a chi-square of 535.096 which is significant at 1 % level showing goodness of fit of the model for the analysis. The result further showed that age, total farm land, contact with extension, agent membership of farmers group and access to land were positively and significantly related to adoption of the technologies by farmers to the study area.

Socio-economic Factor Influencing the Utilization of Improved Root and Tuber Crop Technologies in the Study Area

Table 4 has the result of the Probit regression analysis of socioeconomic factors influencing the utilization of improved root and tuber crop technologies in the study area revealed that age, level of education, total farm land, contact with extension agent, membership to farmer group, income, access to land were significant variable that influenced the utilization of improved root and tuber crop technologies (table 4). These are the only variables of interest in relationship with the farmer's personal charactertics or attributes to be considered in determining the adoption or other wise of these root and tuber crop technologies. In other words the probabilities of these variables influencing the utilization of improved root and tuber crop technologies are significant.

Specifically, age, total farm land, contact with extension agents, and membership of farmer groups and access to land conformed to *a priori* expectation and had positive relationship with utilization of improved root and tuber crop technologies. These means that as these variables increases individually, there is the tendency that utilization of root and tuber crop technologies will also increase in the study area. Among this age, total farm land, contact with extension agents were very strongly related at 1% level of significance while membership to farmer group was significant at 5%, access to land had a week significance level of 10%. Conversely, house hold size, level of education, and income, had negative but significant relationship with utilization of root and tuber crop.

Conclusion

Farmers in the study area were middle aged and productive, mostly male and educated. The study revealed that majority of the farmers in the study area was aware of the yam-based technologies and were adopting most of them. Cocoyam based-technologies had high rate of awareness but low rate of adoption. Sweetpotatoes base technologies on the other hand, had both low rate of awareness and adoption. Technologies on cultural practices had both high rate of awareness and adoption among the farmers in the study area. Scarcity of planting materials, lack of fund, scarcity/high of fertilizer, use of crude implement, lack of impute among others were the identified constraints to the utilization of the technologies in the study area.

Among the socioeconomic factors that influenced the adoption of root and tuber based technologies in the area, age level of education, total farm land, contact with extension agents, and membership of farmer groups, income and access to land were the most important variables to consider in the adoption process. It is therefore concluded that root and tuber crops technologies in the study area are quite known to the farmers and these farmers are willing to put them into use. The mass media method could also be employed to further disseminate these technologies since the people are well educated. The technologies are most likely to increase the incomes of the farmers as low is in available to then for farming activities. Enlightenment campaigns on these technologies to further generate interest are advocated for.

Table1: **Socio-economic Characteristics of Root Crops Farmers in Ebonyi State**

Variable	Frequency	Percentages
Age in years		
< 20	4	4.00
21- 40	42	42.00
41- 60	46	46.00
> 60	8	8.00
Total	100	100.00
Sex		
Female	26	26.00
Male	74	74.00
Total	100	100.00
Farming Exp. (in years)		
< 10	27	27.00
11 - 20	34	34.00
21 - 30	28	28.00
31 - 40	10	10.00
> 40	1	1.00
Total	100	100.00
House- hold Size		
0	1	1.00
1 - 3	32	32.00
4 - 6	38	38.00
7 - 9	22	22.00
10 -12	4	4.00
>12	3	3.00
Total	100	100.00
Education Status		
No education	0	0.00
Primary	2	2.00
Secondary	31	31.00
Tertiary	67	67.00
Total	100	100.00
Total Farm Land (in ha)		
< 1	16	16.00
1 - 2	24	24.00
3 - 4	31	31.00
< 5	29	29.00
Total	100	100.00
Access Credit		
No	49	49.00
Yes	51	51.00
Total	100	100.00
Income		
<100, 000	40	40.00
100, 000-200,000	19	19.00
201,000-300,000	10	10.00
301, 000 – 400,000	9	9.00
> 400,000	22	22.00
Total	100	100.00
Access to Land		
No	19	19.00
Yes	81	81.00
Total	100	100.00

Source: Field survey data, 2013

Table 2: Extent of Awareness and Adoption of Improved Root and Tuber Crops Technologies in Ebonyi State, Nigeria

Variables	None		Awareness		Adoption	
Yam	Freq	%	Freq	%	Freq	%
White yam	5	5.000	95	95.00	63	63.00
Yellow yam	5	5.000	95	95.00	62	62.00
Water yam	30	30.00	60	60.00	28	28.00
Chinese yam	48	48.00	52	52.00	15	15.00
Yam minisett	11	11.00	89	89.00	62	62.00
Yam value addition	9	9.00	91	91.00	50	50.00
Cocoyam						
Coco India	36	36.00	64	64.00	17	17.00
Ede Ofe green	34	34.00	66	66.00	43	43.00
Ede Ofe Pup	20	20.00	80	80.00	40	40.00
Giant Edeofe	21	21.00	79	79.00	40	40.00
Ede Ukpong	50	50.00	50	50.00	30	30.00
Ede Ghana	69	69.00	31	31.00	20	20.00
Ede Ocha	48	48.00	52	52.00	26	26.00
Ede Uhie	63	63.00	37	37.00	25	25.00
Ede Okokoro	68	68.00	32	32.00	18	18.00
Cocoyam minisett	47	47.00	53	53.00	41	41.00
Cocoyam flour	32	32.00	68	68.00	36	36.00
Cocoyam crisp	53	53.00	47	47.00	25	25.00
Cocoyam soup thickener	42	42.00	56	58.00	38	38.00
Sweet potato						
TIS 8441	35	36.00	64	64.00	36	36.00
TIS 8164	39	39.00	61	69.00	38	38.00
TIS 8710087	52	52.00	48	48.00	25	25.00
CIP Wagebolye	71	71.00	29	29.00	16	16.00
Ex. Igbariam	68	68.00	32	32.00	15	15.00
Sweet potato flour	54	54.00	46	46.00	18	18.00
Sweet potato chips	45	45.00	55	55.00	28	28.00
Ginger drink	63	63.00	37	37.00	16	16.00
Cultural Practices						
Land clearing	13	13.00	87	87.00	61	61.00
Weeding 2-3 times	6	6.00	94	94.00	70	70.00
Use of herbicides	8	8.00	91	91.00	68	68.00
Disease control measures	19	19.00	81	81.00	69	69.00
Recommended spacing	15	15.00	85	85.00	67	67.00
Use of fertilizer	7	7.00	93	93.00	70	70.00
Methods of staking	25	25.00	75	75.00	44	44.00
Mulching	36	36.00	64	64.00	43	43.00

Source: Field survey data, 2013

Tables 3: Distribution of Respondents According to the Constraints Militating Against Adoption of the Technologies.

Constraints	Frequency	Percentage
Scarcity of planting materials	93	93.00
Lack of fund	92	92.00
High cost of fertilizer	88	88.00
Crude implement	73	73.00
Lack of input	60	60.00
Poor extension contact	53	53.00
Poor weather condition	46	46.00
Problem of land	43	43.00
High cost of labour	42	42.00
Poverty	8	8.00

Source: Field survey data, 2013

Table 4: Probit Analysis of Socio-economic Factors Influencing the Utilization of Improved Root and Tuber Crop Technologies in Ebonyi State, Nigeria

Variables	Coefficient	Z	Sig
Age	0.022	3.661	0.000***
Sex	0.329	1.326	0.185
Farming Exp.	0.023	1.261	0.207
Household Size	-0.038	-0.427	0.669
Education	-0.531	-2.902	0.004***
Total Farm Land	0.209	4.992	0.000***
Contact with Extension Agent	1.421	4.217	0.001***
Membership to Farmer Group	0.304	2.336	0.029**
Income	-0.189	-1.873	0.061*
Access to Credit	-0.221	-1.491	0.139
Access to Land	0.274	1.761	0.078*
Intercept	-2.681	-4.113	0.000***
chi-square	535.096***		
DF	88		

Source: Field survey data, 2013

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