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Utilization of Cocoyam Production Technologies Among Rural Households in South East, Nigeria

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ABSTRACT
The paper examined production and utilization of cocoyam among rural households in Southeast, Nigeria. The specific objectives of the study included: ascertain the level of use of cocoyam in the study area; ascertain level of utilization of cocoyam production technologies and analyze the relationship between farmer's socioeconomic characteristics and their cocoyam utilization of cocoyam production technologies in the study area. Purposive and multi-stage random sampling techniques were employed in selecting a sample size of four hundred and eighty (480) respondents from three states. Structured questionnaire was used to collect relevant data from the respondents, while descriptive statistics and ordinary least square (OLS) regression model were employed to analyze the data. Most cocoyam farmers in the zone used cocoyam highly as "Achicha eaten during hunger period' ($\bar{x}$ = 3.11), and "Cocoyam Paste used as soup thickener" ($\bar{x}$ = 3.5). The results revealed that eighth out of the eleven (11) production technologies disseminated to farmers were highly utilized. They included, "April – May planting time" ($\bar{x}$ =4.22), "Use of high yielding planting materials"(3.33), etc On the other hand, "processing of cocoyam soup thickener" ($\bar{x}$ = 3.62) was the only value addition technology highly utilized in the zone. The results also indicated that Use of high yielding planting materials (1.86), Treatment of planting materials with relevant agrochemicals ($\bar{x}$ =4.92), Use of appropriate fertilizer NPK 12:12:17-MgO_2 (4.033) and Cocoyam minisett technology ($\bar{x}$ =3.29) all had significant relationships with the level of cocoyam produced in the study area. The results of regression estimate of the influence of farmers socio economic characteristics on traditional patterns of cocoyam utilization in the study area revealed that, sex, educational status, household size, monthly income and access to credit had significant positive relationship with their utilization of cocoyam production technologies in the study area at <0.5 level of significance. Therefore, the study recommended that relevant government agencies responsible for promoting technologies should organize training for cocoyam farmers on modern best practices for cocoyam utilization.

Key words: Production, Technologies, Cocoyam Utilization

INTRODUCTION

The main nutrient supplied by cocoyam, as with other root and tubers, is dietary energy provided by its carbohydrate content. Its protein content is low (1-2%), and as in almost all root crops proteins, sulfur-containing amino acids are limiting. Cocoyam *(Colocasia esculentum*) (L) Schott and (*Xanthosoma sagittifolium)* (L) Schott. *(Colocasia species*),both of which originated from South-East Asia and South America, respectively, refer to two members of the *Araceae.* They are herbaceous perennial plants. Colocosia is also referred to as taro, old cocoyam, while Xanthosoma also Tannia is referred to as new cocoyam (Talwana, Seren, Ndubikunze, Nnadi, Tumuhimbise, Kaweesi, Chumo and Palapala, 2009; Azeez and Madukwe, 2010). Furthermore, Offor and Onyewuchi (2013) observed that as Nigeria searches for a solution to the challenge of food insecurity, embracing cocoyam production and consumption will empower Nigeria economically, socially and health wise.

Cocoyam ranks third in importance after cassava and yam among the root and tuber crops cultivated and consumed in Nigeria. Nigeria has been the world's leading producer of cocoyam (taro), accounting for up to 3.7 million metric tonnes in 2009 (Nwosu, 2009) and still maintains the lead among cocoyam producing nations, with an annual production of 4.55 million metric tonnes in 2012, representing 61.2 and 43.1 % total production in West Africa and Africa, respectively and also with an annual production rate of 5.49 million metric tonnes, equivalent to 45.9% of world production and 72.2% total output of cocoyam in West Africa in 2015 (Chukwu, 2015).

Cocoyam is a tuber crop with lots of potentials. According to Ugbajah and Uzuegbunam (2012), a large number of households grow cocoyam as cash crop, selling at least half of their yearly production. As food, cocoyam corms and cormels are eaten in homes in various forms. They can be boiled or roasted like yam, pounded alone or mixed with cassava and eaten with soup. The corms and cormels sliced, can be dried and used to make flour or sliced and fried to make chips. The leaves of the plant and flower are also edible and are usually consumed as a vegetable and spice to garnish food in dishes such as stews (Chukwu *et al*., 2015b).

Cocoyam flour is highly digestible and it is used for invalids and as an ingredient in baby foods (Darkwa and Darkwa, 2013). The flour is also used as soup thickener in preparation of soup, biscuits, bread, beverages and puddings. In Nigeria, cocoyam is grated, mixed with condiments and wrapped in leaves and steamed for about 30minutes to prepare a delicacy popularly known as *epankuko (ikokore*). Cocoyam flakes is another end product of cocoyam which is cooked, cut into chips and dried under the sun. The resulting flakes are later soaked in water and cooked with vegetable and *Cajanus cayan* seeds during famine or planting season when food is scarce (Onwuka, 2012).
Malnutrition in Nigeria and other developing nations is traced to the consumption of low quality and quantity of food (Nnabuko *et al*., 2012a). The production of cocoyam especially in south-east Nigeria is labour-intensive with most operations carried out manually at the traditional level (Okoye *et al.,* 2008). Despite the wide adaptability, as well as nutritional and economic values of the crop, cocoyam has received minimal interest and attention by producers, consumers and even researchers. The potentials of cocoyam for food security, income generation and nutritional enhancement in the households seem to be grossly underutilized.

In view of the fore going, this paper ascertain the level of use of cocoyam produce; ascertain the uses of cocoyam production technologies and analyze the relationship between farmers socio economic characteristics and their level of cocoyam utilization in the study area.

METHODOLOGY

The study was carried out in the South-East agro-ecological zone of Nigeria. The choice of this region was informed by the fact that all the States in the zone produce and utilize cocoyam. The zone comprises five States, namely: Abia, Anambra, Ebonyi, Enugu, and Imo. The south-east agricultural zone of Nigeria lies between latitudes 4°20'N and 7°25'N and longitude 5°21' and 8°51E (Ekwe, 2004). Purposive and multi-stage random sampling techniques were employed in selecting the respondents. In the first stage, three out of five States in the zone were purposively selected

basically because of high intensity of cocoyam production and utilization in the States. The states included Abia, Ebonyi, and Enugu.

In the second stage, two agricultural zones were randomly selected from each State. In the third stage, two blocks were randomly selected from each zone. In the fourth stage, four circles in each of the selected blocks were randomly selected. Finally, ten (10) cocoyam farmers were randomly selected from each circle. This meant that there were 160 respondents randomly sampled from each State. Thus a sample size of four hundred and eighty (480) respondents was randomly selected. The services of agricultural extension agents were engaged in locating and collecting data from the respondents. Data collected were analyzed using descriptive statistical tools such as frequency counts, percentages. Extent of use of Cocoyam production technologies (is the frequency of utilization of the improved and recommended cocoyam production technologies) in the study was realized using descriptive statistics such as mean scores. A five point Likert-type scale was employed to determine the magnitude of responses and numerical values assigned as follows;

Strongly agree (SA) = 5
Agreed (A) = 4
Undecided UD) = 3
Disagree (DA) = 2
Strongly disagree (SD) = 1

The mean value of the rating was determined with the formula:

$$\overline{X} = \frac{\sum n}{n}$$
$$= \frac{5+4+3+2+1}{5} = \frac{15}{5} = 3.0 \quad (1)$$

Thus a mean decision point (3.0) was obtained from the five point Likert-type scale and use as benchmark for the objectives. Any mean score greater than or equal to the bench-mark mean was considered high extent of use of cocoyam value addition technologies, otherwise was regarded as low. Any variable with mean ($\overline{X}$) value of 3.0 and above was regarded as possessing superior grade variable and so employed in the interpretation of the results.

Inferential statistics was equally employed in testing objective 3 using ordinary least square (OLS) regression model implicitly expressed as:

$$Y = f(X_1, X_2, X_3, X_4, X_5, X_6, X_9, X_{10}, X_{11}, X_{12}) \quad (2)$$

Where in equation (1),
Y_1 = level of utilization of cocoyam (mean score)
X_1 = Sex (male = 1; Female = 0)
X_2 = Age (actual number of years lived by the respondent)
X_3 = Marital Status (married = 1, others 0)
X_4 = Level of Education (number of years)
X_5 = Occupational status (Full-time farmer = 1; part-time = 0)
X_6 = Farming experience (number of years spent in cocoyam production)
X_7 = Farm size (number of hectares cultivated)
X_8 = Household size (actual number of persons living in a household)
X_9 = Monthly income (in naira)
X_{10} = Membership of Social Organization (Membership = 1 ; otherwise = 0)
X_{11} = Access to Credit (Access = 1 ; otherwise = 0)
X_{12} = Extension contact (Have had contact = 1 ; otherwise = 0)

RESULTS AND DISCUSSION

Uses of cocoyam among rural household

The study identified the uses of cocoyam among the respondents in order to ascertain the reasons for which a farmer would embark on cocoyam production and adopt promoted value addition technologies. The result as presented in Table 1 showed that the cocoyam farmers across the States used cocoyam highly for "Achicha/boiled dried cocoyam" eaten during hunger period' ($\bar{x}$ = 3.11), and cocoyam paste used as soup thickener ($\bar{x}$ = 3.5).The results also showed that the various States varied in their traditional uses of cocoyam. For instance, In Abia State, cocoyam cornels were traditionally boiled and prepared as porridge ($\bar{x}$ 3.31), cocoyam paste was used as soup thickener ($\bar{x}$ =3.02). In Ebonyi State, however, cocoyam cornels were boiled and prepared as porridge ($\bar{x}$ =3.05), eaten as *Achicha/boiled dried cocoyam* during hunger period ($\bar{x}$ = 3.58), and cocoyam paste is used as soup thickener ($\bar{x}$ =3.64) and in Enugu State, *Achicha/boiled dried cocoyam* was eaten during hunger period ($\bar{x}$ = 3.35), and cocoyam paste used as soup thickener ($\bar{x}$ = 3.84).

Many authors (Oti and Chukwu, 2011; Chukwu, 2015b; Chukwu *et al.,* 2015a) have observed that cocoyam has a lot of untapped potentials apart from the traditional uses which most of the respondents are yet to tap into accounting for the level of commitment by the farmers. In order to salvage the situation, there is need to drive awareness of the importance of cocoyam much more than what has been done and as well arm farmers with value addition technologies to enable them maximize opportunities for increased income and economic sustainability provided by cocoyam.

Table 1: Distribution of Respondents by traditional patterns of cocoyam utilization in the study area

Traditional Patterns of cocoyam utilization	Abia Mean	Ebonyi Mean	Enugu Mean	S/E Mean	Remark
Cocoyam corms pounded with fufu	2.22	2.21	2.09	2.17	**Low**
Cocoyam cornels boiled and prepared as porridge	3.31	3.05	1.17	2.51	**Low**
Cocoyam flours used in soup making	1.93	1.79	1.69	1.80	**Low**
Cocoyam leaves dried and used for soup making	1.36	2.81	2.44	2.20	**Low**
Achicha/boiled dried cocoyam eaten during hunger period	2.42	3.58	3.35	3.11	**High**
Cocoyam paste used as soup thickener	3.02	3.64	3.84	3.5	**High**
Grand mean	2.38	2.85	2.43	2.55	**Low**

Source: Field Survey, 2017; Benchmark score=3.00; where 0-2.59 = low use and 3.00-5.00= high use

Extent of use of Cocoyam Production Technologies

The result as presented in Table 2 on the extent of use of Cocoyam production technologies revealed that eight (8) out of the eleven (11) production technologies disseminated to the farmers had their means above the 3.0 benchmark. The study showed that "Corms and cormels as planting materials" ($\bar{x}$ =3.84), "April – May planting time"($\bar{x}$ =4.22), "High yielding planting materials"(3.33), "Two species of cocoyam (*Taro* and *Tannia spp*.)" ($\bar{x}$ =3.55), "Appropriate planting spacing (1mx50cm)" ($\bar{x}$ =3.21), "Use of right fertilizer (NPK 12:12:17-MgO_2)" ($\bar{x}$ =3.12), "Soil topping after 2nd weeding operation" (4.1), and "Storage in cool and dry environment" ($\bar{x}$ =4.57) were the highly utilized cocoyam production technologies.

The result further showed significant variations across the three States that constituted the study area. For instance, in Abia State, "Corms and cormels as planting materials" ($\bar{x}$ =3.01), "April – May planting time"($\bar{x}$ =4.02), "High yielding planting materials"($\bar{x}$ =3.16), "Two species of cocoyam (*Taro* and *Tannia spp*.)" ($\bar{x}$ =4.14), "Chemical treatment of planting materials" ($\bar{x}$ =3.16),

"Appropriate planting spacing (1mx50cm)" ($\bar{x}$ =3.56), "Three times weeding (NPK 12:12:17-MgO_2)" ($\bar{x}$ =3.12), "Soil topping after 2nd weeding operation" ($\bar{x}$ =4.1), and "Storage in cool and dry environment" ($\bar{x}$ =4.57) were the highly utilized cocoyam production technologies. The result supported the findings of Nwaobiala and Apu (2016) conducted in a State in the south-east that showed high utilization of most of the NRCRI promoted cocoyam production technologies among farmers.

For Enugu State, "Corms and cormels as planting materials" ($\bar{x}$ =4.33), "April – May planting time"($\bar{x}$ =4.67), "High yielding planting materials"($\bar{x}$ =3.55), "Two species of cocoyam (*Taro* and *Tannia spp*.)" ($\bar{x}$ =3.85), "Appropriate planting spacing (1mx50cm)" ($\bar{x}$ =3.69), "Use of right fertilizer (NPK 12:12:17-MgO_2)" ($\bar{x}$ =4.18), "Three times weeding (NPK 12:12:17-MgO_2)" ($\bar{x}$ =3.70), "Soil topping after 2nd weeding operation" ($\bar{x}$ =4.09), and "Storage in cool and dry environment" ($\bar{x}$ =4.78) were the highly utilized cocoyam production technologies.

On the other hand, Ebonyi state, recorded fewer number of highly utilized technologies utilized at a high rate. Such technologies as; "Corms and cornels as planting materials" ($\bar{x}$ =4.19), "April – May planting time"($\bar{x}$ =3.99), "High yielding planting materials"($\bar{x}$ =3.30), "Cocoyam minisett" ($\bar{x}$ =3.33), "Soil topping after 2nd weeding operation" ($\bar{x}$ =4.35), and "Storage in cool and dry environment" ($\bar{x}$ =4.53) were the highly utilized cocoyam production technologies. The result is in line with *apriori* expectation, since most of the respondents were not aware of these technologies, especially in Ebonyi State.

Table 2: Distribution of respondents' mean responses of the extent of use of cocoyam production technologies in the study area

Production Technologies	Abia Mean ($\bar{x}$)	Ebonyi Mean ($\bar{x}$)	Enugu Mean ($\bar{x}$)	South East Zone Mean ($\bar{x}$)	Remark
Corms and cornels as planting materials	3.01	4.19	4.33	3.84	High
April-May planting time	4.02	3.99	4.67	4.22	Low
High yielding planting materials	3.16	3.30	3.55	3.33	High
Species of cocoyam (*Taro* and *Tannia* spp.)	4.14	2.66	3.85	3.55	High
Chemical Treatment of planting materials	3.16	1.78	1.04	1.99	Low
Cocoyam minisett	2.64	3.33	1.31	2.42	Low
Appropriate planting spacing (1m x 50cm)	3.56	2.39	3.69	3.21	High
Use of right fertilizer NPK (12; 12:17 mg o_2)	2.90	2.03	4.18	3.12	High
3-times weeding	4.02	2.03	3.70	2.25	Low
Soil topping after 2nd weeding operation	3.86	4.35	4.09	4.1	High
Store in cool and dry environment	4.40	4.53	4.78	4.57	High

Source: Field Survey, 2017; Benchmark score=3.00; where 0-2.59 = low use and 3.00-5.00= high use

Influence of farmer's socio-economic characteristics on utilization of cocoyam production technologies.

Table 3 showed the linear regression estimate of the influence of farmers socio economic characteristics on the utilization of cocoyam production technologies in the study area. Linear functional form was chosen based on conformity with *a priori* expectation of signs, magnitude of

coefficients multiple determination, overall significance of the functional form (F-statistics) and explanatory power of the variables included in the model. The F –value is statistically significant at 1% level which implies that the independent variables (Xs) included in the model were good. The R^2 value was 0.963 which indicates that 96.3% of the total observed variations in cocoyam utilization pattern were explained by the variables included in the model, while 3.7% of the variation was due to error of estimation or other variables not included in the model. The F – ratio was significant at1% indicating the goodness-of-fit of the model.

The coefficient of sex was statistically significant at 10% and negatively related to the utilization of cocoyam production technologies. This inverse relationship implies that female cocoyam farmers had higher utilization pattern than their male counterparts. This result corroborates those of Ikwelle *et. al.*, (2010) who reported that cocoyam is a woman's crop. The coefficients of age was statistically significant at 1% and negatively related to the cocoyam production technologies. The result also suggests that ageing farmers would be less energetic to work and also less flexible to adopt new technologies for crop production and utilization and this could lead to low productivity as well as low efficiency.

The coefficient of farming experience was statistically significant at 10% and positively related to cocoyam production technologies. It shows that an increase in the years of farming experience will lead to a corresponding increase in cocoyam utilization of the farmers. The coefficient for education was positively signed and significant at 10% level of probability. This implies that any increase in education will lead to increase in the cocoyam production technologies in the study area. The coefficient of farmers' income was positively signed and statistically significant as expected. This implies that income encourages the adoption of improved technologies for cocoyam production and utilization of cocoyam.

Table 3: Linear regression estimate of the influence of farmers socio economic characteristics on the utilization of cocoyam production technologies in the study area.

Parameter	Coefficients	Standard error	t-value
Constant	0.0161	0.1448	0.1114
Sex (X_1)	0.691	0.1968	3.511***
Age (X_2)	-0.029	0.005	-6.108***
Marital Status (X_3)	0.0283	0.0143	0.1981
Educational Level (X_4)	1.3805	0.7150	1.93*
Occupational Status (X_5)	0.0283	0.0143	0.1981
Farming experience (X_6)	0.1382	-0.1189	-3.61***
Farm size (X_7)	-0.005	-0.089	0.0562
Household size (X_8)	1.011	0.124	8.1532***
Monthly income (X_9)	0.004	0.0009	4.6007***
Membership of org. (X_{10})	-0.131	0.0019	-69.215
Access to credit (X_{11})	0.225	0.0994	2.263**
Extension contact (X_2)	-0.033	0.0457	-0.019
R^2	0.963		
Adjusted R^{-2}	0.959		
F-ratio	212.24***		

Source: Field Survey Data, 2018

CONCLUSION AND RECOMMENDATIONS

The study showed that most cocoyam farmers in the zone traditionally used cocoyam highly as "*Achicha/boiled dried cocoyam* eaten during hunger period', and cocoyam paste used as soup thickener. The results of estimate of relationship between farmers socio economic characteristics and their traditional patterns of cocoyam utilization in the study area showed that, sex, educational status, household size, monthly income and access to credit had significant positive relationship with their traditional patterns of cocoyam utilization in the study area. On the other hand, age and

farming experience had significant negative relationship with their utilization of cocoyam production technologies.

Therefore, the study recommended that:

- Research Institute, Ministry of agriculture, Agricultural Development Programmes (ADP) and other private extension agencies responsible for developing and promoting technologies should organize training for cocoyam farmers on modern best practices for cocoyam utilization.
- Also, more Village Extension Workers (VEW) should be trained on cocoyam production technologies for onward dissemination to the rural farmers so as to sustain the consumption of cocoyam which hitherto is considered as a neglected crop.

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