DETERMINANTS OF ADOPTION OF RECOMMENDED IRISH POTATO (*Solanum tuberosum*) PRODUCTION TECHNOLOGIES BY SMALLHOLDER FARMERS IN PLATEAU STATE, NIGERIA

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ABSTRACT

The study assessed the determinants of adoption of recommended Irish Potato production technologies by small scale farmers in northern agricultural zone of Plateau State. A total of 150 farmers were drawn through multistage sampling procedure for the study. Data were analysed using descriptive and inferential statistical tools. The mean age of the respondents was 45 years. Most respondents (55.3%) were female, implying that women invested more into Irish potato production than their male counterpart. A vast majority (98%) of the respondents had some form of education qualification in the study area. The mean years of farming experience was 23 years, with mean household size of 9 persons. Farmers had mean total land size of 3.2 hectares and mean of 1.7 hectares of farm land allocated for Irish potato farming. The mean annual income of farmers was estimated at ₦895,800. The predictors that significantly determined the adoption of recommended Irish potato production technologies were age, number of extension contacts and level of education. It was recommended that deliberate and consistent intensification and diversification of Nigeria's public extension is pertinent be engaged in by stakeholders in the private sector and government.
Keywords: Determinants, adoption, Irish Potato, production, technologies, small-scale farmers

INTRODUCTION

Technology adoption is a strong pre-determinant of agricultural productivity enhancement. For instance, in all OECD countries technological change has been the major driving force for increasing agricultural productivity and promoting agriculture development countries. Indeed, recent experiences with industrialization in countries such as China, India, and Brazil support this proposition (OECD, 2001). Agriculture is becoming more integrated in the ago-food chain and the global market, while environmental, food safety and quality, and animal welfare regulations are also increasingly impacting on the sector. 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 (OECD, 2001).

History tells us that agricultural revolutions have preceded industrial revolutions in most countries with rural populations. Productivity growth in agriculture is expected to be the main source of successful structural transformation and industrialization for pre-industrial

developing countries with an un-captured potential in agriculture. Productivity growth in agriculture requires the availability of technological innovations for agriculture and adoption of these innovations by the farm community. In recent years, emphasis has been given to the lag between the presumed availability of promising innovations and their adoption. Many factors can be associated with lack of adoption, such as credit constraints, lack of insurance coverage, high transaction costs on markets, or behavioral inadequacies (de Janvry *et al.*, 2016).

The economic significance of the Irish potato has left watchers and stakeholders alike perplexed by its low productivity levels in Plateau State. Although the State records the highest production indices in Nigeria, per capita productivity is still low. Factors affecting productivity of the crop and its potential as a food security and poverty eradicating crop enterprise include: perishability, lack of storage facilities and low production. Its productivity stands at an average of 6.5tons per hectare falling below an optimal standard of 20tons per hectare (FAOSTAT, 2011). This difference in yield has been attributed to low quality seed, limited use of improved agro-inputs among other constraints (Wagoire *et al.*, 2005).

Even with the commitment given to the potato programme in Kuru by the NRCRI decreasing level of production brings to mind the constraints facing production. The objectives of the study are to: (i) describe the socio-economic characteristics of the respondents; (ii) determine the effect of farmer's socio-economic characteristics on their level of adoption of the recommended production technologies,

To underscore the importance of Irish Potato in addressing the world food crises, the United Nations officially declared 2008 as the international year of the potato in order to raise the profile in developing nations calling the crop "hidden treasures" (FAO, 2008). This research will bring to light major recommended production technologies of Irish potato in the area and their level of adoption. The results of this study will as well help extension workers in the study area to develop effective extension strategies to disseminate the recommended Irish potato production technologies to the potato farmers. Considering the present situation where farmers still use traditional (manual) technology, the study will give light to farmers on the need to adopt new technology in Irish Potato production. It will also identify improved Irish potato technologies that have been introduced to farmers.

Research hypotheses of the study

The following hypotheses were stated in null-form: (i) There is no significant relationship between socio-economic characteristics of the respondents and their level of adoption of Irish potato technologies in the study area. (ii) There is no significant relationship between the number of extension contacts with respondents and their level of adoption of Irish potato technologies in the study area.

Socio-demographic attributes of the respondents

Jwanya *et al.* (2014) analysing the economics of irrigated Irish potato production in Plateau State, Nigeria employed descriptive statistics. Results revealed that 58.33% of the

respondents were adults who have had several years of experience in Irish potato irrigation farming. Their long years of experience coupled with their age, according to Jwanya *et al*., (2014), was responsible for enhancing efficiency and productivity. Majority (84.17%) of the respondents were men. This agrees with the findings of Onuk *et al.* (2010) that men had greater access to land as a productive resource than women in most African societies.

Sani *et al.* (2015) examined the economics of Irish potato (*Solanum tuberasum*) production under irrigation system in katsina metropolis, katsina local government area, katsina state, Nigeria and concluded that 48.3% of the respondents fell within the age range of 34-48 years, 33.3% fell within 19 – 33 age range while 18.3% fell within 49 – 63 age range. This implies that majority of the respondents were within their active productive age. Age is regarded as an important determinant of productivity and efficiency. Congruently, the FAO (2008) has posited that economic productive age is between 15 – 54 years. All the respondents (100%) were male confirming the findings of FAO (2008) who reported that the economic status and contribution of women is less in developing countries due to their continuous dependence on their male counterpart and the social arrangement of their society. Majority of the respondents (66.6%) were married. Lupilya (2007) noted that there is a trend for rural youth to start having responsibilities at an early age than urban youth. The tendency to marry early help in building a virile farming population which also agreed with the assertion of Lupilya (2007) who reported that young people in rural areas get married earlier than their urban counterpart. Majority (85%) of the respondents had no contact with the extension agent while 15% had contact with extension agent. Extension officers at any level have direct effect in the innovation of the farmers (Roger, 1998).

Garba (2013) investigating the factors influencing adoption of recommended Irish potato production practices in Kudan and Giwa Local Government Areas of Kaduna State, Nigeria observed that majority (78%) of adopters were between the ages of 24 – 45 years with mean age of 43 years, while approximately 70% of non-adopters were between the ages of 24 – 45 years with mean age of 42 years suggesting that age was not a determinant of adoption. This finding disagrees with the findings of Pur *et al*., (2007) who stated that the level of youth involvement in agriculture has reduced due to schooling and part-time farming.

Effect of farmer's socio-economic characteristics on their level of adoption of the recommended production technologies

Garba (2013) inquiring into the factors influencing adoption of recommended Irish potato production practices in Kudan and Giwa Local Government Areas of Kaduna State, Nigeria applied multiple regression analysis to analyse the Socio-economic, institutional and technological factors influencing adoption of recommended Irish potato production. The R-squared value was 0.599 implying that the independent variables explained 59.9% of the variations in the dependent variable. The result further revealed that age, household size, farm size, farming experience, access to credit, information source, and membership of association, relative advantage and compatibility index were the factors that significantly influenced the adoption of recommended Irish potato production practice.

The coefficient of farm size, access to credit, farming experience was found to be positive and statistically significant at 10% level of significance. Implying that farmers with larger farm land, more access to credits and more farming experience were more likely to adopt

recommended technologies. Land size is also one of the indicators of the level of economic resources available to farmers (Ajibefun, 2006). Further, due to the risks associated with farming as a result of the vagaries of agriculture, farmers must have stayed in farming business for quite some time (Ajibefun, 2006). And access to credits offers farmers the chance of experimenting on new technologies as they have enough money to buffer in the event of a loss.

Membership of cooperatives was significant at 5% while relative advantage index and Compatibility index were negative and statistically significant at 1%. Cooperative association enhances access to information on recommended practices, material inputs of the practices such as fertilizers and credit for the purchase of inputs and payment of hired labour. This finding is in consistent with the study of Deji (2005) who found membership of cooperative societies as a predictive factor of adoption behaviour of farmers. Compatibility of the innovation increases the adoption of the innovation when the practice is similar and agrees with the existing culture it will hasten the adoption of such recommended practices. This finding agrees with Rogers (1995) who stated that characteristics new technologies such as compatibility and complexity of the technology affect farmers' rate of adoption.

Kafle and Shah (2012) carried out a study on the adoption of improved potato varieties in Nepal using logistic regression model for factors associated with adoption of improved potato varieties found out that the fit of the models was satisfactory. The results show that household size, land tenancy, cattle ownership, access to extension agents, age and level of education were the significant factors that influenced the adoption of improved potato varieties.

METHODOLOGY

Description of the Study Area

This study was conducted in the Northern Agricultural Zone of Plateau State. The Northern Agricultural Zone of the State covers Barkin-Ladi, Jos North, Jos South, Jos East, Bassa and Riyom Local Government Areas (LGAs). The study area lies between longitudes 8° 40' and 9° 50' E and latitudes 9° and 10° 45' N (NRCRI, 2005).

The mean annual rainfall varies from 131.75 cm (54 inches) in the southern part to 146cm cm (57 inches) on the Plateau. The highest rainfall is recorded during the wet season months of July and August. The study area has near temperate climate with an average temperature of between 18 and 22^oC Harmattan winds cause the coldest weather been December and February. The warmest temperatures usually occur in the dry season months of March and April (PADP, 2000).

Fig. 2: Map of Plateau State with Plateau Northern Agricultural Zone, shaded in pink.
Source: *http://www.plateaustate.gov.ng* (2006)

Key

Study area

The 3 LGAs used for the study

Sampling Procedures and Sample Size

The target population for this study was the small-scale Irish potato farmers in Northern Agricultural Zone of Plateau State. A multi-stage sampling procedure was used for this study. In the first stage, three (3) LGAs out of the six LGAs in the zone were purposively selected based on high concentration of Irish potato production. These are Barkin Ladi, Riyom and Jos South LGAs. Stage 2 involved the selection of 5 Irish potato producing villages from each of the three (3) selected LGAs, giving a total of fifteen (15) villages. Finally, stage 3 involved the random selection of ten (10) Irish Potato farmers from each of the 15 villages to give a total of 150 respondents for the study.

Method of Data collection

Primary data was collected from farmers through a set of structured questionnaires which was administered to the Irish Potato Farmers in the study area. The questionnaire was designed to elicit relevant information necessary to achieve the stated objectives. The instrument used was subjected to validity test by experts and used as enumerators to administer the questionnaire.

Method of data Analysis

Both descriptive and inferential statistics were employed and used to analyse the data collected. The multiple linear regression analysis was used to test the hypotheses. The adopted multiple linear regression models as implemented by Garba (2013) is presented below;

$Y = f(X_1, X_2, X_3, X_4, X_5, X_6, X_7, X_8, X_{9, e})$

Where: Y= Level of adoption of recommended production technologies of Irish potato measured in percentage

X_1 = Age (years)

X_2 = Sex (dummy) (male = 0, Female = 1)

X_3 = Level of education (years spent in formal education)

X_4 = Farming experience (years)

X_5 = Annual Income (Naira)

X_6 = Farm size (Hectare)

X_7 = Access to credit (Amount of loan obtained in Naira)

X_8 = Extension contacts (No of visits per year)

X_9 = Membership of social organizations (dummy, 1 for being a member 0 = not a member)

E = Error term

RESULTS AND DISCUSSION
Socio-economic characteristics of the respondents
Age distribution: From Table 1 majority (70.7%) of the respondents were within the ages of 41 – 60 years, 25.3% of the respondents were between the age of 21 – 40 years 3.3% of the respondents were above 60 years while 0.7% of the respondents was less than 21 years. The mean age of the respondents was 45 years. The result implies that most of the respondents were in their prime, meaning they were still energetic and hence can actively involve in production activities. This result agrees with Garba (2013) who implied that farmers in the labour age are energetic for agricultural productivity.
Sex of respondents: Most (55.3%) respondents were female while 44.7% were male (Table 1). This implies that women were more into Irish potato production than their male counterpart. This disagrees with the findings of Onuk *et al.*, (2010) that females are used mainly for domestic work and for the fact that women have always been denied access to productive resources. Therefore, if women are given the necessary support in terms of agricultural inputs, access to land, credit facilities, effective security and adequate market information, much development could be attained from their involvement in Irish potato production.

Level of education of respondents: Most (66.6%) of the respondents had National Diploma or National Certificates of Education, 14.0% had Higher National Diploma or Degree certificates, 8.7% had secondary and primary school certificates while only 2% had non-formal education. The result implies that 98% of the respondents had some form of educational level of qualifications in the study area. Education plays an important role in farmers' adoption of improved technologies and decision making and also improves their ability in evaluating and managing risk that determines success of their farm enterprises. Ogunbameru (2001) noted that education would likely enhance the adoption of modern farm technologies by farmers and thereby sustaining a virile farming population.

Farming experience: About 38% of the respondents had between 11 and 20 years of farming experience, 30.7% of the respondents had farming experience ranging between 21 and 30 years of farming experience, 17.3% had above 40 years of farming experience while 13.3% of the respondents had between 1 – 10 years of farming experience. The mean farming experience in the study area was 33 years. Long years of experience coupled with their age, according to Jwanya *et al.* (2014), helps in enhancing efficiency and productivity. And this will lead to higher income and improved living standard.

Marital status: Majority (78.0%) of the respondents were married, 11.3% of the respondents were widowed, 6.0% of the respondents were single and 4.7% were divorced. Sani *et al.* (2015) postulated that marriage has the tendency to help in building a virile farming population.

Household size: More than half (52.7%) of the respondents had household size of between 6 and 10 persons, 20% of the respondents had household size of between 11 and 15 persons, 18% of the respondents had household size of 1 – 5 persons, while, 6.7% and 2.7% of the respondents had household sizes of 16 – 20 persons and above 20 persons respectively. The mean household size in the study area was 9 persons and this shows that it is higher than the national average of 6 persons per household. The result implies large household size in the study area. Large family size implies availability of free family labour, this will lower cost of labour but subject to the readiness of the members to participate in farming activities. According to Garba (2013) a fairly large household could probably serve as an insurance against short falls in supply of farm labour. Household size has a great role to play in family labour provision in the agricultural sector (Sule *et al*., 2002).

Total farm size: As revealed on Table 1, majority (89.3%) of the respondents had a total of between 1 and 5 hectares of farm land, 10.0% of the respondents had a farm land of between 6 and 10 ha, while 0.7% of the respondents had farms ranging from 11 – 15 ha. The mean farm size of the respondents was estimated at 3.2 hectares. This implies that majority of the respondents were small-scale farmers with less than 2 hectares average.

Annual income: Furthermore, the result shows that 44.0% of the respondents had annual income of between N501,000 and N1,000,000, 25.3% of the respondents had annual income ranging from N1,000 – N500,000, while 17.4% and 13.3% of the respondents had annual income of N1,001,000 – N1,500,000 and above N1,500,000. The mean annual income of farmers in the study area was calculated at N895,800. This implies that farmers in the study area earn a reasonably high income. It is not easy to determine the income level of farmers because a lot of farmers do not keep farm record. Agbamu and Orhorhoro (2006) reported

that the higher the income level of farmer the lesser he or she will be disposed to fear of taking a risk in respect of adopting a given technology.

Contact with extension agents/ Number of contacts with extension agents. Majority (87.3%) of the respondents had contacts with extension agents while 12.7% of the respondents did not have any contact with extension agents. The results of the respondents' contacts with extension agents further indicated that majority (84.0%) of the respondents reported their contacts with extension agents as between 1 and 5 times 16.0% of the respondents had contacts with extension agents between 5 and 10 times. This implies that extension contact which is supposed to be one of the main sources of agricultural information/technologies for improved methods of agricultural activities was sufficient in the study area. Extension officers at any level have direct effect in the innovation of the farmers (Roger, 1998).

Cooperative membership: Also, most (68.7%) of the respondents were members of cooperative/social organizations while 31.3% of the respondents were not members of any cooperative/social organizations. Membership of cooperative societies has advantages of ensuring that members derive benefits from the groups such that could not be derived individually. Cooperative members pool their resources together for a better expansion, efficiency and effective management of resources and for profit. Membership of an organization will help in getting high value for their investment. This may be because of the collective bargaining derive of the group and possibly economy of scale of goods and services to be procured. This finding is in line with Odebiyi (2010) who advanced that cooperative groups ensure that their members derive benefits from the groups such as they could not derive individually.

Access to credit/ Source of credit and amount accessed in the last 2 years: The results on Table 1 show that all the respondents (100%) had access to credits in the study area. Most (53.0%) of the respondents got loans of ₦1,000 - ₦500,000 from Clubs/associations/cooperatives, 16.0% of the respondents got loans of between ₦1,000 and N500,000 from friends/family members, 12.0% of the respondents got loans ranging from N1,000 - N500,000 from Agric. Banks, 8.0% of the respondents got loans of between N1,000-N500,000 from Produce buyers and Commercial Banks and 2.6% of the respondents obtained loans of between ₦1,000 and ₦500,000 from Government ministry/ Parastatal. Lack of credit decreases the efficiency of farmers by limiting the adoption of high yielding varieties and the acquisition of information needed for increased productivity. According to Tijani *et al.* (2006) access to credit provides the farmer with a means of expanding and improving his farm operation and other related value chain improvements. It also determines the ease with which he adopts new practices and technologies in his enterprise.

Table 1: Socio-economic characteristics of respondents

Variable	Frequency	Percentage	Mean
Age (years)			
1 – 2	1	0.7	
21 – 40	38	25.3	**45 years**
41 – 60	106	70.7	
61 and above	5	3.3	
Sex			
female	83	55.3	
male	67	44.7	
Education			
Non-formal education	3	2.0	
Primary school	13	8.7	
Secondary school	13	8.7	
ND/NCE	100	66.6	
HND/Degree	21	14.0	
Farming experience (years)			
1 – 10	20	13.3	
11 – 20	58	38.7	**22.5 years**
21 – 30	46	30.7	
31 and above	26	17.3	
Marital status			
Single	9	6.0	
Married	117	78.0	
Divorced	7	4.7	
Widowed	17	11.3	
Household size (No. of persons)			
1-5	27	18	
6-10	79	52.7	
11-15	30	20.0	**9 persons**
16-20	10	6.7	
21 and above	4	2.7	
Total farm size (ha)			
1-5	134	89.3	**3.2 hectares**
6-10	15	10.0	
11-15	1	0.7	
Annual income (₦)			
1,000-500,000	38	25.3	
501,000-1,000,000	66	44.0	**₦895,800:00**
1,001,000 -1,500,000	26	17.3	
1,501,000 and above	20	13.3	
Contact with extension agents			
Yes	131	87.3	
No	19	12.7	
Number of Extension contacts per?			
Zero contacts	126	84.0	
1-5	6	4.0	
5-10	18	12.0	
Cooperative membership			
Yes	103	68.7	
No	47	31.3	
Access to credit			
Yes	150	100	
No	0	0.0	
Source of credit			
Clubs/associations/cooperatives	48	53.0	
Friends/family members	24	16.0	
Agric. Banks	18	12.0	
Produce buyers	12	8.0	
Commercial Banks	12	8.0	

Government ministry/parastatals	4	2.6
Total	**150**	**100**

Source: Field survey (2018)

Effects of socio-economic characteristics on level of adoption of the recommended production technologies

Multiple linear regression analysis was employed to determine the effect of socio-economic characteristics of respondents on their level of adoption of improved Irish potato production technologies. The adjusted R^2 value was found to be 0.564 implying that the independent variables explained 56.4% of the variations in the dependent variable. The result revealed that age, contacts with extension agents and level of education were the factors that significantly influence the adoption of improved Irish potato varieties adoption all at 1%. Level of education though significant but was negatively significant to the adoption of improved Irish potato varieties adoption.

The co-efficient of age was found to be positive and statistically significant at 1% level of significance. This means that an increase in age of farmers will increase the probability of adoption of recommended improved Irish potato production technologies. This implies that older farmers are more experienced in potato production and therefore adopt improved varieties more. This is consistent with the findings of Etoundi and Dia (2008) which reported positive and significant relation between age group and improved maize variety in Cameroon. The coefficient of number of contacts with extension agents was found to be positive and statistically significant at 1% level of significance. As expected, number of contacts with extension agents was positively associated with adoption of improved potato varieties which is very consistent with several studies (Kudi *et al.,* 2010; Namwata *et al*., 2010).

Education was inversely related to adoption of recommended Irish potato production technologies. This implies that increase in level of education will reduce the probability of adoption of recommended Irish potato production technologies by farmers in the study area and vice versa. The increase in years of formal education of farmers will likely make farmers to be averse to high risk associated with Irish potato production. This result agrees with Ugwoke *et al.* (2005) who revealed that respondents with higher levels of education tend to take less risk in farming activities and vice versa but disagrees with the findings by Nnadi and Akwiwu (2008) who revealed that education level positively influenced participation in rural agricultural activities.

These findings provide evidence for the rejection of both of the null hypothesis as the results have shown that there exists significant relationship between the number of extension contacts with respondents and their level of adoption of Irish potato production technologies. Also, significant relationships between socio-economic characteristics of the respondents and their level of adoption of Irish potato production technologies

Table 2: Effect of socio-economic characteristics level of adoption of the recommended production technologies

Explanatory variable	β- value	Standard error	t-value
Constant	.707	.472	1.496
Age	.561	.157	3.582***
Level of education	.-.074	.023	-3.243***
Farming experience	.142	.084	1.688
Total farm size	-.238	.222	-1.073
Annual income	.123	.079	1.571
Number of extension contacts	.493	.186	2.652***
Amount of loan borrowed	.147	.098	1.508
$R^2=0.564$			

Source: Field survey (2018)   Note: *** = Significant at 1%

Conclusion

Based on the findings of this research work it can be concluded that the determinants of adoption of new Irish potato technologies were age, level of education and number of extension contacts. It is therefore recommended that;

i.   The role and importance of advisory services (agricultural extension) has been shown to be significant, therefore the intensification and diversification of Nigeria's public extension is pertinent for stakeholders in the private sector and the government.

ii. More training and extension teaching should be given to practising farmers as it has been shown that greater experience eventually leads to greater adoption. There has to be a significant equity in administration for both genders since women are even more predominant Irish potato cultivators than the male folks.

iii. Deliberate policy must be designed to curtail the excessive phenomenon of youth apathy toward agriculture; the result showing adoption relative to increase in age implies a significant absence and lack of interest of young people toward agriculture.

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