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ANALYSIS OF FACTORS INFLUENCING THE ADOPTION OF POTATO PLANTING MATERIAL TECHNOLOGIES IN PLATEAU STATE, NIGERIA

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ABSTRACT
The study examined the factors influencing the adoption of potato planting material technologies in the central agricultural zone of Plateau State, Nigeria. Multistage sampling procedure was employed to select 306 potato farmers randomly from the study area. Primary data was collected through structured questionnaire. The data were analysed using descriptive statistics, adoption index, logit regression and factor analysis. The result revealed that 74.8% of the potato farmers were males, with a mean age of 40 years. The study further revealed that majority (91.2%) of the respondents had a form formal education with a mean household size of 6 persons. The results from the adoption index showed that seed tuber technology was highly adopted with an adoption score of 5.96, cutting seed technology with 2.52 and true potato seed technology with adoption score of 1.81. The results of logit regression revealed that household, labour and other occupations other than potato farming all significantly influenced adoption of potato planting technologies. The result of factor analysis revealed the major constraints faced by farmers to include poor technical information, economic problem, inadequate resources, environmental problem, pathological problem and technological problem. The study concluded that seed tuber potato planting technology was the most highly adopted in the study area. The study recommended that the dissemination of technical information should be increased by ensuring more contacts with farmers by extension agents; and proper soil, water, pest and disease management practices should be intensified among farmers.

Keywords: Adoption, Adoption index, Factors, Influencing, Technology.

INTRODUCTION
The commercial potato derived from the wild species *Solanum tuberosum* originates from Andes in South America. Originally it was cultivated next to the present border separating Peru and Bolivia some 8000 years ago. The Spanish took the potato from Latin America to Europe in 16th century. Potato was first admired for its flowers before been appreciated for its tubers and since then potato became a major carbohydrate source in human and animal diets around the world. Potato was introduced into Nigeria in the later part of the 19th century by the Europeans notably to the tin miners in the Jos Plateau (Jwanya *et al.*, 2014). Potato is grown for food as well as a commercial crop. It is a major source of income among the rural farmers on the Jos Plateau. Potato's high energy content and ease of production have also made it an important component of urban agriculture which provides jobs and food security to some 800 people globally (Garba, 2013). Maganga (2012), pointed out that the potato sector can help improve the incomes of smallholder farmers and subsequently curb food insecurity together with poverty.

According to Loevinsohn *et al*. (2013). the most common areas of technology development and promotion for crops include improved planting materials and management

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practices; soil as well as soil fertility management; weed and pest management; and as well as irrigation and water management. By increasing the ratio of output to input, improved technology tends to reduce the cost of production which in turn results in substantial gains in farm income (Challa, 2013). One way of transforming agriculture is therefore by exposing farmers to improved agricultural production technologies, such as high yielding seed varieties. Adopters of improved technologies increase their productions, leading to constant socio-economic development. Adoption of improved agricultural technologies has been associated with: higher earnings and lower poverty; improved nutritional status; lower staple food prices; increased employment opportunities as well as earnings for landless laborers (Margaret and Samuel, 2015). Although, agricultural technology adoption study has vital implications in agricultural development. Nevertheless, the adoption of innovations by smallholder farmers in Africa has always come with some tradeoffs especially as farmers' input are either not harvested or integrated into the development of technology package meant for them. Rasheed *et al.* (2019) reported that adoption decisions are influenced by some socioeconomic, demographic, ecological and institutional factors coupled with the mismatch between technology characteristics and technology preferences. Many factors can be associated with lack of adoption, such as credit constraints, lack of insurance coverage, high transaction costs on markets, or behavioural inadequacies (de Janvry *et al*., 2016).

Over many decades, policies for agriculture, trade, research and development, education, training and advice have been strong influences on the choice of technology, the level of agricultural production and farm practices (Girei *et al.*, 2020). However, many farmers rely on traditional methods of production and this has lowered their level of productivity Increasing agricultural productivity is critical to meet expected rising demand and, as such, it is instructive to examine recent performance in cases of modern agricultural technologies (Challa, 2013). Furthermore, new potato production technologies are often adopted slowly and several aspects of adoption remain poorly understood despite being viewed as an important route out of poverty in most of the developing countries (Girei *et al.*, 2020). It is therefore against this backdrop that this study seeks to analyses the factors influencing the adoption of potato planting material technology in Plateau State. The objectives of this study were to: describe the socio-economic characteristics of potato farmers in the study area; determine the level of adoption of potato planting material technologies in the study area; examine the socio-economic characteristics influencing adoption of potato planting material technologies in the study area; and describe the constraints associated with the adoption of various planting material technologies in the study area.

MATERIALS AND METHODS

The Study Area

The study area is the Central Agricultural Zone of Plateau State. The zone is located between 9^0 18´ 00´´N and 9^0 06´ 00´´ E with an altitude of 1200 meters above sea level (Plateau State government, 2017). The zone has a population of a projected figure of 1,554,774 people at 3.2% growth rate per annum with land area of 8385Km^2 (National Population Commission [NPC], 2021). Though situated in the tropical region, a higher altitude makes the zone, have a near temperate climate with an average temperature between $13^0 – 22^0$; the area has an annual rainfall range 180mm-280mm (Climate-data.org, 2021). The study area has a high concentration of potato farmers in the state. The major economic activities of potato farmers are production and marketing of potato.

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Sampling Techniques

A multistage sampling procedure will be employed for the study. In the first stage the Central Agricultural Zone of the State was purposively selected from the three agricultural zones, because the central agricultural zone has the highest potato production in the state. In the second stage two local government areas (Mangu and Bokkos) were selected from the central agricultural zone of the State. The third stage involved a selection of two districts (Mangu and Kerang from Mangu and Bokkos and Richa from Bokkos) from each local government area. In the fourth stage two villages were purposefully selected from each of the districts. A feasibility study of the two local government areas, (Mangu and Bokkos) revealed a total of 1,530 (Table 1) registered potatoes farmers were identified, therefore in the final stage a random sampling technique will be used to select 20% (n = 306) of the total number of potato farmers in each of the selected villages. This percentage was chosen using sample size formula given by Yamane (1967).

The sample size formula is given as:

$$n = \frac{N}{1+N(e)^2} \quad \ldots(1)$$

where;

n = sample size.

N = population size.

E = margin of error.

Table 1: Sample size selection plan of the study

LGA	District	Villages	Sample frame	Sample size 20%
Mangu	1. Mangu	i. Mangu Halle	200	40
		ii. Sabon Gari	210	42
	2. Kerang	i. Sabon Kerang	150	30
		i. Sabon Kerang	150	30
		ii. Ampang	200	40
Sub-total			**760**	**152**
Bokkos	1. Bokkos	i. Bot	220	44
		ii. Butura	100	20
	2. Richa	i. Richa	200	40
		ii. Barkul	250	50
Sub-total			**770**	**154**
Total			**1,530**	**306**

Source: Field Survey, 2021.

Method of Data Collection

The primary data were collected in the study through the administration of structured questionnaires to respondents with the assistant of trained enumerators.

Analytical Techniques

The tools used for data analysis were descriptive and inferential statistics. Descriptive statistics such as the frequency distribution, percentages and mean were used to achieve objective i, while objective ii was achieved using adoption index through the use of sigma scoring method. Logit regression was used to achieve objectives iii, and factor analysis was used to achieve objective iv.

Model specification for objective 4 is given as:

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$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta 6 X_6 + \beta_7 X_7 + \beta_8 X_8 + \cdots e \quad \ldots (2)$$

Y = Adoption of potato planting technology (adoption= 1, non- adoption= 0).
where;
β_0 = Intercept,
$\beta_1 - \beta_n$ =Regression coffeiceints,
X_1 = Age of respondents, (years),
X_2 = Sex of respondents (male=1, female=2),
X_3 = Marital status (single=1, married=2, divorced=3, widowed=4 and others=5),
X_4 = Educational level (years),
X_5 = Household size (Actual number),
X_6 = Farm size (hectares),
X_7 = Years of experience (years),
X_8 = Occupation (civil servant=1, livestock production=2, fish farming=3, trading=4, others=5),
X_9= Labour (family labour=1, hired labour=2, others=3),
X_{10} = Farmer's income (₦).

RESULT AND DISCUSSION

Socio-economic Characteristics of the Potato Farmers

The result in Table 2 reveals that 14.7% of the farmers were within the age of 20-29 years, while 13.4% were within the age of 50-59 years. However, the majority of the farmers fell within the age bracket of 30-39 years, and the mean age of potato farmers was 40 years. These age distribution shows that majority of the respondents are still in their active stage of life, these young people are opened to new ideas and agricultural innovations been spread to them. This finding is in line with Ironkwe *et al.* (2016), in a study about the adoption of roots and tubers technologies, showing that the majority of the respondents were between age 41-50 years old. An economic and productive age that can facilitate adoption of technologies. The result in Table 2 also shows that majority (74.8%) of the respondents were males, and few (25.2%) females. This implies that there are more male farmers involved in potato production than female farmers in the study area. This could be due to the fact that agricultural production in Nigeria is still typically traditional with the majority of the activities, been carried out using crude tools and implements. Thus, the usual drudgery that comes with the use of crude tools puts men in a position of advantage. This result corroborates with the findings of Bawa *et al.* (2018) which reported that the contribution of women in agriculture is usually less compared to men due to their continuous dependence on their male counterparts and social arrangements of the society. Furthermore, the results revealed that majority of the respondents (80.4%) were married, and 16.7% were single. This implies that the majority of the respondents are responsible for one or more family members and will want to adopt innovations to boost production so as to meet up with the food needs of their families. Also, the tendency to marry early helps in building a strong and full of energy farming population, which will reduce the cost of hired labour. This finding agrees with Nmadu *et al.* (2015), who opined that the large percentage of married respondents implied that more members of the family are available for production. Table 2 also reveals that 3.6% of the respondents had adult education, 32.4% of the respondents had secondary education, 20.9% of the respondents had primary education and majority (34.3%) had tertiary education. This indicates that 91.2% of the respondents had some form of education in the study area. Education is very important in the area of farmer's adoption of improved technologies and decision making. This result agrees with Girei *et al.* (2020) that

education has a likelihood to enhance the adoption of modern farm technologies by farmers. The result from Table 1 also shows that 3.6% of the respondents had a household size of 11 and above persons, 35.6% had a household size of 1-5 persons, while majority (60.8%) had a household size of 6-10 persons with a mean size of 6 persons. This implies that farmers had a fairly large household, this will increase the availability of free family labour. Garba (2013) noted that a fairly large household could serve as an insurance against short falls in supply of farm labour.

Furthermore, the result from Table 2 revealed that 1.3% of the respondents had farm size ranging between 4.5 and above hectares, 4.6% of the respondents had farm holding of 3.5-4.4 hectares, 35.6% of the respondents had a farm size of 1.5-2.4 hectares, while majority (40.2%) of the respondents had a farm holding between 0.5-1.4 hectares, with a mean farm size of 1.8 hectares. This result implies that majority of the farmers are small scale farmers with less than 2 hectares on average per farmer, this has an adverse effect on meaning investment and return to scale on food security. This is in line with the findings of Adejare and Arimi (2013) which noted that most rural farmers in northern Nigeria are small-scale farmers. Table 2 also shows that 4.2% of the respondents had farming experience of 31 and above years, 18.6% had a farming experience of 21-30 years, 37.3% had a farming experience of 1-10 years and majority (39.9%) of the respondents had a farming experience of 11-20 years. The mean farming experience in the study area was 16 years. This result implies that most of the respondents had long years of farming experience, implying that such farmers are likely to make decisions that would increase their output and income. Jawanya *et al.* (2014) revealed that long years of experience in enhancing efficiency and productivity, thus improving farmer's income and standard of living. The result in Table 2 reveals that 4.2% of the respondents engaged in fish farming, 6.9% of them were civil servants, 24.8% of them engaged in livestock production, while 36.3% of the respondents were engaged in trading. This implies that farmers in the study area diversify their source of livelihood by engaging in activities like livestock production, fish farming and trading. This allows that to increase their sources of income, thereby improving their standard of living. Dilruba and Ray (2012) supported these findings that majority of rural producers have more than one source of income, hold their wealth in various forms of assets or use their resources in more than one activity. Also, the result in Table 2 reveals that 29.7% of the respondents used hired labour for potato production, 65.0% of respondents used family labour while 5.2% of them used other various types of labour. As a result of the study area having slightly high household sizes, it is imperative that majority of the household will utilise family labour. Furthermore, the result in Table 2 reveals that 4.2% of the respondents engaged in fish farming, 6.9% of them were civil servants, 24.8% of them engaged in livestock production, while 36.3% of the respondents were engaged in trading. This implies that farmers in the study area diversify their source of livelihood by engaging in activities like livestock production, fish farming and trading. This allows that to increase their sources of income, thereby improving their standard of living. Dilruba and Ray (2012) supported these findings that majority of rural producers have more than one source of income, hold their wealth in various forms of assets or use their resources in more than one activity. Also, the result in Table2 shows that, 4.2% of the respondents had a monthly income between ₦90,000-₦129,999, 22.2% of the respondent had a monthly income ranging between ₦50,000-₦89,999, while majority (72.9%) of the respondents had a monthly income between ₦10,000-₦49,999. The mean monthly income of the farmers in the study area was estimated at ₦40,194. This implies that farmers in the study area are low-income earners. It should however be noted that it is not easy to determine the income level of farmers because a lot of farmers do not keep farm record. According to Melesse (2018), annual income of the respondents has a significant

and positive relationship with the adoption of recommended technologies, this means the higher the annual income of the respondents, the more the adopted recommended technologies.

Table 2: Socio-economic Characteristics of Potato Farmers

Variable	Frequency	Percentage	Mean
Age (years)			
20-29	45	14.7	
30-39	107	35.0	
40-49	97	31.7	**40**
50-59	41	13.4	
60 and above	16	5.2	
Total	306	100.0	
Sex			
Male	229	74.8	
Female	77	25.2	
Total	306	100.0	
Marital status			
Single	51	16.7	
Married	246	80.4	
Divorced	3	1.0	
Widowed	5	1.6	
Other	1	0.3	
Total	306	100.0	
Educational status			
None	27	8.8	
Adult Education	11	3.6	
Primary Education	64	20.9	
Secondary Education	99	32.4	
Tertiary Education	105	34.3	
Total	306	100.0	
Household size			
1-5	109	35.6	
6-10	186	60.8	**6**
11 and above	11	3.6	
Total	306	100.0	
Farm size			
0.5-1.4	123	40.2	
1.5-2.4	109	35.6	
2.5-3.4	56	18.3	**1.8**
3.5-4.4	14	4.6	
4.5 and above	4	1.3	
Total	306	100.0	

Source: Field Survey, 2021

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Table 2: Socio-economic Characteristics of Potato Farmers **Cont'd.**

Variable	Frequency	Percentage	Mean
Farming experience (years)			
1-10	114	37.3	
11-20	122	39.9	
21-30	57	18.6	**16**
31-Above	13	4.2	
Total	306	100.0	
Occupation			
Civil Servant	21	6.9	
Livestock Production	76	24.8	
Fish Farming	13	4.2	
Trading	111	36.3	
Other Crops	85	27.8	
Total	306	100.0	
Monthly income			
₦10,000- ₦49,999	223	72.9	
₦50,000- ₦89,999	68	22.2	
₦90,000-₦129,999	13	4.2	**₦40,194**
₦130,000 and above	2	0.7	
Total	306	100.0	

Source: Field Survey, 2021

Obtaining adoption index through the use of sigma scoring method involves converting frequency counts to normal scores, as depicted in Table 3. The result reveals that 3.6% of the respondents adopted the True seed potato technology with an adoption score of 1.81, 8.2% of the respondents in the study area adopted Cutting seed technology with an adoption score of 2.52 while, majority (98.7%) of the respondents adopted the seed tuber technology with an adoption score of 5.96. Seed tuber technology was adopted highest for a variety of reason such as its relative advantage, compatibility, complexity etc. This result corroborates with the findings of Peter *et al.* (2012), which revealed that the characteristics of technology largely affects its adoption.

Table 3: Adoption Scores for Potato Planting Material Technologies

Potato Planting Material Technology	Number of Adopters	Percentage of Adopters. N=306	Adoption Score
True Potato Seed Technology	11	3.6	1.81
Cutting Seed Technology	25	8.2	2.52
Seed Tuber Technology	302	98.7	5.96
		Total Score= 10.29	**Mean= 3.43**

Source: Field Survey, 2021

The result from Table 4 shows that sex, civil servant, livestock farming, trading, hired labour and household size were significant. The coefficient of sex was positive and significant at $P \leq 0.05$. The study revealed a high level (74.8%) of adoption of planting material technology was within male adopters, this could be because male farmers are more likely to adopt seed tuber technology. However, this does not agree with the study of Mbanaso *et al.* (2011) which

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reported that sex was not a significant factor affecting the adoption of sweet potato technology in south eastern Nigeria. The coefficient of civil servant, livestock farming and trading were positive and significant at P≤ 0.1, P≤ 0.05 and P≤ 0.01 respectively. These variables represent off farm income activities from potato production, implying that the more farmers engaged in off farm activities the more the adoption of seed tuber technology, this could be because an increase in income will improve farmer's ability to buy farm inputs. This agrees to the findings of Chomba (2016), which noted that off-farm income is significant to the adoption of organic farming technologies in Kenya. The coefficient of hired labour was positive and significant at P≤ 0.01. This implies that the use of hired labour favoured the adoption of seed tuber technology, this could be because the technology is labour intensive. The coefficient of household size is positive and significant at P≤ 0.1. This implies bigger household sizes favours the adoption of seed tuber technology, this could be because large household size provides cheap family labour needed for potato production. This result corroborates with the findings of Mbanaso *et al.* (2011) which reveals that household size was positively significant to the adoption of sweet potato production technology. Sani *et al.* (2018) supported these findings reporting that household size, farming experience, attending agricultural exhibition and consulting newspaper were all significant at P<0.05, farm size significant at P<0.10 and extension contact at P<0.01 in influencing farmers' adoption of the agricultural technology and adoption efficiency in western agricultural zone of Bauchi State, Nigeria.

Table 4: Socio-economic Determinants Influencing Potato Adoption

Variable	Coefficient	Standard Error	Wald	Sig.	Exp(B)
Age (X_1)	0.046	0.036	1.668	0.197	1.047
Sex (X_2)	2.048**	0.825	6.161	0.013	7.756
Marital status (X_3)	-0.383	0.525	0.532	0.466	0.682
Educational level (X_4)	-0.024	0.045	0.280	0.597	0.977
Household size (X_5)	0.935**	0.427	4.801	0.028	0.392
Farm size (X_6)	0.033	0.264	0.016	0.900	0.967
Years of experience (X_7)	0.037	0.038	0.963	0.326	0.963
Occupation (X_8)					
Civil servant	1.587*	0.858	3.423	0.064	0.204
Livestock farming	1.255**	0.629	3.981	0.046	0.285
Fish farming	0.092	1.127	0.007	0.935	1.096
Trading	1.891***	0.694	7.425	0.006	0.151
Others	-0.702	0.675	1.082	0.298	0.496
Labour (X_9)					
Family	0.154	0.496	0.096	0.757	1.166
Hired	1.436***	0.537	7.138	0.008	4.203
Others	1.162	1.241	0.876	0.349	3.195
Farmers Income (X_{10})	0.423	0.367	1.329	0.249	0.655
Constant	2.306	1.775	1.688	0.194	10.037

*=P≤ 0.1, **= P≤ 0.05 and ***= P≤ 0.01
Source: Field Survey (2021)

Factor analysis using the principal factor model with varimax rotation was used to determine major variable constraining the adoption of potato planting material technology by framers. The results from Table 5 represents the varimax rotated factors constraining the adoption of potato planting technology by farmers. The factor loadings are represented having significant loadings of magnitude of 0.50 and above (Ather and Balasundaram, 2009). The

identified constraint factors were; poor technical information, economic problem, inadequate resource problem, environmental problem, pathological problem and technological problem. Items that loaded high in components factor 1 (poor technical information) included inadequate experience (0.708), low educational level (0.675) and inadequate information (0.619). This implies that information was a major barrier to adoption in the study area and it is important that farmers receiving technology require adequate technical knowledge about the technology (Mbanaso *et al.,* 2011). Consequently, a poor technical knowledge for the technology could contribute in making the adoption of potato planting material difficult. The items that loaded highly in component factor 2 (economic problem) included; inadequate income (0.930), non-availability of inputs associated with technology (0.919) and non-availability of inputs when needed. This implies that adoption was hampered by some economic factors. However, ensuring a sustainable production requires an increase in the use of purchased inputs like herbicides, fertilizers etc. (Mbanaso *et al.,* 2011).

Table 5: Varimax Rotated Factors Constraining the Adoption of Potato Planting Technology by Farmers

Variable	**Components**					
	1	**2**	**3**	**4**	**5**	**6**
Inadequate experience	0.708					
Proximity to Inputs	0.706					
Low education level	0.675					
Inadequate information	0.619					
Inadequate income		0.930				
Non availability of inputs associated with technology		0.919				
Non availability of inputs when needed		0.910				
Inadequate farm size			0.739			
Soil degradation				0.799		
Soil erosion				0.783		
Inadequate rainfall				0.589		
Pest and disease					0.828	
Low yield						0.881
Poor palatability						0.756
Late maturity						0.622

Source: Field Survey, 2021

As presented in Table 5, acquiring these inputs require funds and should be readily available when needed. The issue that loaded highly under factor component 3 (inadequate resource) was inadequate farm size. Farm size has a positive influence on the adoption decision

(Garba, 2103), therefore having inadequate farm size could discourage adoption. Items that loaded high in components factor 4 (environmental problem) were; soil degradation (0.799), soil erosion (0.783) and inadequate rainfall (0.589). Farid *et al.* (2015), concluded that environmental factors such as drought has a negative effect on the adoption of improved farm practices by farmers in Northern Bangladesh. The item that loaded high in component factor 5 (pathological problem), was pest and disease (0.828), the study by Kolawole *et al.* (2017) reported that pest and disease infestation was a major constraint against the adoption of improved sweet potato technology in Kwara State. Items that loaded in component factor 6 (technological problem) included; low yield (0.881), poor palatability (0.756) and late maturity (0.622), all these problems are related to the characteristics and relative performance of the technology. A study by Melesse (2018), revealed that the characteristics of the technology is a major determinant for its adoption.

CONCLUSION AND RECOMMENDATIONS

Based on the result of the study the following conclusion were made; that seed tuber potato planting material technology was the most adopted technology in the study area. The variables of sex, household size, labour and other occupations other than potato farming were significant in determining farmer's decision in adopting potato planting material technology. Furthermore, the study concluded that the major constraint faced by potato farmers in the study area, during adoption of planting material technology can be categorised into; poor technical information, economic problem, inadequate resource, environmental problem, pathological problem and technological problem. The study recommends that; (i) Extension agents should increase number of contacts with farmers so as to disseminate technical knowledge needed for adoption of technologies. (ii) Proper soil, water, pest and disease management practices such as; mulching, irrigation, no tillage cultivation, use of natural predators for pest and early planting to prevent bacteria blight should be encouraged among farmers. (iii) Credit should be made available to farmers at the right time as this will increase the economic prowess of the farmers and enable them get the needed inputs to boost production.

REFERENCES

Adejare, G. T. and Arimi. K. (2013). Determinant of Labour Use for Selected Tree Crops in Oyo and Ondo States, Nigeria. *New York Science Journal,* **6**(8): 76-77.

Ather, S. and Balasundaram, N. (2009). Factor Analysis: Nature, Mechanism & Uses in Social and Management Researches. *Journal of Cost and Management Accountant, Bangladesh,* **37**: 15-25.

Bawa, A. G., Sani, M. H. and Iliyasu, Y. (2018). Analysis of the Effects of Insurgency on Cowpea Production in Potiskum Local Government Area of Yobe State, Nigeria. *Journal of Agriprenurship and Sustainable Development,* **1**(1): 82-89.

Challa, Merga. (2013). *Determining Factors and Impacts of Modern Agricultural Technology Adoption in West Wollega, Munich.* GRIN Publishing from: http://www.grin.com/en/e-book/280336/determiningfactors-and-impacts-of-modern-agricultural-technology-adoption.

Chomba, T. M. (2016). *Influence of Farmers Characteristics, Agricultural Extension and Technology Specific Factors on Adoption of Organic Farming Technologies in Embu West Kenya.* A Research Project Submitted in Partial Fulfilment for the Requirement of the Award of the Degree of Masters of Arts in Project Planning and Management of the University of Nairobi.

Climate-Data.org. (2021). Retrieved 20th February 2022 from: https://en.climate-data.org/

de Janvry, A., Macours, K. and Sadoulet, E. (2016). Learning for adopting: Technology adoption in developing country agriculture. Policy briefs from the workshop organized by Ferdi and SPIA on June 1 and 2, 2016, in Clermont-Ferrand.

Dilruba, K. and Roy, B. C. (2012). Rural Livelihood diversification in West Bengal; Determinants and constraints. *Journal of agricultural research review*. **25**(1) 115-124.

Farid, K. S., Tanny, N. Z. and Sarma, P. K. (2015). Factors Affecting Adoption of Improved Farm Practices by the Farmers of Northern Bangladesh, *J. Bangladesh Agril. Univ.* **13**(2): 291–298

Garba, U. (2013). Factors Influencing Adoption of Recommended Irish potato Production Practices in Kudan and Giwa Local Government Areas of Kaduna State, Nigeria. A Dissertation Submitted to the School of Postgraduate Studies, Ahmadu Bello University, Zaria, in Partial Fulfilment of the Requirements for the Award of Master of Science Degree in Agricultural Extension and Rural Sociology.

Girei, A. A., Salau, E. S., Audu, S.I., and Darason, Y. M. (2020). Determinants of Adoption of Recommended Irish Potato (*Solanum tuberosum*) Production Technologies by Smallholder Farmers in Plateau State, Nigeria, *Journal of Agriculture and Research,* **6**(6): 1-14.

Ironkwe G. I., Ezebuiro N. C. and Ewuziem, J. E. (2016). Adoption of Root and Tuber Technologies Disseminated by the National Root Crops Research Institute in Anambra State. *Journal of Agricultural Extension,* **20**(6): 39-52.

Jawanya, B. A., Dawang, N. C., Zarmai, D. U. and Mashat, I. M. (2014). Economic Analysis of Irrigated Irish Potato Production in Plateau State: *Developing Country Studies*: **4**(12):80-86.

Kolawole, E. A., Owolabi, A. O., Ajala, A. O. and Onuh, C. (2017). Factors Influencing Adoption of Improved Sweet Potato Technology in Kwara State *Moor Journal of Agricultural Research* **18**: 151 – 161.

Loevinsohn M., Sumberg J. & Diagne A. (2012). Under what circumstances and conditions does adoption of technology result in increased agricultural productivity? Protocol. London: EPPI Centre, Social Science Research Unit, Institute of Education, University of London.

Maganga, M. M., Abdi-Khali, E. and Greenwell, C. M. (2012). Unexploited Profit Among Smallholders Farmers in Central Malawi: What are the Sources? *International Journal of Applied Economics,* **9**(2): 83-95.

Margaret, M. and Samuel, K. (2015). Factors Determining Adoption of New Agricultural Technology by Smallholder Farmers in Developing Countries. *Journal of Economics and Sustainable Development,* **6**(5): 21-35.

Mbanaso, E. O., Agwu, A. E., Anyanwu, A. C. and Onwubuya, E. A. Personal and Socio-economic Factors Affecting the Adoption of Sweet Potato Production Technology by Farmers in South-East Zone of Nigeria. *Journal of Tropical Agriculture, Food, Environment and Extension,* **10**(3): 60-68.

Melesse B (2018) A Review on Factors Affecting Adoption of Agricultural New Technologies in Ethiopia. *J. Agri. Sci. Food Res.,* **9** (3): 226.

National Population Census [NPC] (2021). *National Population Commission, projected population census figures of Nigeria.*

Nmadu J. N., Sallawu, H. and Omojeso, B. V. (2015). Socio-Economic Factors Affecting the Adoption of Innovation by Cocoa Farmers in Ondo State, Nigeria. *European journal of business, Economics and Accountancy*, **3**(2): 58- 66.

Peter, H. and Cathal, O. D. (2012). Factors Affecting Farmers Adoption of Agricultural Innovations: A Panel Data Analysis of the Use of Artificial Insemination Among Dairy Farmers in Ireland. *Journal of Agricultural Science,* **4**(6): 171-179.

Rasheed G. A., Kehinde Y. O., and Williams A. A. (2019). Adoption Intensity Determinants for Improved Sweet Potato Varieties among Farmers in Nigeria. *International journal for Agricultural Management and Development*, **9**(3): 203-211.

Sani, M. H., Kushwaha, S. and Madaki, M. Y. (2018). Analysis of agricultural technologies and adoption efficiency in western agricultural zone of Bauchi State, Nigeria. *Journal of Agripreneurship and Sustainable Development*, **1**(1): 1-10.

Yamane, T. (1967). *Statistics, An Introductory Analysis.* 2nd Ed., New York: Harper and Row.