

# **INTERNATIONAL JOURNAL OF AGRICULTURE, MANAGEMENT AND TECHNOLOGY**



**Vol 7(1) 2023**

**Published by**  
Federal College of Agriculture,  
Ishiagu Ebonyi State

## DETERMINANTS FACTORS TO INTENSITY OF ADOPTION OF COCOYAM PRODUCTION TECHNOLOGY IN ANAMBRA STATE, NIGERIA

Ede, ON and Achebe, U

National Root Crop Research Institute (NRCRI), Igbariam Sub-station. Anambra State, Nigeria

**Corresponding Author;** edeno@gmail.com

### ABSTRACT

*This study assessed the determinants of intensity of adoption of cocoyam production technologies in Anambra State, Nigeria. Specifically, the objectives of this paper are to: (i) describe the socioeconomics characteristics of the respondents; (ii) determine the intensity of the adoption of cocoyam technologies and (iii) analyze identify the constraints to the adoption of the technology in the study area. The sample size consists of 120 cocoyam farmers selected randomly from three notable Agricultural zones in the State. Structured questionnaire and oral interview were used to collect the data. Percentage responses and Tobit model analysis were used to address the objectives of the study. The result of the farmers' socioeconomic characteristics showed that most the farmers were aged, moderate household size, well experienced and had fair extension outreach. Furthermore, the variables that were positive and significantly influenced the intensity of cocoyam production technologies were household size, farm size, farming experience and extension services. The constraints to the adoption of the technologies were poor access to credit, poor access to fertilizer, unavailability and high cost of planting material and problem of transportation. Programmes to improve contact with extension agents, increased farm size, enhanced access to credit, increased access to fertilizer and encourage experienced farmers to remain in the business were proffered in order to increase the intensity of adoption of the technology by the farmers.*

**Keyword;** Determinants Factors, Intensity, Adoption, Cocoyam Production, Technology.

### Introduction

The agricultural sector continues to play a foremost and premeditated role in economic growth and development, curtailing poverty and enhancing food security of most countries in sub-Saharan Africa. The aforesaid capabilities of the agricultural sector may perhaps only be accomplished through enhancing productivity of smallholder farmers, through adoption of innovation as posited among literatures to be partly to the success stories that emanated from the Green Revolution in Asia (Food Agriculture Organization, (FAO), 2014). Agricultural innovations also play a significant role in fighting poverty, lowering per unit costs of production, boosting rural incomes and reducing hunger (In the sub-Saharan, African region, among the crops grown by the smallholder farmers, the farming population is cocoyam (Liu, Bruins and Heberling, 2018). Cocoyam refers to two members of the Araceae family; *Colocasia esculentum* (L.) Schott and *Xanthosoma sagittifolium* (L.) Schott and serves as staple and cash crop across many agro-ecological zones of sub-Saharan Africa, Asia and the Pacific *Colocasia esculenta* otherwise known as taro is more popular than *xanthosoma sagittifolium*, otherwise known as tannia (Chukwu, Okoye, and Nwosu, 2012).

In Nigeria for instance, due to cocoyam gaining wide popularity, the government in collaboration with National Root Crop Research Institute (NRCRI) and International Institute for Tropical Agriculture (IITA) prioritized the development and dissemination of improved cultivars of cocoyam (e.g. Tce 2, 15, 19, 27 & 36, "Ede ofe" and "Kochoium etc.) and innovations (such as spacing, disease control, fertilizer application, rapid multiplication of corms, pesticide application, weed control and among others) to the farmers (NRCRI, 1989; Chukwu; *et al*; (2012). Nevertheless, the rise in the status of the crop as asserted by Nzeako and Ume, (2022) could be correlated to the high food energy yield per unit area, thrive in marginal soil, tolerates erratic rainfall and survives many years through small dormant tubers intrinsic features of the crop. Also, it has nutritionally superior to both cassava and as well has easily digestible starch that is an ideal source of carbohydrate for diabetic patients, pancreatic, peptic ulcer, gallbladder, chronic liver and inflammatory bowel diseases (Chukwu, *et al*;2012)

Evidence abounds in the literature on the positive impact of cocoyam technology adoption on productivity. For instance, studies conducted by Edet

and Nsikak, (2007), Ezedinma, (2006) and FAO, (2014) show that farmers that adopted the aforesaid technologies had outputs of about 6 -8tons per hectare compare to non-adopter with output of 3.5 – 5 tons. The implication is that the increased in farmers' productivity as result of the adoption of the technology and subsequent poverty reduction may be very difficult to achieve, unless the majority of the farmers in the study area in particular and Nigeria, adopt the technologies. Empirical studies show that some farmers adopted the technologies, however, the level of the adoption varies .This implies that some farmers used almost all available farming space for production of cocoyam using the technologies, while others put a small portion of their farmland for the crop production. By this, three vital questions could be raised; (i)Why do some farmers adopt the technology, while others do not?, (ii)Why do the intensity of adoption differs ? and (iii) what are the constraints to the adoption of the cocoyam production technologies?. The information from the study could be vital in future agricultural planning, but unfortunately there is dearth of new studies in the subject area. Most studies to the best knowledge of the researchers were in 80s (Lynonga and Nzietcheng, 1986: Okoli, 1986: NRCRI, 1987), thus leaving a knowledge gap the study tends to fill. Specifically, the objectives of this paper are to: (i) describe the socioeconomic characteristics of the respondents; (ii) determine the intensity of the adoption of cocoyam technologies and (iii) analyze identify the constraints to the adoption of the technology in the study area

**MATERIALS AND METHODS.**

**Study Area**

Anambra State in south east Agro ecological zone of Nigeria is located between latitude 5038 'N and 6047 'E of Equator and longitude 6036 'N and 7021 'E of Greenwich Meridian. The state is bounded in the east by Enugu State, in the West by Delta State, in the South by Imo State and in the North by Kogi State. Anambra State has Awka as its capital with population figure of 4.184 million people (National Population Commission (NPC, 2006). Anambra State has annual rainfall range of 1600 mm -1700 mm and average temperature of 27°C. Anambra State comprised of four agricultural zones; Onitsha, Aguata, Otuocha and Awka. The inhabitants of the state are into crops and animal production. The state is blessed with cassava processing entrepreneurs. The off - farm employment opportunities in the state are trading, salon, vulcanizing, auto mechanics and tailoring

**Sampling Procedure and Sample Size**

Purposive and multi stage random sampling techniques were used to select zones, blocks, cycles and

respondents. First, two agricultural zones were purposively selected from four zones because of intensity of cocoyam production in the areas. The selected zones were Anambra and Aguata zones. Second, three blocks were randomly selected from each of the selected zones. This brought to a total of six blocks. Thirdly, ten circles were randomly selected from each of the six blocks, making a total of sixty circles. Finally, two respondents were selected from each of the sixty circles. These brought to a total of one hundred and twenty respondents for detailed study.

**Data collection**

Primary data were collected with aid of structured questionnaire and oral interview The primary information collected were on the socioeconomic characteristics of the farmers (age, household size, educational level, farming experience and farm size) and constraints to adoption of cocoyam technology.

**Analysis Methods**

Descriptive statistics such as percentages and mean was used to analyze the farmers' socio economic characteristics, while Tobit model analysis was used to estimate farmers' intensity of adoption. Factor analysis model was employed to address the constraints to adoption of technology in the study area.

**Model Specification**

**Tobit Model Analysis**

The objective 4, determination of extent of technology adoption was captured using Tobit model. The tobit model was developed by Tobin (1957) would be expressed as:

$$Y^* = x\beta + e \dots\dots\dots(1)$$

Where  $\beta$  is a vector of unknown coefficient,  $x$  is a vector of independent variables;  $e$  is an error term that is assumed to be independently distributed with mean zero and a variance of  $S^2$ .  $Y^*$  is a latent variable that is unobservable. If the data for the dependent variable is above limiting factor, zero is this case;  $Y$  is observable as continuous variable. If  $Y$  is the limiting factor, it is held at zero. This rushing is presented mathematically in the following two equations.

$$Y = Y^* \text{ if } Y^* > Y_0,$$

$$Y = 0 \text{ if } Y^* < Y_0 \dots\dots\dots (2)$$

Where:  $Y_0$  is the limiting factor. There two equations represent a censored distribution of the data. The tobit model can be used to estimate the expected value of  $Y$  as a function of a set of explanatory variables ( $x$ ) weighed by the probability that  $Y_i \geq 0$  (Oladele, 2005). Maddala, (2003) shows that the expected intensity of adoption

$$\sum(Y) \text{ is } \sum Y = x\beta f(z) + \alpha f(z) \text{ and } Z = x\beta/\sigma \dots\dots\dots(3)$$

Where  $f(Z)$  is the cumulative normal distribution of  $Z$ ,  $f'(Z)$  is the value of the derivative of the normal curve at a given point (unit normal density).  $Z$  is the  $Z$  score for the area under the normal curve and  $S$  is the standard

error of the error term. The coefficients for variables in the model,  $\beta$  do not represent marginal effect directly but the sign of the coefficient will give the researcher information as to the direction of the effect.

The intensity of adoption of cocoyam production technology in the study area can be represented as:  $Y = f(x_1, x_2, x_3, x_4, x_5, x_6, x_7, x_8, x_9, x_{10} \dots x_n + e) \dots \dots \dots (4)$

Where:  $y$  = percentage (%)

$x_1$  = Age of the Farmers (in years),  $x_2$  = Farmers level of schooling (yrs),  $x_3$  = Access to Extension services (Dummy),  $x_4$  = Household size (No.),  $x_5$  = Farm size (hectare),  $x_6$  = Farming experience (in years),  $x_7$  = Credit access (Naira),  $e$  = error term.

**Factor Analysis**

Factor analysis is used to address limiting factors to rice production by the sampled farmers. Principal

component factor analysis with varimax —rotation and factor loading of 0.4 was used. The impediments reported by the respondents in the course of cocoyam adoption were characterized into three factors using varimax rotation and factor loading of 0.40. The principal component factor analysis model is specified as

$$Y_1 = M_{11} Y_1 + M_{12} Y_2 + \dots + M_{1n} Y_n \dots \dots (5)$$

$$Y_2 = M_{21} Y_2 + M_{22} Y_2 + \dots + M_{2n} Y_n \dots \dots (6)$$

$$Y_3 = M_{31} Y_3 + M_{32} Y_2 + \dots + M_{3n} Y_n \dots \dots (7)$$

$$Y_n = M_{n1} Y_1 + M_{n2} Y_2 + \dots + M_n Y_n \dots \dots (8)$$

Where;  $K_1 = cn$  = observed variable /Restrictions in cocoyam adoption,  $M_1 = M_n$  = factor loading or relating coefficients.  $Y_1 = Y_n$  =unobserved fundamentals motivating factors limiting the adoption of cocoyam in the study area.

**Results and Discussion**

**Table 1 Description of Variables used in Tobit regression Model**

Variable	Measurement	Apriori expectation
Age	Age of the household head in years.	
Household Size	No .of people that resides and fed by the household head	+
Farm Size	No of hectares of land cultivated by the farmer	+
Farming experience	No of years spent in farming	+
Educational Level	No. of years spent schooling or acquiring western education	+

Table 2; Distribution of Respondents According to Socioeconomic Characteristics

Variable	Frequency	Percentage
<b>Age</b>		
>40	42	35
40 – 50	64	53.4
<50	12	11.6
<b>Educational Level</b>		
No formal education	20	16.7
Primary education	50	41.7
Secondary education	30	25
Tertiary Education	20	16.3
<b>Farm Size</b>		
I hectare	60	50
1 – 2	30	25
2 – 3	20	16.7
Above 3	10	8.3
<b>Farming Experience</b>		
10	45	37.5
– 20	36	30
< 20	49	40.84
<b>Household Size</b>		
>10	70	58.4
< 10	50	41.6

Source; Field Survey; 2021

Table 2 show that 65% of the farmers were above 40 years of age, while 35% were less than 40 years. This

could mean that most of the respondents were aged, and older farmers as affirmed by Adepogu and

Awodunyila, (2008) have higher amass capital and larger family size for accomplishment of improved productivity through efficient technology adoption The finding of Edet and Nsikak, (2007) did not concur to above assertion. They posited that youths are innovative and motivational individuals to attain high productivity through high intensity of technology adoption. Table 2 moreover reveals that 16.7% of the respondents had no formal education, whilst 83.3% had formal education. Education catalysis the process of information flow and leads the farmer to as wide as possible, the different pathways of getting information about a technology. The more information pathways the farmer has, the more the farmer intensifies adoption of cocoyam technologies (Alene, Poonyth and Hassan, 2000).

Besides, 50% of the respondents had farm sizes below a hectare, followed by 25%; 1 – 2 hectares, 8.3%; above 3 hectares. The implication of the finding is that majority of the cocoyam farmers in the study area operated in small scale and may not have enough land

to practice new technologies, thereby affecting their intensity of technology adoption (Atala and Abdullahi, 1998). Moreover, 58.4% of the sampled farmers had household size below 10 persons, whilst, 41.6% had more than 10 persons. Household heads with many household members that are of labour age according to Awotide, Diagne , Wiredu and Ojehomon (2012) could enhance the farmers’ proxy to family labour and this practice is common especially in many countries in sub Saharan African where farming is still at subsistence level. Furthermore, the result of the cocoyam farmers’ years of farming experience showed that 37.5% of the respondents had farming experience below 10 years, whereas 62.5% had above 10 years. Adepogu and Awodunyila, (2008) reported that number of years of experience enhances the farmers’ intensity of technologies adoption through experimentations and observations of technologies The Intensity of adoption of cocoyam production technology is shown in Table 3

**Table 3 Intensity of Adoption of Cocoyam Production Technology**

Intensity of adoption	Coef.	Std. Error	T	P > t
Constant	0.852	0.951	0.896	0.372
Age (years)	-0.026**	0.018	2.436	0.037
Education level (years)	-0.011*	0.016	5.234	0.000
Household size(number of persons)	0.271***	0.091	2.978	0.003
Farm size(hectare)	0.301***	0.016	4.549	0.000
Farming experience(years)	0.088*	0.010	2.089	0.076

\*, \*\*, &\*\*\* are significance level at 10, 5 & 1% respectively. R<sup>2</sup> = 0.898

**Source; Field Survey; 2022**

Tobit model was employed to analyze factors determining the intensity of improved agricultural technologies adoption among smallholder farmers. Dependent variable is improved cocoyam adoption intensity which is measured as an area allocated for improved cocoyam technologies to total area allocated for cocoyam production. Table 2 reveals that the sign of the coefficient of age of the household in accord to *a priori* expectation and finding of Okoronkwo, *et al*, ( 2017) had a negative impact on the intensity of adoption of technologies. This implies that a year increase to the household’s age would tantamount to decrease in the intensity of improved cocoyam adoption by – 02.6%. Solomon, Bekele, Franklin, Mekbib, (2011) reported that decline in households’ age, the higher the odds of jettisoning technologies adoption that needed high financial investments (seed, fertilizers, chemicals, and labour) and intensive field managements. However, Ogada,*et al*; (2014) was of the view that old farmers more likelihood to adopt innovation more

than youthful farmers, since they have the ability to invest his personal capital in new innovation adoption; better access to privileged information from staff of development programmes and equipped with better skills in evaluating the prospects of new technologies to old types. The finding of Adesina and Zinnah, (1993), was not synonymous with the negative correlation between age and technology adoption. They opined that younger farmers have higher inclination to adopt new innovations as they are more knowledgeable, open to risk-taking, and have longer planning horizon than aged farmers.

As well, the negative and statistical significant of the coefficient of educational level of household heads as indicated in Table 1 did not concur with a *priori* expectation but in conformity with Onyenweaku, Okoye, and Okorie, (2010). This implies as the number of years spent in schooling by the household head increase, the greater the probability of decrease in the intensity of improved cocoyam adoption by - 01.1%. The negative sign of the coefficient could be

related to the negative attitude of the educated people to farming in preference to ‘white collar jobs’ in most countries in sub-Saharan Africa. Nevertheless, the trend is fast changing especially with declining economic trends in some of these countries, unemployment and population growth (Obeta and Nwagbo,1998). However, several studies (Onyenweaku; *et al*; 2010 and Ume, Eluwa, Okoro and Silo; 2017; Pannell and Zilberman, 2020) did not coincide to the affirmation. They remarked that educated farmers have high intensity to source for agricultural related information for higher agricultural production than the uneducated ones. The result of analysis of Table 4 moreover revealed that size of the farm of the household interconnected positively with intensity of improved cocoyam use adoption and found to be statistically significant at 5% probability level. This could imply that one hectare increase to the households’ farm size, would enhance the adoption decision and intensity of cocoyam use by 30.1%. The finding is in consent with studies on improved cassava varieties in Anambra State, Nigeria by Ezeano, *et al*; (2017) and adoption of improved chickpea varieties in Gujurat, India by Shiyani, Joshi, Asokam and Bantilan, (2002). They emphasized that farmers total land holding served as a good proxy for wealth status and income level, thus affecting the adoption decision and the intensity.

The coefficient of Farming experience interrelated positively with the intensity of adoption of improved cocoyam use at 10% significant level. This implies that as years of farming experience of the household increase by one year, the intensity of improved cocoyam adoption increases by 08.8%. This implies that the propensity to adopt decreases as experience in farming, measured by the number of years put into farming activities increases. This could be due to the fact that farmers become adapted to certain ways of doing things and the tendency to adopt a new innovation is seldom. Studies (Alene, *et al*; 2002; Shiyani, *et al*; 2003; Diiora, 2013, Pannell and

Zilberman, 2020) conform to the affirmation that intensity of technology adoption and years of farming experiences of the farmer positively correlated. The sign identity of the variable is expected, since the more experienced farmers are, the more they are bequeath with better skills in production, reduced uncertainty about innovations performance and able to evaluate the gains of technology being considered, thereby influencing their adoption decision and intensity (Nzeako and Ume, 2022).

In addition, household size coefficient was also found to be positive and had statistically significant influenced in the intensity of improved cocoyam adoption at 5% significance level. This implies that an increase in the number of household member that is of labour age by one would increase the intensity of improved cocoyam adoption by 27.1%. This implies that as the number of household members’ increases, the probability of households to allocate more land for improved cocoyam production. This is true since larger family size is generally associated with greater labor force availability for the timely operation of farm activities, especially among peasant farmers (Ezedinma, 2004). Household members had positive influence on intensity of adoption as opined by Arellanes and Lee, (2003) in their study but not in harmony with Ezeano, Ume and Gbughemobi, (2018).They related the negative relationship to the increased consumption pressure often correlated with large family size that are dependents (Onyenweaku, *et al*.2010).

The constraints to the adoption of improved cocoyam production technologies are shown in Table 7. Herein, three factors were extracted based on the response of the sampled farmers, Factor 1= economic/institutional factor, Factor 2 = infrastructural factor and Factor 3 = socio-financial factor (Ume, *et al* 2017). Only variable with factor loading of 0.30 and above at 10% overlapping variance could be utilized in naming the factors.

**Table 4 Varimax-Rotated Factors Against Constraints to Adoption of Cocoyam production Technologies.**

Variable	Factor 1	Factor 2	Factor 3
Land Problem	-0.235	0.034	0.398
Fertilizer	0.260	0.70	0.429*
Theft	0.411*	0.427*	0.409*
Problems of pesticides	-0.223	0.205	-0.410
Poor access to credit	0.462*	-0.173	0.214
High labour cost	0.233	-0.229	.406*
Pests and Diseases	0.152	-0.158	0.270
Unavailability and high cost of planting materials.	0.407*	0.321	0.275
Transportation	0.301	0.438*	0.322

Source: computed from SAS 2021

The factors with variable loading of 0.40 and above were considered as vital factors limiting farmers adoption of cocoyam production technologies in the study area. The factor loading of less than 0.40 was considered as not influencing farmers' adoption of the technologies, whereas those loaded more than one factor were discarded. Variables that loaded more than one factor were transportation and theft were discovered. Limitations under the economic /institutional factor were poor access to credit (0.462) and unavailability and high cost of planting material (0.407). Poor access to credit by farmers may perhaps be attributed to ignorance of loan facility as most banks are located in urban areas away from farmers residing in rural areas (Ume, *et al*; 2017). Credit availability could facilitate the intensity of adoption of technology through ease of procuring material inputs and payment of labour (Pannell and Zilberman, 2020). Besides, the problem of unavailability and high cost of planting materials is complicated by fact that the same planting material is the edible portion of the crop, thus making the resource very costlier especially during planting season, hence adversely affecting adoption of the technology. (NRCRI, 2012).

Under infrastructural factor, poor transportation (0.438) was considered. The poor linkage of rural and urban feeder roads are in highly deplorable conditions, hence lessening vehicle usage leading to high transport fare in evacuations of farmers' outputs and inflow of improved farm inputs, thus affecting the rate of technology adoption (FAO, 2014). Also, the variables under socio-financial factors were Fertilizer (0.429) and high cost of labour (.406). High cost of fertilizer has adverse affected on the intensity of adoption of improved crop yield, as most of the innovations needed adequate fertilizer application to attain its yield potential (Ume, *et al*; 2017). In addition, the high cost of labour influences negatively intensity of adoption of intensive – labour technology as most of the farmers in sub-Saharan Africa is poor resourced (Chukwu, *et al*; 2014).

#### Conclusion and Recommendation

The result of the farmers' socioeconomic characteristics showed that most the farmers were aged, moderate household size, well experienced and had fair extension outreach. Furthermore, the variables that were positive and significantly influenced the intensity of cocoyam production technologies were household size, farm size, farming experience and extension services. The constraints to the adoption of the technologies were poor access to credit, poor access to fertilizer, unavailability and high cost of planting material and problem of transportation

Based on the conclusion, the following recommendations were proffered;

Policies and programmes aimed at increasing farmers' access to credit from commercial banks at reduced interest rate.

As well, farmers with large household size should be encouraged to be actively involved in adoption of technologies since large household size would provide the much needed labour requirements in cocoyam production activities at low cost, compared to hired labour.

Also, policies that will encourage experienced farmer to remain in cocoyam farming should be intensified and such policies, including provision of improved input at subsidized rate to the farmers.

Furthermore, the need to expose farmers to labour - saving devices such as hand driven plough by appropriate government agencies and Non-Governmental Organization in order to curtail minimally cost of production. Moreover, there is need to develop good networks of rural roads, especially the roads linking the farms to the rural markets. This will encourage more transporters to operate in these areas, thereby decreasing transportation cost and thus providing the necessary incentive to the farmers to increase their level of cocoyam production.

Additionally, programmes aimed at subsidizing the price of fertilizer at farm level should be enacted by government agency concerned and Non-Government organization (NGO), so that genuine farmers could have access to the resource in order to enhance their farm outputs.

#### REFERENCES

- Adepogu, A.A. and Awodunyila, D.J. (2008): Economics of cocoyam production and marketing in Ekiti State, Nigeria. *Research Journal of Applied Science*, 3(2): 9-12.
- Adeshina, A.A. and Zinnah, M.M. (1993): Technology characteristics, farmer's perception and adoption decision. A Tobit model application in Sierra Leone. *Agric Economics*, pp. 297 – 311.
- Alene, A.D, Poonyth,D and Hassan, R M (2000). Determinants of Adoption and Intensity of Use of Improved Maize Varieties in the Central Highlands of Ethiopia: A Tobit Analysis. *Agrekon*, 39(4): 633-643.
- Arellanes P., D. and Lee, R(2003). The determinants of adoption of sustainable agriculture technologies: Evidence from the Hillsides of Honduras." *International Association of Agricultural Economists* 25826:
- Awotide, B.A., A. Diagne , A. N Wiredu , and Vivian Ebihomon Ojehomon (2012). Wealth Status and Agricultural Technology Adoption among Smallholder Rice Farmers in Nigeria.



- International Journal of Sustainable Development* 05 (2), PP: 97-114.
- Chukwu, G., Okoye, B and Nwosu, K. (2012). Cocoyam rebirth in Nigeria. Lap-Lambert Academic Publishing, Germany, 100 pp.
- Diuro, G., (2013). Impact of off-farm income on technology adoption intensity and productivity: Evidence from rural maize farmers in Uganda. International Food Policy Research Institute, Working Paper 11.
- Edet, J.U. and Nsikak, A.A.E. (2007): Cocoyam farms in Akwa Ibom, Nigeria: A stochastic production function frontier approach. *Mendel Agric Journal*; 6(2):15 – 26.
- Eze, C. I. and Akpa, C. E. (2010). Analysis of technical efficiency of National Fadama II facility on arable crop farmers in Imo State, Nigeria. *Nigeria Agricultural Journal*, 41(1): 109-115.
- Ezeano, I C, Ume, S I and Gbughemobi, B O (2018) Socio-Economic Determinant to Adoption of Improved Cassava Varieties by Agricultural Development Programme (ADP) Contact Farmers in Anambra State, Nigeria. *Life Science Archives (LSA)*.4; 3; 1352 – 1364.
- Ezedinma, F.O. (2006). Production cost in the cocoyam based cropping systems of South Eastern Nigeria. RCMP Research Monograph. No 6 Resource and crop Management program. IITA, Ibadan Nigeria.
- F.A.O. (2014): FAOSTAT Statistics Division of the food and agriculture organ. <http://FAO.Stat:FAC.org>.
- Food and Agriculture Organization of the United Nations (FAO). (2012). 18 Mar. 2013. <http://faostat3.fao.org/home/index.html>.
- Liu, T., Bruins, R.J.F., and Heberling, M.T. (2018). Factors Influencing Farmers' Adoption of Best Management Practices: A Review and Synthesis. *Sustainability* 10(2): 1–27.
- Lynonga, S.N. and Nzietcheng, S. (1986): Cocoyam and Africa food crisis. "Tropical root crop and the African food crisis". Proceeding of the third Triennial Symposium of the International Society for Tropical Root Crops held at Owerri, Nigeria, from 17 – 23 August, 1986.
- Maddala, G. S. (1983): Limited dependent and qualitative variables in Econometrical, Cambridge University Press; pp. 24 – 36.
- NPC (National Population Commission), (2006): Population census of Federal Republic of Nigeria: Analytical report at the national level. National Population Commission, Abuja.
- NRCRI (1989): Annual report of National Root Crop Research Institute, Umudike, Umuahia
- Nzeako, F C and Ume, S I (2022). Determinants to decision and intensity of adoption by taro farmers under lowland and upland production systems in Anambra State, Nigeria" *International Journal of Agriculture and Food Science*. 4(2)52 - 62
- Obeta, M. E. and Nwagbo, E.C. (1999). The adoption of agricultural innovations in Nigeria. *A case study of an improved IITA cassava technology packages in Anambra State, National Farming System Research of Nigeria*.
- Odoemenem I. U., Obinne, C. P. O., (2010). Assessing the factors influencing the utilization of improved cereal crop production technologies by small-scale farmers in Nigeria. *Indian Journal of Science and technology*; 65; 165- 194.
- Ogada J. M., Mwabu, G. and Muchai D., (2014). Farm technology adoption in Kenya: a simultaneous estimation of inorganic fertilizer and improved maize variety adoption decisions. *Agricultural and Food Economics* 2: 12.
- Ojiako, I.A. (2011). Socio-economic stratification and its implication for adoption and use intensity of improved soybean technology in northern Nigeria. *Agricultural Journal*, 6 (4), 145-154.
- Okoli, O.O. (1986): Adoption of farm technology in Eastern Nigeria: *Quarterly Journal International Agriculture*; 19(13): 237 – 249
- Okoronkwo, M. O., Ume, S. I., Ahaiwe, M O, Nwagwu, Alex, C and Okoro, Sunday, F (2017); Determinants of Cassava Production and Marketing in Obubura Local Government Area of Cross Rivers State, Nigeria. *International Journal of Management and Technology*. 1(1)40 – 46.
- Onyenweaku, C. E., Okoye, B. C. and Okorie, K. C. (2010). Determinants of fertilizer adoption by rice farmers in Bende Local Government Area of Abia State, Nigeria. *Nigeria Agricultural Journal*, 41(2): 1-6.
- Pannell, D., and Zilberman, D. (2020). Understanding Adoption of Innovations and Behavior Change to Improve Agricultural Policy. Applied Economic Perspectives and Policy, Special Issue: *Adoption of Agricultural Innovations*, Volume 42 (1): 3-7.
- Shiyani, R. L., Joshi, P. K., Asokam, M. and Bantilan, M. C. S., (2002). Adoption of improved chickpea Varieties: Krishak Bharati Cooperative (KRIBHCO) Experience in tribal region of Gujarat, India. *Agricultural Economics*, 27: 33-39



- Solomon, A., Bekele, S., Franklin, S., Mekbib, G., (2011). Agricultural technology adoption, seed access constraints and commercialization in Ethiopia. *JDAE* 3: 436-447.
- Tobin, J. (1958): Estimation of relationship for limited dependent variables. *Econometrics*; 26:25-27.
- Ume, S. I., A. N. Eluwa, A N, Okoro, G.O and Silo, B J(2017)Adoption of improved Cassava crop production technology by Agricultural Development Programme (ADP) contactfarmers in Anambra state, Nigeria: a Training and Visit (T&V) System Approach. *International journal of innovations in Agricultural Science*. 1; 2; 72 – 82.